The Prevalence of Traumatic Brain Injury in a South African, Juvenile Delinquent Sample.

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Abstract

Traumatic brain injury (TBI) may result in damage to the prefrontal cortex that can result in impulsive and aggressive behaviour. Interestingly, juvenile delinquents (JD) tend to exhibit antisocial behaviour that is similar to that of an individual who has sustained a TBI. International research has established an association between sustaining a TBI and JD behaviour. The primary purpose of this study was to investigate the rate of TBI in a South African JD sample and whether it is higher than international rates. The rational of this investigation is that South Africa has one of the highest prison populations in the world and there is also a higher risk of sustaining a TBI in South Africa. A sample of 44 male, mixed race JDs, 12 – 17 years of age were interviewed using the Comprehensive Health Assessment Tool (CHAT) to establish TBI. The secondary purpose of this study was to assess the between-group differences between JDs with TBI and those without a TBI on antisocial behaviour and other factors contributing to juvenile delinquency. Callous-unemotional behaviours, substance abuse, alcohol dependence, general physical and psychological health, and depression were assessed using the Inventory of Callous-Unemotional Traits (ICU), the Alcohol Use Disorders Identification Test (AUDIT), The Maudsley Addiction Profile (MAP) and The Beck Depression Inventory-II (BDI-II), respectively. The prevalence rate of TBI found in the sample was 50%. Of these 40.9% ($n = 9$) reported no loss of consciousness (LOC) but feeling 'Dazed/Confused' at the time of injury, 18.2% ($n = 4$) reported LOC for less than five minutes and 40.9% ($n = 9$) reported LOC for more than an hour. The prevalence rate found is similar to rates reported in international literature. Further, no statistically significant differences were found between TBI and non-TBI JDs in terms of callous-unemotional behaviours, substance abuse, alcohol dependence, general physical and psychological health, and depression.

Keywords: traumatic brain injury, juvenile delinquency, callous-unemotional behaviour, prevalence, South Africa.

The Prevalence of Traumatic Brain Injury in a South African, Juvenile Delinquent Sample.

Adjectives such as impulsive, aggressive, having a lack of empathy and displaying mood swings are often used to describe victims of traumatic brain injury (TBI). Interestingly, these adjectives are also often used to describe juvenile delinquent (JD) behaviour (Slaughter, Fann, & Ehde, 2003). International research has established a relationship between TBI and criminal behaviour in both child and adult populations. TBI is predominantly caused by motor vehicle accidents (MVA) and interpersonal violence. These types of injuries cause diffuse damage to the prefrontal cortex which may result in aggressive and psychopathic behaviours that are characteristic of criminals (Blair, 2001; Blair, 2007; Farrer & Hedges, 2011). A link between childhood TBI, juvenile delinquency and continual offending has been described. Thus, an emerging area in TBI research has centred on JDs (Leon-Carrion & Ramos, 2003).

It is postulated that the prevalence rates of TBI amongst JDs might be higher in South Africa for two reasons. First, the TBI prevalence found in the general South African population 15 years of age and older is higher than the rates found internationally. Second, the occurrence of MVAs and interpersonal violence is drastically higher in South Africa than international rates (Bruns & Hauser, 2003; Levin, 2004). These factors, concomitant with reports that TBI may contribute to the behavioural dysfunction characteristic of JDs provide the motivation for this research (Leon-Carrion & Ramos, 2003; Williams, Cordan, Mewse, Tonks, & Burgess 2010). Understanding of this behavioural dysfunction and the role that TBI may play in it could add to the understanding of JD behaviour and possibly aid rehabilitation programs for youth in conflict with the law. Therefore, it is important to investigate the prevalence of TBI in a South African JD sample.

TBI in the General Population

In 1990, a South African TBI prevalence study conducted in the general population reported an annual incidence of 316 per 100 000 people, aged 15 and above (Bruns & Hauser, 2003; Nell & Brown, 1991). By comparison in the United States, the annual incidence is notably lower at only 101 per 100 000 people in the entire population (Shiroma, Ferguson, & Pickelsimer, 2010). There is a large discrepancy between these different incidence rates. The South African study had a restricted age range, yet a much higher incidence rate. This variance may be explained by the higher risk of sustaining a TBI in South Africa compared to other countries (Bruns & Hauser, 2003; Hyder, Wunderlich, Puvanachandra, Gururaj, & Kobusingye, 2007; Levin, 2004).

Etiology of TBI. TBIs occur as a result from a blunt or penetrating trauma to the head that leads to a level of loss of consciousness (LOC). International research estimates that 60% of TBIs are caused by MVAs, 20-30% by falls, 10% by interpersonal violence and 10% by work and sport related injuries (Hyder et al., 2007). South Africa has one of the highest MVA rates in the world and an estimated mortality rate for interpersonal violence that far exceeds the global rate (Levin, 2004; Norman, Matzopoulos, Groenewald, & Bradshaw, 2007). In 1990, interpersonal violence and MVAs accounted for 10% and 70% of TBI in a sample of South African adult White males, respectively. These results differed for adult Black males, where interpersonal violence and MVAs accounted for 51% and 26% of TBI, respectively (Nell & Brown, 1991). Although the rates reported differ by ethnicity, it is still evident that MVAs and interpersonal violence contribute to a high proportion of TBI in a South African adult sample.

MVAs also account for a majority of hospital admissions for TBI in the paediatric South African population, although literature demonstrating such incidence is limited. From 1984 to 1989, 17.1% of the residing paediatric patients aged 0 to 13 years old at the Red Cross Children's Hospital in Cape Town South Africa, were admitted for a TBI. In a subset sample of 102 of the children admitted for severe TBI, 83% had sustained their injury as a result of a pedestrian MVA, 11% from falls and a further 6% were sustained from passenger MVAs and assaults (Semple, Bass, & Peter, 1998).

A more recent study conducted in South Africa investigated the spectrum of head injuries for patients aged 8 to 78 years of age admitted to a regional hospital in Pietermaritzburg. In this study, 41% of patients reported sustaining a TBI due to interpersonal violence, while 28% of patients sustained a TBI as a result of MVAs (Alexander et al., 2010).

Therefore, there is a high risk of sustaining a TBI in South Africa, specifically as a result of MVAs and interpersonal violence. These types of injuries may cause diffuse damage to the brain that may result in detrimental consequences in terms of cognitive functioning and behavioural outcomes (Anderson et al., 2006).

Pathophysiology of TBI. Functional magnetic resonance imaging has demonstrated that the prefrontal cortex (PFC) is a common site of neuronal damage from TBIs. Studies on aggression also report a decrease in grey matter volume of the PFC amongst convicted criminals (Fabian, 2010). However, even though there is a possible correlation between the neurology of criminal behaviour and TBI, there remains a paucity of research investigating this relationship. Nevertheless, there is neuropsychological evidence analysing the relationship between aggression and TBI.

PFC lesions. Two areas of the PFC are pertinent to the relationship between frontal lobe lesions sustained by TBI and aggressive behaviours: the orbitofrontal cortex (OFC) and the ventromedial frontal cortex (VFC). Damage to the OFC may lead to a lack of inhibition, impulsivity, aggression, and a general dysregulation of behaviour. Damage to the VFC can result in an inability to initiate or monitor behaviour, inability to delay gratification, and lack of cognitive flexibility and abstract reasoning (Brower & Price, 2001; Fabian, 2010). All these processes are linked to executive functions and the regulation of behaviour. Lesions to these areas may result in dysregulation of behaviour and may lead to reactive aggression. Reactive aggression is a non-goal orientated violent response to a frustrating situation or a situation that is perceived as threatening (Blair, 2001).

Reactive aggression is evident in many war veterans who have sustained a TBI. War veterans with VFC and/or OFC lesions sustained via TBI are more likely to be aggressive compared with veterans inflicted by TBI with no frontal lobe lesions and veterans with no TBI (Grafman et al., 1996). However, not all TBI cases result in aggression that causes criminal behaviour. Research indicates that antisocial behaviour is prominent amongst criminals and may be the mediating factor between TBI and offending behaviour (Roose, Bijttebier, Decoene, Claes, & Frick, 2009).

Callous-Unemotional Behaviour

VFC dysfunction is repeatedly associated with psychopathic behaviour in adults. Damage to the VFC or associating structures may result in a break-down in care-based moral reasoning. This break-down often leads to psychopathy which is frequently associated with criminal behaviour (Blair, 2007; Moffitt & Caspi, 2001).

Psychopathy is characterized by emotional dysfunction. This dysfunction produces diminished fearfulness and empathy for others, impulsive behaviour and poor behavioural inhibition; characteristics that are commonly associated with severe and violent antisocial behaviour in criminals (Blair, 2007; Moffit & Caspi, 2001; Roose et al., 2009).

Children who develop antisocial traits tend to exhibit callous and unemotional behaviour which leads to poor emotional and behavioural regulation that is life persistent. Adult psychopathic and criminal behaviour can be traced back to the onset of the antisocial behaviour in childhood. A longitudinal study conducted in New Zealand utilized a birth cohort of 1037 children. By the age of 26, participants who had a childhood onset of antisocial behaviour were involved in more serious criminal behaviour than other children without antisocial behaviour (Frick et al., 2003; Moffit, Caspi, Harrington, & Milne, 2002).

Thus, the PFC is particularly susceptible to damage from a TBI. Further, damage inflicted to the VFC may cause antisocial behaviour amongst youth. Therefore, TBI may consequently result in life-persistent conflict with the law. TBI damage to the brain may diminish the ability to regulate behaviour, a problem that is evident amongst JDs (Anderson et al., 2006). However, there are various other factors that may contribute to JD behaviour.

Antecedents of Offending Behaviour

Poverty, physical and mental health problems, alcohol and drug abuse, family problems and inadequate education are factors that may contribute to offending behaviour in youth. Gang involvement is associated with more violent offending amongst JDs (Siegel & Welsh, 2011). In South Africa, violent crime occurs more in marginalized, low socio-economic status areas. These areas tend to be Black and Mixed Race townships that expose youth to various social ills which may contribute to juvenile delinquency (Foster, 2012). A study conducted amongst 15 South African high school students found methamphetamine usage to be positively correlated with aggressive behaviours (Plüddemann, Flisher, McKetin, Parry, & Lombard, 2010).

Similarly, these factors are also risk factors for TBI. Incidence rates of TBI in rural areas tend to be higher than in urban settings. Violence and substance abuse are reported to be significant contributors to this trend (Gabella, Hoffman, Marine, & Stallones, 1997; Peek-Asa, Zwerling, & Stallones, 2004; Semple, Bass, & Peter, 1998). Therefore, TBI may function as a marker for these factors associated with juvenile delinquency or may also contribute further to JD behaviour. Leon-Carrion and Ramos (2003) describe that in a context with many factors that contribute to criminal behaviour, sustaining a TBI may further facilitate the association between these contextual factors and life persistent violent offending.

Prevalence Rates found for TBI in Offending Populations

International studies investigating a possible relationship between TBI and criminality have indicated high rates of TBI in adult prison populations. Interviews conducted with a male adult Australian prison population found that 82% of the sample had previously sustained a TBI with or without LOC (Schofield et al., 2006). This study and others conducted in various countries (e.g. The United States, the United Kingdom) with adult criminal populations show high rates of TBI amongst prison inmates, indicating a possible global correlation between sustaining a TBI and criminal conviction (Slaughter et al., 2003; Williams, Mewse, Tonks, Burgess, & Cordan, 2010).

The rates of TBI in adult offender populations may however simply be a function of the prevalence of TBI in the general population. A recent meta-analysis dispels this possibility. The results show a significantly higher TBI rate amongst adult prison inmates than amongst adults in the general population (Farrer & Hedges, 2011). This finding suggests that globally there is a higher incidence of TBI amongst a prison population than in the general population. However, a study assessing the incidence rate of TBI in the general population as compared to the prison population has not been conducted to confirm this trend in an adult population of South Africa. Also, this trend has not been confirmed in a paediatric population.

Despite the relatively small geographical size of the country, South Africa's prison population is amongst the highest in the world (Naidoo & Mkize, 2012). Currently, there are no South African studies assessing the incidence of TBIs in an offending population. However, given the high rate of TBI in the general population and the higher risk of sustaining a TBI, matched with a large prison population; it is reasonable to expect that there may be a higher incidence of TBI in the South African criminal population than that reported in international literature.

Recently, evidence suggesting a link between childhood TBI and offending behaviour that begins in adolescence has developed (Leon-Carrion & Ramos, 2003). Thus, international research has begun investigating the association of offending behaviour in JDs and TBI.

TBI Amongst JDs

Youth in the United States aged above 10 have a 5.5% chance of being sent to juvenile court. International prison population trends indicate that male youths have a higher probability of being convicted in court than female youths. Furthermore, the United States National Center for Injury Prevention and Control identified the age range from 15 to 19 years to be the highest risk period for TBI, of which adolescent males are at particular risk (Forrest, Tambor, Riley, Ensminger, & Starfield, 2000; Shiroma et al., 2010; Williams et al., 2010). Therefore, male youth are the population of interest for investigating the association between TBI and juvenile delinquency.

Recent research. Eighteen percent of 720 JDs from Missouri between the ages of 11 and 20 reported sustaining severe TBI with LOC of 20 minutes or more. However, this study only investigated severe TBI. Research in the United Kingdom indicated that 46% of 186 JDs aged 11 to 19 years old self-reported a TBI with LOC of any time period. Both these studies reported elevated rates of substance abuse, mental illness and violent crimes amongst JDs with TBI in comparison to JDs without TBI (Perron & Howard, 2008; Williams et al, 2010).

A group comparison study looked at the prevalence of TBI amongst JDs and non-JDs using parent reports. The results showed significantly more TBI cases amongst JDs compared to non-JDs. In addition, the parents of one-third of the delinquent youths with TBI indicated that they had witnessed a marked change in behaviour post-TBI in their children and that it had a long-term effect on their conduct (Hux, Bond, Skinner, Belau, & Sanger, 1998).

A retrospective study investigating the long term effects of TBIs sustained during childhood or adolescence was conducted with 49 male criminals. Of these, 78% of violent criminals and 46% of non-violent criminals reported an untreated childhood TBI (Leon-Carrion & Ramos, 2003). Therefore, there may be long-term consequences of TBI for JDs. Life persistent offending behaviour poses a problem to society.

Re-offending. For prison inmates, persisting behavioural problems from TBI may result in continual criminal behaviour. Offending adolescents with TBI have indicated a younger onset of criminal behaviour, a greater likelihood of reporting more violent offences and repeat offending (Mullin & Simpson, 2007; Williams et al., 2010). Thus, TBI could indicate a lifetime disposition to criminal activity. The theory of Gradualistic Moral Disengagement proposes that crimes may become more violent as the frequency of crimes committed increases (Bandura, 1999). Therefore, identifying adolescents with TBI may possibly be a means of crime prevention. Cognitive rehabilitation may result in a decrease of negative behaviours and reduction in the probability of re-offending (Leon-Carrion & Ramos, 2003).

Summary and Rationale

TBI victims and JDs both tend to display aggressive, impulsive and antisocial behaviour (Hawkins & Trobst, 2000; Slaughter et al., 2003). Adolescence is a crucial period for the onset of juvenile delinquency as well as a high-risk period for sustaining a TBI. The literature offers substantial evidence for a potential association between sustaining a TBI and exhibiting offending behaviour. Behaviours often characteristic of JDs, such as aggression, impulsivity and callous-unemotional traits, may occur from the neuronal damage sustained from a TBI. These behaviours, which can be caused by TBI, can often be life persisting and may result in re-offending behaviour for some JDs.

South Africa has a prison rate that is amongst the highest in the world. Furthermore, there is a high incidence of TBI reported compared to other countries due to the high-risk factors of sustaining a TBI amongst South African youth especially as a result of MVAs and interpersonal violence (Bruns & Hauser, 2003; Naidoo & Mkize, 2012; Semple, Bass, & Peter, 1998). Thus, an investigation is required into the rate of TBI amongst a sample of

South African JDs. Understanding how TBI may contribute to JD behaviour in South Africa may contribute to the development of rehabilitation programs to reduce continual offending behaviour that continues into adulthood.

Specific Aim and Hypothesis

The primary objective of the study was to investigate the rate of TBI in a JD sample in South Africa. The secondary aim was to assess whether there were between group differences on antisocial behaviour between JDs with and without TBI. For the purpose of this study, JD was defined as youth who are awaiting trial or who have been previously convicted by the court of law. The following hypotheses were tested:

1. There is a higher rate of TBI amongst South African JDs in the study sample than rates reported internationally.
2. JDs with TBI display significantly more antisocial behaviour than JDs without TBI in the study sample.

Methods

Design and Settings

The study was cross-sectional in design and a pilot study for a larger project. First, the rate of self-reported TBI was assessed. The presence of TBI was then used as a criterion for the independent variable and to form two groups, TBI and non-TBI. These groups were compared on the dependent variable, callous-unemotional behaviour, which was a measure of antisocial behaviour. In addition the groups were compared on learning problems, alcohol dependence, substance abuse, general physical and psychological health symptoms, and depression as these may also contribute to JD behaviour. The aim of the larger project is to expand the sample size and to measure executive functioning and aggression of JDs with TBI.

Data collection occurred at the premises of an institution housing the JDs included in this study. All testing was conducted with a principal researcher and co-researcher in a private room in order to minimize distractions.

Participants

Participants were recruited from a JD institution in the Cape Town area which institutionalizes convicted youth or youth awaiting criminal trial. The institution is a private organization that acts as the legal guardian (caregivers) of the youth in their care. Social workers in the institution who were unaware of the hypotheses of the research were requested to randomly identify potential participants within the institution.

The inclusion criteria were English speaking males, aged 12 to 17 years old, who were guilty of or currently awaiting trial for a criminal offence. All participants were mixed race and from a low socio-economic status backgrounds. The language criterion was set for ease of administration. Further, only mixed race participants were selected to facilitate the between-group comparisons between JDs with and without TBI as it offered greater homogeneity between the groups.

G*Power (Erdfelder, Faul, & Buchner, 1996) indicated that the ideal sample size to obtain a significance level of $p = .05$ with an effect size of $r = .3$, for an ANOVA is $n = 111$. Similarly, to obtain a significance level of $p = .05$ with 1 degree of freedom and an effect size of $V = .3$, the ideal sample size for a chi-squared analysis is $n = 145$.

Measures

The Comprehensive Health Assessment Tool (CHAT). The CHAT (Offender Health Research Network [OHRN], 2012) is a self-report questionnaire that was developed specifically for use with juvenile offender populations to obtain a full physical and mental health analysis. For the purpose of this study, the sections assessing TBI and learning disabilities were used. The questions pertaining to TBI consisted of 12 items assessing the presence, frequency, severity, symptoms from worst TBI sustained and causes of head injuries.

History of learning problems, current learning difficulties and ability to function independently was assessed from the 16 item learning disability section. The questionnaires consisted of open-ended questions, Likert scales and yes/no questions. The CHAT has been used in previous international research as a screening measure for TBI, but has not yet been utilized in South African research (see, e.g., OHRN, 2012). However, the CHAT is still under development, thus no psychometric properties are currently available.

The Inventory of Callous-Unemotional Traits youth version (ICU). The ICU (Appendix D; Frick, 2004) was specifically developed to identify traits that research indicates as markers of adolescent psychopathology. A three-factor structure is assessed in the ICU: callousness, and uncaring and unemotional traits. The ICU is a comprehensive assessment that consists of 24 items measured on a 4 point Likert scale. A statement is provided in each item and the participant is required to evaluate how well the statement describes them by selecting an option of "Not at all true," "Somewhat true," "Very true," or "Definitely true." The ICU has an internal consistency of $\alpha = .77$ and is reported to have high construct validity (Essau, Sasagawa, & Frick, 2006). The ICU was developed in particular for use in adolescent

offending populations but has not yet been used in South African research. International research has used the ICU in offending youth populations (see, e.g., Mooney, 2010).

The Alcohol Use Disorders Identification Test (AUDIT). The AUDIT (Appendix E; Saunders, Aasland, Babor, Fuente, & Grant, 1993) is a 10-item questionnaire developed by the World Health Organization and is used to assess patterns of alcohol use. The AUDIT investigates the factors of hazardous alcohol use, dependence symptoms and harmful alcohol use (Babor, Higgins-Biddle, Saunders, & Monteiro, 2001). The questionnaire is a self-report instrument that is suitable for all participants above 8 years of age. Participants are required to choose one of four responses to a statement that best describes their drinking patterns over the past year. Scores range from 0 to 40 and a score obtained that is 8 or higher indicates a substance abuse problem. As the score gets higher, the more hazardous and harmful alcohol use is. Test-retest correlation of $r = .86$ indicates high internal consistency of the measure. The AUDIT was specifically developed to be culturally sensitive for international use. Previous South African research has used the AUDIT and it is a reliable and valid measure (see, e.g., Kalichman, Simbayi, Jooste, Cain, & Cherry, 2006).

The Maudsley Addiction Profile (MAP). Two subsections consisting of 29-items of the MAP (Marsden et al., 2002) were used for this study. The frequency and routes of substance abuse, anxiety and depression, and physical health symptoms were evaluated. The measure has an intra-class correlation coefficient (ICC) of $r = .94$ which suggests excellent reliability. Thus, the measure has high test-retest reliability (Marsden et al., 2002). Previous research involving adolescent offenders have utilized the MAP (see e.g., Williams et al., 2010), however South African research has not yet used the instrument in any research.

The Beck Depression Inventory-II (BDI-II). The BDI-II (Appendix F; Beck, Steer, & Brown, 1996) is a self-report instrument which measures the presence and degree of the clinical symptoms of depression. This instrument is in a multiple choice format and consists of 21 items. Each item consists of four statements and the participant is required to select the statement that best describes them over the past two weeks. The BDI-II can be used in adolescent and adult populations. The BDI-II has good psychometric properties with a test-retest reliability of $r = .93$ and high internal consistency measure of $\alpha = .91$ (Beck et al., 1996). South African research has used the BDI-II and it has been a reliable and culturally sensitive measure (see, e.g., Ward, Flisher, Zissis, Muller, & Lombard, 2003).

Procedure

I contacted the institution where the study was conducted and explained the purpose and nature of the study. I then submitted a letter of motivation explaining the importance and

rationale of the research (Appendix A). Once I was granted approval for the study at the relevant institution, I started the participant recruitment process. Minors were the population of interest in this research; thus, consent (Appendix B) was obtained from parents during visiting hours or parents were contacted telephonically. When this was not possible, the director of the institution granted consent. The institution acts as the legal guardian of the youth, in the absence of the participants' parents.

Once consent was received, participants were asked for both their verbal and written assent to willingly participate in the study (Appendix C). The entire process was tape recorded as a precaution to back-up the information collected.

The questionnaires were administered to participants in one sitting that lasted from 30-40 minutes. All questionnaires were read through together with the participants to ensure they understood the questions and to allow them to ask questions. The participants were administered the questionnaires in the following order, the CHAT, the AUDIT, the MAP, the BDI-II, and lastly the ICU.

Upon completion of the interview, participants were given refreshments, and were encouraged to ask any questions they had. Thereafter, the participants were thanked for their participation. All participants received a Checkers shopping voucher valued at R50 to compensate them for participation. The voucher was given to the secretary at the institution in front of the participant for them to receive upon their release.

Ethical Considerations

Ethical approval for this study was received from the Department of Psychology, University of Cape Town and from the institution where the study took place. No deception was used in this study. The rationale, significance, anonymity, rights, harm and benefits of the study were outlined in the consent form (Appendix B) and were also verbally explained to the parents/caregivers by the co-researcher and I to ensure the details of the study were understood. Parents/caregivers were encouraged to ask us any questions before signing the consent form.

The assent form (Appendix C) was also verbally explained to the participants to ensure it was understood. Participants were informed what was required of them and it was emphasized that the entire process was voluntary and anonymous. They were encouraged to ask questions at any point during the process and were allowed to take breaks if required in order to avoid any discomfort or fatigue effect. Verbal and written consent was also obtained from the participant before the recording device was turned on.

Data Analysis

SPSS Version 20.0 was used for data analysis. The initial analysis included investigating the descriptive statistics of the sample. Thereafter, I examined the frequencies of TBI, various etiologies, multiple injuries and symptoms in the sample.

For the secondary analysis, TBI formed an independent variable which was used to form two groups within the JD sample: TBI and non-TBI. The scores from the ICU, AUDIT, MAP and the BDI-II were used as continuous variables. Further, the total score for learning problems, the AUDIT and the BDI-II were also converted into categorical data as stipulated by their relevant manuals for frequency analyses.

Between-group comparisons were run between the TBI and non-TBI JD groups. Group comparisons were also conducted between participants with the most severe TBIs in the sample matched randomly on age to a group of participants with no TBI. Chi-squared analyses were used for the categorical data and analysis of variance (ANOVA) for continuous variables. In some of the chi-squared analyses, 50% of the expected frequencies were below 5. Thus, Fishers Exact test was used to calculate the significance values. If assumptions were violated for the continuous variables in the between-group analyses, then non-parametric Mann-Whitney tests were conducted. The statistical tests Cohen's d and Cramer's V were used as effect size estimators. The statistically significant threshold was set at $\alpha = .05$.

Results

It was hypothesized that there would be a high prevalence of TBI in a South African JD sample. The results are presented in two components. First, the prevalence of TBI is reported. Second, the results of the between group analyses between JDs with and without TBI are presented.

Participant Demographics

The co-investigator and I were able to approach a total sample of 47 participants, in the time available for this pilot study. Among these participants, one participant was over the age of 18 and thus met the age exclusion criterion and two participants were excluded due to incomplete data. The resultant sample size was 44 participants. The participant age range was between 14 and 17 years of age ($M = 16.78$; $SD = 0.76$).

Self-Reported TBI

There was a high prevalence of TBI found in the sample. From a total of 44 participants, 22 (50%) self-reported sustaining a TBI. Of these 40.9% ($n = 9$) reported possible TBI with no LOC but feeling 'Dazed/Confused' at the time of injury, 18.2% ($n = 4$) reported a LOC < 5 minutes and 40.9% ($n = 9$) reported TBI with a LOC > 60 minutes.

From the overall sample 63.6% (n = 14) sustained only one TBI. Of these 57.1% (n = 8) were in the 'Dazed/Confused' category, 43% (n = 2) had reported LOC < 5 minutes and 28.6% (n = 4) had experienced LOC > 60 minutes. Therefore, from the entire sample 29.5% (n = 13) reported a TBI with LOC. Two or more TBIs were reported by 36.4% (n = 8) of the sample, 62.5% (n = 5) of these had experienced LOC > 60 minutes, 25% (n = 2) stated that they had LOC < 5 minutes and only 1 respondent reported sustaining multiple TBIs that each caused them to feel 'Dazed/Confused.'

Table 1 presents the frequency of the various causes of TBI reported. In the event of multiple injuries, the cause of the injury with the longest LOC or most severe symptoms was reported. The most frequent cause of TBI reported was assault. The age at sustaining a TBI ranged between 3 to 17 years of age (M = 14.18, SD = 3.57). The mode age for sustaining a TBI was 15 years of age (n = 6), while 22.7% (n = 5) reported sustaining a TBI during the current year at the age of 17 years.

Table 2 displays whether a participant sought medical attention across severity of injury. With regard to visiting a hospital post-TBI, participants who were Dazed/Confused' were statistically significantly different to participants who had experienced LOC, χ^2 (1) = 6.14, p = .02. The effect size of the relationship indicated a relatively strong association between LOC and visiting a hospital after sustaining a TBI, V = .53.

Table 1. *Causes Self-Reported TBI*

	Frequency	% of TBI Sample
Road Traffic Accident	3	13.6
Fall when Sober	3	13.6
Sport Injury	1	4.5
Assault	15	68.2

Table 2. *Frequency of Seeking Medical Attention Across TBI Severities*.

	No	Yes
Dazed/Confused (*n* = 9)	5 (22.7)	4 (18.2)
LOC < 5 minutes (*n* = 4)	1 (4.5)	3 (13.6)
LOC > 60 minutes (*n* = 9)	0 (0)	9 (40.9)

Note. Frequencies are presented with the percentage in parentheses.

Symptoms of TBI. Cross tabulations on severity of injury and severity of symptoms were calculated for all of the following analyses. Headache symptoms were still experienced by 36.3% (*n* = 8) of the TBI group. Of these 87.6% (*n* = 7) had experienced LOC from the TBI. Severe headaches were reported by 5 respondents, of which 80% (*n* = 4) had suffered a period of LOC. A total of 41% (*n* = 9) reported still experiencing symptoms of dizziness since sustaining a TBI, from these 8 respondents had a period of LOC. Dizziness was a severe problem for 3 respondents of the total TBI group (13.6%), all of which had experienced LOC > 60 minutes. Nausea was not experienced by 86.3% of the respondents. Only 3 respondents (13.7%) experienced nausea as a problem since sustaining a TBI, of these 66.7% (*n* = 2) found nausea to be only a mild problem. Only 22.8% (*n* = 5) of the sample experienced poor concentration, while 72.7% (*n* = 17) did not experience poor concentration at all and 4.5% (*n* = 1) had experienced poor concentration but do not anymore. Forgetfulness and confusion were each experience by 28.3% (*n* = 6). In both variables, 4 respondents (18.1%) had sustained LOC > 60 minutes, with 1 participant experiencing the symptom as a severe problem. Difficulties in recalling everyday activities and fogginess of thought were both not experienced by 77.2% (*n* = 17) of the sample. Only participants with LOC reported fogginess of thought (*n* = 5). Table 3 displays the frequencies and the percentage of each group that experienced the relevant symptom.

Table 3. *Symptoms Frequencies across all Severities*

	Dazed/Confused (*n*= 9)	LOC < 5 minutes (*n* = 4)	LOC > 60 minutes (*n* = 9)
Headaches	1 (11.1)	2 (50)	5 (55.5)
Dizziness	1 (11.1)	2 (50)	6 (66.6)
Nausea	1 (11.1)	0 (0)	2 (22.2)
Forgetfulness	0 (0)	2 (50)	6 (66.6)
Poor Concentration	2 (22.2)	0 (0)	3 (33.3)
Confusion	1 (11.1)	1 (25)	4 (44.4)
Fogginess	0 (0)	2 (50)	3 (33.3)
Difficulties Recalling Everyday Events	2 (22.2)	1 (25)	2 (22.2)

Note. Frequencies are presented with the percentages in parentheses.

Between-Group Comparisons: JDs with TBI vs. JDs without TBI

Between-group comparisons were conducted to analyse the differences between respondents with TBI and those with no TBI on the measures of callous-unemotional behaviour, learning problems, risk of alcohol dependence, substance abuse, general physical and psychological symptoms, and depression.

Callous-Unemotional Traits. No statistically significant difference in self-reported CU behaviour for TBI (*M* = 30.82, *SD* = 8.99) and non-TBI JDs (*M* = 28.59, *SD* = 6.59) was found, $F(42) = -.94$, $p = .35$. Cohen's d statistic was conducted to compute the effect size of the analysis and a small effect was found, $d = .28$.

Learning problems. Table 4 displays the frequencies participants experienced different aspects of learning problems and how this differed for the TBI and non-TBI JD groups. Chi-square could not be run on the variable 'Able to get ready on their own' as all the participants in both the TBI or non-TBI JD groups responded positively. There were no statistically significant differences between the two groups on any of the learning problems investigated. The effect sizes for these analyses were calculated using Cramer's statistic and are also reported in Table 4. Negligible dependence was found for the variables 'Struggle with schoolwork', 'Received extra support in lessons', 'Statement of special education needs', 'Attended a specialist school' and 'Told to have a learning disability or learning needs'. Cramer's statistic indicated weak dependence for the variables 'Contacted a learning

disability service' and 'Struggles with reading and/or writing'. A moderate dependence was found for the variable 'Able to prepare food'.

Table 4. *Frequencies of Learning problems in TBI and non-TBI JD Groups*

		Non-TBI	TBI	χ^2	df	*p*	*V*
Struggle with School Work (*n* = 44)	No	9 (20.5)	9 (20.5)	0	1	1	0
	Yes	13 (29.5)	13 (29.5)				
Received Extra Support in Lessons (*n* = 44)	No	15 (34.1)	14 (31.8)	.1	1	.75	.05
	Yes	7 (15.9)	8 (18.2)				
Statement of Special Education Needs (n = 44)	No	15 (34.1)	14 (31.8)	.1	1	.75	.05
	Yes	7 (15.9)	8 (18.2)				
Attended a Specialist School (*n* = 44)	No	14 (31.8)	12 (27.3)	.38	1	.54	.09
	Yes	8 (18.2)	10 (22.7)				
Told to have a Learning Disability or Learning Needs (*n* = 44)	No	14 (31.8)	14 (31.8)	0	1	1	0
	Yes	8 (18.2)	8 (18.2)				
Contacted a Learning Disability Service (*n* = 44)	No	16 (36.4)	19 (43.2)	1.26	1	.26	.17
	Yes	6 (13.6)	3 (6.8)				
Struggles with Reading And/or Writing (*n* = 44)	No	15 (34.1)	11 (25)	1.5	1	.22	.19
	Yes	7 (15.9)	11 (25)				
Able to Prepare Food (*n* = 44)	No	4 (9.1)	1 (2.3)	2.03	1	.35	.22
	Yes	18 (40.9)	21 (47.7)				
Able to Get Ready on Their Own (*n* = 44)	No	0 (0)	0 (0)	-	-	-	-
	Yes	22 (50)	22 (50)				

Note. Frequencies are presented with the percentage in parentheses.

Risk of alcohol dependence. From the total sample, 68.2% (*n* = 30) reported consuming alcohol within the last year. For exact percentages in each risk level, please refer to Table 5 which displays the frequency of risk for alcohol dependence in the TBI and non-TBI JD groups. An ANOVA comparing the total scores of risk of alcohol dependence showed no statistically significant difference in the TBI (*M* = 9.04; *SD* = 8.5) and non-TBI (*M* = 8.95; *SD* = 7.64) JD groups, *F* (42) = -.037, *p* = .97. Cohen's d statistic found an effect size showing almost complete independence of risk of alcohol dependence and presence of TBI, *d* = .01.

Table 5. *Risk Level of Alcohol Dependence in TBI and non-TBI JD Groups*

	No Alcohol	Low Risk	Medium Risk	High Risk
No TBI (*n* = 22)	7 (15.9)	4 (9.1)	7 (15.9)	4 (9.1)
TBI (*n* = 22)	7 (15.9)	4 (9.1)	8 (18.2)	3 (6.8)
Total	14 (31.8)	8 (18.2)	15 (34.1)	7 (15.9)

Note. Frequencies are presented with the percentage in parentheses.

Substance Abuse. Table 6 displays the specific drug substances the respondents reported using as well as the general substance use of the sample. There was no statistically significant difference between the TBI and non-TBI JD groups across the different drug substances and across the general use of drugs. The effect sizes found showed weak associations between the independent and dependent variables. Table 7 shows the frequencies with which participants used substances in general and specific drug substances across the TBI and non-TBI JD groups.

Table 6. *Substance Use Comparison Between TBI and non-TBI JD Groups*

	non-TBI (*n* = 22)	TBI (*n* = 22)	F	df	p	d
Cannabis	11.14 (13.27)	10.91 (12.51)	.06	42	.95	.02
Amphetamine	1.36 (4.05)	2.73 (8.83)	-.66	42	.51	-.16
Methaqualone	1.36 (4.79)	3.09 (8.87)	-.8	42	.47	-.2
General Substance Use	19.59 (19.8)	19.73 (24.72)	-.02	42	.98	.01

Note. Means are presented with the standard deviations in parentheses.

Table 7. *Substance Use in TBI and non-TBI JD Groups*

	non-TBI (*n* = 22)	TBI (*n*= 22)
Heroin	1 (4.5)	0 (0)
Methadone	1 (4.5)	0 (0)
Cannabis	12 (54.5)	15 (68.2)
Amphetamine	3 (13.6)	2 (9.1)
Methaqualone	2 (9.1)	3 (13.6)
General Substance Use	14 (63.6)	16 (72.7)

General physical and psychological health. Table 8 reports the means and standard deviations of the TBI and non-TBI JD groups and the inferential statistics for the physical and psychological health symptoms variables. There was no statistically significant difference found between the TBI and non-TBI JD groups for either variable. Small effect sizes found further confirmed that the groups did not significantly differ.

Table 8. *Between Group Comparison of Physical and Psychological Health Symptoms in TBI and non-TBI JD Groups*

	TBI	non-TBI	F	p	d
Physical Health Symptoms	8.95 (6.28)	8.18 (6.15)	-.413	.682	.12
Psychological Health Symptoms	10.41 (6.51)	10.73 (6.71)	.16	.874	.04

Note. Means are presented with standard deviations in parentheses.

Depression. Table 9 displays the frequencies of depression along six categories for the TBI and non-TBI JD groups. Chi-squared analysis indicated that there was no overall statistically significant effect, χ^2 (5) = 6.93, p = .22. Cramer's statistic found a moderate association between depression and presence of TBI, V = .39.

Table 9. *Frequency of Levels of Depression in TBI and non-TBI JD Groups*

	Normal	Mild	Borderline Clinical Diagnosis	Moderate	Severe	Extreme
No TBI (n = 22)	0 (0)	2 (4.4)	3 (6.8)	8 (18.2)	3 (6.8)	6 (13.6)
TBI (n = 22)	1 (2.3)	3 (6.8)	1 (2.3)	4 (9.1)	9 (20.5)	4 (9.1)
Total (n = 44)	1 (2.3)	5 (11.4)	4 (9.1)	12 (27.3)	12 (27.3)	10 (22.7)

Note. Frequencies are presented with the percentage in parentheses

Between-Group Comparison: Most severe TBI and Matched non-TBI JD Groups

The respondents that reported a LOC > 60 minutes were considered to have the most severe TBI in the sample. Table 10 shows the between-group comparisons of the dependent variables callous-unemotional behaviour, risk of alcohol dependence, physical health symptoms, psychological health symptoms and depression. No statistically significant differences were found between the JDs TBI with LOC > 60 minutes and non-TBI JD control group. However, the variable, physical health symptoms tended towards significance and had a high effect size. This indicates a possible relationship between TBI and poor physical health.

Except for Cannabis, all of the drug categories were omitted from the comparison as they contained either no or only one data entry each. The assumption of normality was violated for cannabis use and general substance abuse, thus the non-parametric Mann-

Whitney test was used. Cannabis use and general substance abuse yielded the same results and were not statistically significant between the JDs with the most severe TBIs and the JDs matched control group, $U = 38$, $z = -.23$, $p = .86$, $r = -.01$. Further, Table 11 refers to the between-groups comparison of learning problems. Table 11 displays no statistically significant differences between the JDs with the most severe TBI and the non-TBI JD control group on any of the learning problems. Effect sizes found were weak to moderate. Thus, no strong relationship was apparent among the variables.

Table 10. *Between Groups Comparison of TBI with LOC > 60 Minutes and Matched non-TBI JD Control Group*

	non-TBI (*n* = 9)	LOC > 60 Minutes (*n* = 9)	*F*	df	*p*	*d*
Callous-Unemotional Traits	28.56 (8.37)	30.11 (8.45)	.15	16	.70	-.18
Risk of Alcohol Dependence	7.11 (5.97)	7.11 (5.95)	.00	16	.10	.00
Physical Health Symptoms	5.56 (3.94)	10.67 (7.4)	3.35	16	.09	-.69
Psychological Health Symptoms	11.22 (7.38)	11.56 (6.23)	.01	16	.92	-.05
Depression	29.11 (13.04)	31.89 (12.08)	.22	16	.65	-.23

Note. Means are presented with standard deviations in parentheses.

Table 11. *Learning Problems in JDs with LOC > 60 minutes and non-TBI JD Control Group*

		Non-TBI	LOC > 60 min	χ^2	df	*p*	*V*
Struggle with School Work (*n* = 18)	No	4 (22.2)	4 (22.2)	0	1	1	0
	Yes	5 (27.8)	5 (27.8)				
Received Extra Support in Lessons (*n* = 18)	No	6 (33.3)	6 (33.3)	0	1	1	0
	Yes	3 (16.7)	3 (16.7)				
Statement of Special Education Needs (*n* = 18)	No	6 (33.3)	5 (27.8)	.23	1	1	.11
	Yes	3 (16.7)	4 (22.2)				
Attended a Specialist School (*n* = 18)	No	7 (38.9)	5 (27.8)	1	1	.62	.24
	Yes	2 (11.1)	4 (22.2)				
Told to have a Learning Disability or Learning Needs (*n* = 18)	No	6 (33.3)	6 (33.3)	0	1	1	0
	Yes	3 (16.7)	3 (16.7)				
Contacted a Learning Disability Service (*n* = 18)	No	9 (50)	8 (44.4)	1.06	1	1	.24
	Yes	0 (0)	1 (5.6)				
Struggles with Reading And/or Writing (*n* = 18)	No	7 (38.9)	4 (22.2)	2.10	1	.34	.34
	Yes	2 (11.1)	5 (27.8)				
Able to Prepare Food (*n* = 18)	No	3 (16.7)	1 (5.6)	1.29	1	.58	.27
	Yes	6 (33.3)	8 (44.4)				
Able to Get Ready on Their Own (*n* = 18)	No	0 (0)	0 (0)	-	-	-	-
	Yes	9 (50)	9 (50)				

Note. Frequencies are presented with the percentage in parentheses.

Discussion

Summary and Interpretation of Findings

In this study, I predicted that the self-report rate of TBI amongst a South African JD sample would be higher than rates reported in international research. A further investigation was conducted to assess whether antisocial behaviour differed between JDs with and without TBI. I conducted these investigations for two reasons. First, South Africa has a JD prison rate that is amongst the highest in the world. Second, there is a high prevalence of TBI amongst youth reported compared to other countries. This is due to the high-risk factors of sustaining a TBI amongst South African youth via MVAs and interpersonal violence (Bruns & Hauser, 2003; Foster, 2012; Semple, Bass, & Peter, 1998).

The occurrence of TBI. The overall self-report rate of TBI of any severity found in this study is similar to rates reported in international JD studies. Perron and Howard (2008) reported a rate of 18% of TBI in a JD sample consisting of 720 participants. This is lower than the rate found in the current study. However, Hux et al. (1998) reported a rate of 55% of TBIs with or without LOC in a sample of 211 male JDs in the United States. Further, 65% of a sample of 186 male participants from the United Kingdom reported the immediate consequences of LOC or feeling dazed and confused following a TBI (Williams et al., 2010). Thus, the rate of TBI reported in this study does not support the first hypothesis that there would be a higher rate of TBI in a South African JD sample compared to rates reported in the international literature. To evaluate why the findings of this study were inconsistent with the hypothesis formulated, the methods and results of the previous literature are compared.

The age ranges and sample sizes of previous literature differed to that of this study. Hux et al. (1998) and Perron and Howard (2008) utilized large sample sizes of 211 and 720 JDs, respectively. The participants in both these studies were between the ages of 11 and 20 years of age. The sample used by Williams et al. (2010) consisted of 186 participants between the ages of 11 and 19. Therefore, these studies incorporated a wider age range and larger sample sizes then the current study, yet rates of TBI reported were still similar.

A further discriminating variable across the literature is the definition and classifications of severity of TBI. The current study, Hux et al. (1998) and Williams et al. (2010) documented any blows to the head that resulted in immediate consequences such as confusion, headaches, dizziness or a LOC of any duration as a TBI. On the other hand, Perron and Howard (2008) only reported TBIs with LOC greater than 20 minutes. Thus, the method of defining TBI differs across the literature.

Williams et al. (2010) classified TBIs across the following four categories: dazed and confused, LOC less than 10 minutes, LOC between 10 minutes and 6 hours, and LOC greater than 6 hours. In comparison, the categories of the current study as stipulated by the CHAT were as follows: dazed or confused, LOC less than 5 minutes, LOC between 5 and 10 minutes, LOC between 10 and 30 minutes, LOC between 30 and 60 minutes, and LOC greater than 60 minutes. However, only those who experienced Dazed/confused symptoms, a LOC less than 5 minutes and LOC greater than 60 minutes were reported in this study. Thus, the discrepancies in definitions across the literature only affect the comparison of the JDs with the most severe TBI in the sample as compared to the matched non-TBI JDs and not the overall rates reported.

These discrepancies make it problematic to draw conclusions about the findings of the current study in relation to previous research. These are weaknesses of the body of literature on TBI and juvenile delinquency, and not solely of the current study.

Between-group comparisons. The results of the present study showed that antisocial behaviour was slightly higher amongst JDs with TBI in comparison to JDs without TBI. However, this difference was small and not statistically significant. G*Power analysis revealed that a sample size of 111 participants was required to find a significant difference with a moderate effect size. Thus, the sample size of the current study did not have substantial predictive power. However, this study was a pilot study in an on-going investigation.

Further, JDs with and without TBI in this study did not differ significantly on learning problems, risk of alcohol dependence, substance abuse, general physical and psychological health or depression. This is an important finding as it indicates that the groups only differed on the presence of a TBI. However, both Perron and Howard (2008) and Williams et al. (2010) report that JDs with TBI have significantly more learning problems, higher levels of alcohol and substance abuse, and more mental health symptoms than JDs without TBIs. Two explanations are offered for why the current study found results inconsistent with previous research.

First, a likely explanation is that all these factors contribute to JD behaviour in the mixed race sample within this study. Race in South Africa is a proxy for socio-economic status. In Cape Town, South Africa, the mixed race population is generally representative of marginalized, low socio-economic status areas (Foster, 2012; Semple, Bass, & Peter, 1998). Aspects such as inadequate education, poor mental and physical health, and drug and alcohol abuse are commonly associated with low socioeconomic status (Hall & Chennells, 2011).

Moreover, these are considerable risk factors for oppositional conduct and may increase an adolescent's vulnerability to life persistent offending behaviour (Siegel & Welsh, 2011).

Second, the sample size of the current study was small and lacked predictive power. Effect sizes of the analyses conducted ranged from complete independence to only moderate associations. Thus, a lack of significant difference between JDs with and without TBI on the dependent variables learning problems, risk of alcohol dependence, substance abuse, general physical and psychological health, and depression may simply be a function of the small sample size. Again, however, this study was a pilot study in an on-going investigation where a larger sample size will be included.

Despite the disconfirmation of the hypotheses at this stage of the investigation, the results do suggest a potential prevalence of TBI in this South African JD sample, in line with international literature. This is an important starting point for this research, even in light of the identified limitations.

Limitations

This study had methodological limitations. Self-report was used as the method of data collection. As this study was exploratory in nature, self-report was a necessary, efficient manner and starting point to investigate whether a prevalence of TBI in a South African JD population exists. However, this source of information is subject to distortion, thus future research is recommended to confirm the self-report of TBI by using corroborative information from hospital records. Thus, the severity of TBI was not measured using a reliable measure such as the Glasgow Coma Scale (GCS). This is a reliable and objective neurological scale that measures the level of consciousness after a head injury (Gupta & Summors, 2001). This method should be adopted by future research and will help standardize the severity measure and definition of TBI across studies. This is included in the aims of the larger, on-going study. It is important to note that this reliance on self-report data is not only a limitation of the current study, but of most previous literature investigating TBI amongst JDs as well (Hux et al., 1998; Perron & Howard, 2008; Williams et al., 2010).

Lastly, the study sample consisted of only mixed race participants for greater homogeneity between the JDs with and without TBI in the between-group comparisons. Thus, the results are only generalizable to this population.

There may be a prevalence of TBI in a South African, mixed race JD sample. However, given the limitations of this study and previous literature, only tentative conclusions can be drawn from the research conducted. This study was a pilot study for a

larger project which intends on addressing these limitations as well as expanding on the scientific knowledge.

Recommendations for Future Research

A control group from the general population matched to the participant characteristics of the JD sample should be used by future research. Including a control group from the general population will assess whether the prevalence of TBI in the JD sample is merely a function of TBI in the general South African population or if there is a significantly higher prevalence of TBI amongst JDs in comparison to the general population. Including other ethnicities will also allow for between group comparisons across the various races. This will increase the generalizability of the findings.

Future research is recommended to investigate the nature of the association between TBI and juvenile delinquency. TBI may lead to deficits in complex processes such as organization, self-control, attention, problem-solving, inhibition, initiation, impulsivity, working memory, empathy and planning (Hawkins & Trobst, 2000). These processes of executive function are dynamic mechanisms of cognition that have an impact on the execution of behaviours (Gioia & Isquith, 2004). Therefore, executive functions may influence the externalized aggression associated with offending behaviour. Assessing and comparing JDs with and without TBI on neuropsychological dysfunction may lead to further understanding on how TBI may contribute to life-persistent offending behaviour. Further, neuro-imaging studies in JDs with and without TBI may aid the understanding of the neural correlates of JD behaviour.

Corroborative information, such as the date of institutionalization will aid in investigating if a causal ordering exists between the onset of criminal behaviour and sustaining a TBI. Further, investigating the crime of conviction will allow for analysis on what types of behaviours JDs with TBI are more likely to commit.

Attention deficit hyperactivity disorder, family dysfunction and problems in neurodevelopment are factors that are positively associated with behavioural dysfunction in TBI victims. Future research should control for the effect of these factors on behavioural outcomes.

Statement of Significance

The data collected supports and extends previous international research and contributes new preliminary data to South African research on the association between TBI and JDs. It was found that the rate of TBI reported in a sample of South African mixed race

JDs is similar to international literature. However, these statistics must be interpreted with caution.

This research is important because the behavioural characteristics of TBI victims and JDs are strikingly similar. Before the nature of this association between TBI and JD behaviour can be investigated, an exploratory study investigating the existence of TBI amongst JDs was necessary. A prevalence of TBI was found in this South African JD sample. This finding informs and enables future research to investigate the mechanism by which TBI may contribute to JD behaviour. Understanding how TBI may contribute to JD behaviour in South Africa may contribute to the development of rehabilitation programs in institutions to reduce continual offending behaviour that may continue into adulthood. This study was the first step towards this goal.

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Appendix A

Department of Psychology,

University of Cape Town,

Rondebosch, 7700

14 June 2012

To whom it may concern,

My name is Akira Badul. I am an Honours student at the University of Cape Town. For my Honours research project I would like to investigate the incidence of traumatic brain injury (TBI) in a sample of juvenile delinquents/young offenders. This project will serve as a pilot study for a Masters level study on the same topic. This Masters research study will be conducted by Ju-Reyn Ockhuizen who is a neuropsychology Masters student. Both of us will be conducting this research under the supervision of Ms Leigh Schrieff. Ms Schrieff is a Lecturer in the Psychology department at the University of Cape Town, who works in the area of traumatic brain injury in the paediatric population.

International & South African Research

International research indicates that there is a high incidence of TBI amongst juvenile delinquents and that TBI is a risk factor for oppositional behaviour. Research using parent-reports indicate significantly more TBI cases in delinquent youths compared to non-delinquent youth. In addition, the parents of one-third of the delinquent youths with TBI indicate that they had witnessed a marked change in behaviour post-TBI in their children and that it has had a long-term effect on their conduct. Research in the United Kingdom indicates that 46% of 186 juvenile delinquents aged 11 to 19 years old sustained a TBI. This is almost half the adolescent prison population that indicated having sustained a TBI in their past. Also associated with TBI in this sample, was a likelihood of more violent offences and repeat offences.

In 2011, the Department of Correctional Services reported that the prison population rate in South Africa was 310 prisoners per 100 000 people. From the total prison population in South Africa, there is currently an estimated amount of 78 688 juvenile delinquents. However, there is currently no information available on the incidence of TBI in a sample of juvenile delinquents of South Africa. With this, our team would like to begin investigating whether TBI is in any way contributing to this figure in South Africa. In doing so, we would like to investigate the incidence of TBI in adolescents who have been referred to rehabilitative homes for delinquent behaviours by a court of law or who have prior convictions.

Are there any risks and benefits related to participanting in this study?

The method of data collection will be through non-invasive questionnaires. This will cause no harm to any participants. There will be no immediate benefit to the adolescents for participating in this research. However, this is important empirical research in the South African context, based on the information provided above. The organisations involved may also benefit from feedback given by the researchers at the end of the project.

Ethical considerations

This study will not make use of any deception. Participant consent and assent will be sought. It will be conducted on a voluntary basis whereby participants may withdraw at any point with no penalty to them. Participants will be allowed to take breaks whenever necessary during the administration of the questionnaires. Participation is completely anonymous; there will be no link between the results found and each participant. All information is strictly confidential. Ethical approval for this study will be sought from the Research Ethics Committee of the Department of Psychology at the University of Cape Town.

Participants

The research will specifically look at Coloured male juvenile delinquents, between the ages of 12 and 18 years of age. Coloured males are the population of interest because prison surveys previously conducted, report that the majority of the prison population in South Africa consists of Coloured males. We are hoping to recruit fifty (50) participants.

What will be required should you be interested in allowing the adolescents at your facility to participate in this research?

In order to complete the questionnaires, the researcher will require an hour with each child in a quiet environment. There are also forms that the parents / caregiver / guardian of each child will be required to complete. These questionnaires will take approximately 30 minutes to complete.

Key references

Some of the key references for the information provided above are as follows:

Anderson, V. A., Anderson, P., Northam, E., Jacobs, R., & Catroppa, C. (2001). Development of executive functions through late childhood and adolescence in an Australian sample. *Developmental Neuropsychology, 20*, 385-406.

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We hereby kindly enquire whether you would be interested in collaborating with us in conducting this research, which is the first of its kind in the Western Cape and in South Africa. If so, we would like to set up a meeting with you and/or members of your organisation to discuss the possibility of this research further.

You are welcome to respond directly to this email. Alternatively, one of the researchers conducting this study (Akira or Ju-Reyn) will contact your organisation within the following week to set up a meeting.

We are happy to answer or respond to any questions or concerns that you may have.
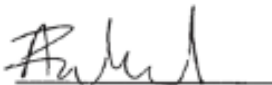
We look forward to hearing from you.

Sincerely,

Akira Badul (BDLAKI001)   and   Ju-Reyn Ockhuizen (OCKHEL001)

Please see our contact details below:

Akira Badul (Honours student)
E-mail: akirabadul@gmail.com
Cellphone number: 082 789 2992

Ju-Reyn Ockhuizen (Masters student)
e-mail: ockhuizen.j@gmail.com
cellphone number: 083 604 3918

Ms Leigh Schrieff (Supervisor)
Email: l.e.schrieff@gmail.com
Telephone number: 021 650 3708

University of Cape Town
ΨPSYCHOLOGY DEPARTMENT
Upper Campus
Rondebosch

Appendix B

Consent Form   Participant No:___

Informed Consent to Participate in Research and Authorization for Collection, Use, and Disclosure of Questionnaire and Other Personal Data

This form provides you with information about the study and asks for your permission for your child to part take in the research study. The Principal Investigator (the person in charge of this research) or a representative of the Principal Investigator will also describe this study to you and answer all of your questions. Your child's participation is entirely voluntary and anonymous. Before you decide whether or not to take part, read the information below and ask questions about anything you do not understand. By your child participating in this study you will not be penalized or lose any benefits to which you would otherwise be entitled.

1. **Name of Participant ("Study Subject")**

_____

2. **Title of Research Study**

   The Prevalence of Traumatic Brain Injury in a South African, Juvenile Delinquent Sample.

3. **Principal Investigator and Telephone Number(s)**

   Akira Badul

   Honours Student

   Department of Psychology

   University of Cape Town

   082 789 2992

Helen Ju-Reyn Ockhuizen

Co-Researcher, Masters in Neuropsychology

Department of Psychology

University of Cape Town

0836043918

Leigh Schrieff

Supervisor

Department of Psychology

University of Cape Town

021 650 3708

4. **Source of Funding or Other Material Support**

   National Research Foundation

5. **What is the purpose of this research study?**

   The purpose of this research is to investigate the prevalence of traumatic brain injury

   (TBI) among juvenile delinquents in South Africa.

6. **What will be done if your child takes part in this research study?**

   You child will be asked to complete questionnaires that ask about head injuries, antisocial

   behaviour, risk of alcohol dependence, substance abuse, general physical and

   psychological health and depression.

7. **If you choose to let your child participate in this study, how long will they be**

    expected to participate in the research?

   Completing the questionnaires will place during one session, which should not last longer

   than one (1) hour.

If at any time during the session they wish to stop their participation, they are free to do so without penalty.

8. **How many people are expected to participate in the research?**

50

9. **What are the possible discomforts and risks?**

There are no known risks associated with participation in this study. Should your child get tired during the study, they will be allowed to rest. If you wish to discuss the information above or any discomforts they may experience, you may ask questions now or call the Principal Investigator listed in #3 of this form.

10a. **What are the possible benefits to you or your child?**

You or the child in your care may or may not personally benefit from participating in this study. Should behavioural problems be identified during the process of this study, your child will be referred to the appropriate services.

10b. **What are the possible benefits to others?**

The information gained from this research study will help improve our understanding of the offending behaviour of juvenile delinquents with TBI.

11. **If you choose to let your child take part in this research study, will it cost you anything?**

Participating in this study will not cost you or your child anything.

12. **Will your child receive compensation for taking part in this research study?**

Your child will receive a R50 Checkers shopping voucher.

13a. **Can your child withdraw from this research study?**

Your child is free to withdraw their consent and to stop participating in this research study at any time. If they do withdraw their consent, there will be no penalty.

If you have any questions regarding your childs rights in this research, you may phone the Psychology Department offices at 021-650-3430.

13b. If your child withdraws, can information about them still be used and/or collected?

Information already collected may be used.

15. Once personal and performance information is collected, how will it be kept secret (confidential) in order to protect your child's privacy?

Information collected will be stored in locked filing cabinets or in computers with security passwords. Only certain people have the right to review these research records. These people include the researchers for this study and certain University of Cape Town officials. The research records will not be released without your permission unless required by law or a court order.

16. What information about your child may be collected, used and shared with others?

The information gathered is records of your responses to questionnaires regarding their behaviour. If you agree to let them be in this research study, it is possible that some of the information collected might be copied into a "limited data set" to be used for other research purposes. If so, the limited data set may only include information that does not directly identify you or your child. For example, the limited data set cannot include your name, address, telephone number, ID number, or any other numbers or codes that link you to the information in the limited data set.

17. Signatures

As a representative of this study, I have explained to the participant the purpose, the procedures, the possible benefits, and the risks of this research study; and how the participant's performance and other data will be collected, used, and shared with others:

_____   _____

Signature of Person Obtaining Consent and Authorization   Date

You have been informed about this study's purpose, procedures, possible benefits, and risks; and how your child's performance and other data will be collected, used and shared with others. You have received a copy of this form. You have been given the opportunity to ask questions before you sign, and you have been told that you can ask other questions at any time.

You voluntarily consent to let your child participate in this study. You hereby authorize the collection, use and sharing of your performance and other data. By signing this form, you are not giving away any of your legal rights.

_____   _____

Signature of Person Consenting and Authorizing   Date

Please indicate below if you would like to be notified of future research projects

conducted by our research group:

_____ (initial) Yes, I would like to be added to your research participation

pool and be notified of research projects in which I might participate in the future.

Method of contact:

Phone number: _____

E-mail address: _____

Mailing address: _____

_____

_____

Appendix C

Assent Form   Participant No:___

ASSENT TO PARTICIPATE IN RESEARCH

We are inviting you to be in our research study because we would like to learn more about children with head injuries and ways to help them.

If you agree to be in this study we will ask you to meet with us once to answer some question about your life.

These activities will not hurt you, but some of them may be long and you may feel tired at times. If you do, you can stop and rest at any time.

Signing this paper means that you want to be in the study. If you don't want to be in the study, don't sign the paper. No one will be upset if you don't sign this paper, and no one will be upset if you change your mind later and want to stop.

You can ask any questions that you have about the study. If you have a question later that you didn't think of now, you can call me on 082 789 2992 or ask me next time.

Signature of Participant _____ Date _____

Signature of Investigator _____ Date _____

Do you agree to us recording the session? (Yes/No) _____

Signature of Participant _____

Appendix D

ICU
(Youth Version)

Name: _____

Date Completed: _____

Instructions: *Please read each statement and decide how well it describes you. Mark your answer by circling the appropriate number (0-3) for each statement. Do not leave any statement unrated.*

	Not at all true	Somewhat true	Very true	Definitely True
1. I express my feelings openly.	0	1	2	3
2. What I think is "right" and "wrong" is different from what other people think.	0	1	2	3
3. I care about how well I do at school or work.	0	1	2	3
4. I do not care who I hurt to get what I want.	0	1	2	3
5. I feel bad or guilty when I do something wrong.	0	1	2	3
6. I do not show my emotions to others.	0	1	2	3
7. I do not care about being on time.	0	1	2	3
8. I am concerned about the feelings of others.	0	1	2	3
9. I do not care if I get into trouble.	0	1	2	3
10. I do not let my feelings control me.	0	1	2	3
11. I do not care about doing things well.	0	1	2	3
12. I seem very cold and uncaring to others.	0	1	2	3
13. I easily admit to being wrong.	0	1	2	3
14. It is easy for others to tell how I am feeling.	0	1	2	3
15. I always try my best.	0	1	2	3
16. I apologize ("say I am sorry") to persons I hurt.	0	1	2	3
17. I try not to hurt others' feelings.	0	1	2	3
18. I do not feel remorseful when I do something wrong.	0	1	2	3
19. I am very expressive and emotional.	0	1	2	3
20. I do not like to put the time into doing things well.	0	1	2	3

21. The feelings of others are unimportant to me.	0	1	2	3
22. I hide my feelings from others.	0	1	2	3
23. I work hard on everything I do.	0	1	2	3
24. I do things to make others feel good.	0	1	2	3

Unpublished rating scale by Paul J. Frick, Department of Psychology, University of New Orleans (pfrick@uno.edu) .

Appendix E

Participant No :_____   **Date:** _____

The Alcohol Use Disorders Identification Test: Self-Report Version

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Administer if participant has used alcohol within the last year.

PATIENT: Because alcohol use can affect your health and can interfere with certain medications and treatments, it is important that we ask some questions about your use of alcohol. Your answers will remain confidential so please be honest.

Place an X in one box that best describes your answer to each question.

Questions	0	1	2	3	4
1. How often during the last year have you had a drink containing alcohol?	Never	Monthly or less	2-4 times a month	2-3 times a week	4 or more times a week
2. During the last year, how many drinks containing alcohol have you had on a typical day when you are drinking?	1 or 2	3 or 4	5 or 6	7 to 9	10 or more
3. During the last year, how often do you have six or more drinks on one occasion?	Never	Monthly or less	2-4 times a month	2-3 times a week	4 or more times a week
4. How often during the last year have you found that you were not able to stop drinking once you had started?	Never	Monthly or less	2-4 times a month	2-3 times a week	4 or more times a week
5. How often during the last year have you failed to do what was normally expected of you because of drinking?	Never	Monthly or less	2-4 times a month	2-3 times a week	4 or more times a week

6. How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session?	Never	Monthly or less	2-4 times a month	2-3 times a week	4 or more times a week
7. How often during the last year have you had a feeling of guilt or remorse after drinking?	Never	Monthly or less	2-4 times a month	2-3 times a week	4 or more times a week
8. How often during the last year have you been unable to remember what happened the night before because of your drinking?	Never	Monthly or less	2-4 times a month	2-3 times a week	4 or more times a week
9. Have you or someone else been injured because of your drinking?	No		Yes, but not in the last year		Yes, during the last year
10. Has a relative, friend, doctor, or other health care worker been concerned about your drinking or suggested you cut down?	No		Yes, but not in the last year		Yes, during the last year
Total					

Appendix F

| ⟨Roche⟩ | **Beck Depression Inventory** | | **Baseline** |
| V 0477 | CRTN: _____ CRF number: _____ | Page 14 patient inits: _____ | |

BDI®-II

Date: _____

Name: _____ Marital Status: _____ Age: _____ Sex: _____

Occupation: _____ Education: _____

Instructions: This questionnaire consists of 21 groups of statements. Please read each group of statements carefully, and then pick out the **one statement** in each group that best describes the way you have been feeling during the **past two weeks, including today**. Circle the number beside the statement you have picked. If several statements in the group seem to apply equally well, circle the highest number for that group. Be sure that you do not choose more than one statement for any group, including Item 16 (Changes in Sleeping Pattern) or Item 18 (Changes in Appetite).

1. Sadness
0   I do not feel sad.
1   I feel sad much of the time.
2   I am sad all the time.
3   I am so sad or unhappy that I can't stand it.

2. Pessimism
0   I am not discouraged about my future.
1   I feel more discouraged about my future than I used to be.
2   I do not expect things to work out for me.
3   I feel my future is hopeless and will only get worse.

3. Past Failure
0   I do not feel like a failure.
1   I have failed more than I should have.
2   As I look back, I see a lot of failures.
3   I feel I am a total failure as a person.

4. Loss of Pleasure
0   I get as much pleasure as I ever did from the things I enjoy.
1   I don't enjoy things as much as I used to.
2   I get very little pleasure from the things I used to enjoy.
3   I can't get any pleasure from the things I used to enjoy.

5. Guilty Feelings
0   I don't feel particularly guilty.
1   I feel guilty over many things I have done or should have done.
2   I feel quite guilty most of the time.
3   I feel guilty all of the time.

6. Punishment Feelings
0   I don't feel I am being punished.
1   I feel I may be punished.
2   I expect to be punished.
3   I feel I am being punished.

7. Self-Dislike
0   I feel the same about myself as ever.
1   I have lost confidence in myself.
2   I am disappointed in myself.
3   I dislike myself.

8. Self-Criticalness
0   I don't criticize or blame myself more than usual.
1   I am more critical of myself than I used to be.
2   I criticize myself for all of my faults.
3   I blame myself for everything bad that happens.

9. Suicidal Thoughts or Wishes
0   I don't have any thoughts of killing myself.
1   I have thoughts of killing myself, but I would not carry them out.
2   I would like to kill myself.
3   I would kill myself if I had the chance.

10. Crying
0   I don't cry anymore than I used to.
1   I cry more than I used to.
2   I cry over every little thing.
3   I feel like crying, but I can't.

Subtotal Page 1

Continued on Back

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NR15645

Roche

V 0477

Beck Depression Inventory

CRTN: _____   CRF number: _____

Baseline

Page 15   patient inits: _____

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11. Agitation

0 I am no more restless or wound up than usual.

1 I feel more restless or wound up than usual.

2 I am so restless or agitated that it's hard to stay still.

3 I am so restless or agitated that I have to keep moving or doing something.

12. Loss of Interest

0 I have not lost interest in other people or activities.

1 I am less interested in other people or things than before.

2 I have lost most of my interest in other people or things.

3 It's hard to get interested in anything.

13. Indecisiveness

0 I make decisions about as well as ever.

1 I find it more difficult to make decisions than usual.

2 I have much greater difficulty in making decisions than I used to.

3 I have trouble making any decisions.

14. Worthlessness

0 I do not feel I am worthless.

1 I don't consider myself as worthwhile and useful as I used to.

2 I feel more worthless as compared to other people.

3 I feel utterly worthless.

15. Loss of Energy

0 I have as much energy as ever.

1 I have less energy than I used to have.

2 I don't have enough energy to do very much.

3 I don't have enough energy to do anything.

16. Changes in Sleeping Pattern

0 I have not experienced any change in my sleeping pattern.

1a I sleep somewhat more than usual.

1b I sleep somewhat less than usual.

2a I sleep a lot more than usual.

2b I sleep a lot less than usual.

3a I sleep most of the day.

3b I wake up 1–2 hours early and can't get back to sleep.

17. Irritability

0 I am no more irritable than usual.

1 I am more irritable than usual.

2 I am much more irritable than usual.

3 I am irritable all the time.

18. Changes in Appetite

0 I have not experienced any change in my appetite.

1a My appetite is somewhat less than usual.

1b My appetite is somewhat greater than usual.

2a My appetite is much less than before.

2b My appetite is much greater than usual.

3a I have no appetite at all.

3b I crave food all the time.

19. Concentration Difficulty

0 I can concentrate as well as ever.

1 I can't concentrate as well as usual.

2 It's hard to keep my mind on anything for very long.

3 I find I can't concentrate on anything.

20. Tiredness or Fatigue

0 I am no more tired or fatigued than usual.

1 I get more tired or fatigued more easily than usual.

2 I am too tired or fatigued to do a lot of the things I used to do.

3 I am too tired or fatigued to do most of the things I used to do.

21. Loss of Interest in Sex

0 I have not noticed any recent change in my interest in sex.

1 I am less interested in sex than I used to be.

2 I am much less interested in sex now.

3 I have lost interest in sex completely.

Subtotal Page 2

Subtotal Page 1

Total Score

NR15645