

# Prevalence and Associations Between Traumatic Brain Injury and Mental Health Difficulties Within UK Veterans Accessing Support for Mental Health Difficulties

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Little is known about the rates of traumatic brain injury (TBI) within UK veterans who are experiencing mental health difficulties. We explored rates of brain injury and symptoms of post concussion syndrome (PCS) within a sample of UK veterans who were seeking support from Combat Stress for mental health difficulties. Combat Stress is a national mental health charity that provides clinical services to veterans in the UK. 123 participants were recruited from referrals to Combat Stress over a six month period. At initial assessment participants completed a range of mental health measures. Participants were contacted again and data collected to explore the prevalence rate of brain injury and symptoms of post concussion syndrome. 63% of the sample reported a TBI. No relationship was observed between TBI and PCS. Significant associations were observed between reporting a TBI and suffering from depression and problems with anger. This study reported the high burden of mental health needs and high prevalence rates of reporting TBI within help-seeking veterans. We observed that participants who reported a TBI also reported an increased risk of experiencing mental health difficulties.

*Keywords:* brain injury, TBI, PTSD, military, veterans, post-concussion syndrome

## Introduction

A traumatic brain injury (TBI) has been defined as an acute brain injury from an external force impacting on the head (Holm, Cassidy, Carrol, & Borg, 2005). The presence of TBI can be considered if individuals report experiencing one of the following symptoms after the head trauma: loss of consciousness, disorientation, confusion or post traumatic amnesia (American Congress of Rehabilitation Medicine, 1993). Data from the UK that explored hospital admission for TBI over a six year period reported incidence rates of 453 per 100,000

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which suggests that over 270,000 people in the UK sustain a TBI annually (Yates, Williams, Harris, Round, & Jenkins, 2006).

Cross-sectional studies of UK service personnel deployed to Iraq and Afghanistan have reported prevalence rates of TBI to be 4.4%, increasing to 9.5% in combat personnel (Rona et al., 2012a). In contrast, prevalence rates in US veterans of these conflicts have been found to be substantially greater (23%), and higher rates again observed in combat personnel (Hoge et al., 2008; Pietrzak, Johnson, Goldstein, Malley, & Southwick, 2009). The above studies have relied on post-deployment measurement. A study of UK personnel that collected data during a deployment to Afghanistan reported lower rates of mild TBI (1.6%) (Jones et al., 2014). The authors concluded that within their sample they observed a one year incidence rate of 3.2% (Jones et al., 2014). This could be suggestive of a bias towards over reporting symptoms of TBI as more time passes following deployment, a finding that has been observed in US personnel (Polusny et al., 2011). Studies on both sides of the Atlantic have reported associations between TBI and symptoms of PTSD and depression (Hoge et al., 2008; Rona et al., 2012a; Jones et al., 2014). Recent research has suggested that after controlling for pre-deployment risk factors, TBIs sustained during deployment were significant predictors of individuals developing symptoms of PTSD (Yurgil et al., 2014).

Less is known about the longer term impact of TBI within military populations. The evidence is mixed whether TBI results in longer term post concussion syndrome (PCS) symptoms (Hoge, Goldberg, & Castro, 2009). One study of US service personnel who had deployed to Iraq concluded that overall the prognosis in terms of neurological impairment in those with mild TBI was positive (Vasterling et al., 2012). This contrasts with an earlier study; which did not employ a military sample, that followed individuals up to eight years post mild TBI and concluded that mild TBI could result in subtle long term neurological impairment (Vanderploeg, Curtiss, & Belanger, 2005). Many researchers have questioned the link between PCS and TBI with compelling evidence presented that PCS may indeed reflect an expression of psychological distress rather than resulting from neurological damage following a TBI (Fear et al., 2009; Friedland, 2015; McCrea, 2008). Maybe as a result of this controversy concerning whether or not there is an association between PCS and TBI, there is inconsistency as to whether post-concussion syndrome is a diagnostic category across two major classification systems (ICD and DSM).

Previous research has focused on exploring prevalence rates of TBI within the wider military population following deployment. Less is known about TBI rates within clinical samples of UK ex-serving military personnel or about the longer term relationship between TBI and mental health symptoms within this population. In this paper, we report on the prevalence rate of TBI within a sample of UK veterans accessing a mental health service. Further, we explore the associations between TBI, symptoms of PCS and a range of mental health outcomes.

## Methods

Combat Stress is a UK charity offering treatment to UK veterans experiencing mental health difficulties. The charity offers a national service, with community outreach teams across the UK. These teams split the UK into three geographical areas (the southern part of the UK, the midlands and northern England and finally Scotland and Northern Ireland). Combat Stress has been commissioned by the UK Department of Health as a national specialist service to treat veterans with PTSD (Combat Stress, 2013) and is recognised as a care pathway for veterans with PTSD by the UK's National Health Service. Further details about the clinical

services offered by Combat Stress have been described elsewhere (Murphy et al., 2015). When individuals first enter Combat Stress, they are offered an initial assessment by the relevant community outreach team. Initial assessments are conducted by a Mental Health Practitioner. As part of this assessment, individuals are asked to complete a number of psychometric measures. Following this, assessed individuals are assigned to be either active or passive clients. Active clients are those experiencing mental health difficulties and who request further support. Passive clients are individuals who do not meet criteria for experiencing a mental health difficulty and/or individuals who indicate during or immediately after the assessment that they no longer require support.

### **Participants**

Participants for this study were drawn from all new admissions to Combat Stress from the southern region of England between January 1st 2014 and July 31st 2014. Participants for this study were restricted to those clients who, after assessment, were defined as active. This was because we wanted to draw our sample from a pool of veterans with diagnosed mental health difficulties so we could understand the co-morbidity between mental health difficulties and TBI within this population. Data for this study was collected at two time points. The first was at initial assessment and the second was a follow up telephone interview, at which time information was collected in relation to potential brain injury. Telephone interviews were conducted between October 2014 and December 2014. Researchers attempted to telephone participants three times to ask them to complete the interview. In addition, a single mail-out of measures was sent in December 2014 to individuals whom the research team had been unable to contact by telephone.

### **Materials**

#### **Outcome Measures**

At initial assessment, participants completed a range of psychometric measures to evaluate the presence of mental health difficulties and substance misuse. The following measures were used: the nine item Patient Health Questionnaire (PHQ-9) to measure symptoms of depression and the cut-off for meeting case criteria was defined as a score of 10 or above (Kroenke & Spitzer, 2002; Spitzer, Kroenke, & Williams, 1999), the Generalised Anxiety Disorder assessment (GAD-7) was used to measure anxiety and to meet case criteria individuals had to score eight or above (Swinson, 2006), the five item Dimension of Anger Reactions (DAR-5) was used to assess problems with anger and the cut-off was a score of 12 or above (Forbes et al., 2014), the Revised Impact of Events Scale (IES-R) was used to measure symptoms of PTSD and meeting case criteria was defined as score of 33 or above (Creamer, Bell, & Failla, 2003), and the Alcohol Use Disorders Identification Test (AUDIT) was used to explore alcohol difficulties and a score of eight or above was used to define hazardous drinking (Babor, Higgins-Biddle, Saunders, & Monteiro, 2001).

#### **Brain Injury Measures**

The Brain Injury Screening Index (BISI) was used to assess the prevalence of brain injury. This tool has been found to be a valid (Pitman, Haddelsey, Ramos, Oddy, & Fortescue, 2014) and reliable (O'Sullivan, 2015) tool for screening for acquired brain injury. This was used to assess the presence and severity of a brain injury by defining whether any participants reported evidence of a brain injury, including TBI and other forms of acquired brain injury. Participants were deemed as having had a TBI if they reported experiencing a serious blow to the head and one or more of the following immediate symptoms as a result of to this head injury (1) alteration of mental state (e.g., dazed); (2) having a gap in memory of over one hour; and (3) loss of

consciousness. Symptoms of post-concussion syndrome (PCS) were measured by asking about the presence of seven key symptoms over the last month. These were dizziness, double vision, concentration difficulties, headaches, ringing in the ears, memory/forgetfulness problems and irritability or angry outbursts. We chose these symptoms because they have previously been identified as core symptoms of PCS (World Health Organization, 1992). These symptoms have been used within UK (Fear et al., 2009) and US military (Hoge et al., 2008) populations to explore the presence of PCS and include five symptoms that been shown to differentiate between individuals with TBI and a control group (Kashluba, Casey, & Paniak, 2006). Using these seven symptoms, we generated a marker for the presence of PCS symptoms (none, 1-3, 4+ symptoms).

### **Statistical Analyses**

For our analyses, the primary outcome measures were the presence of TBI (BISI) and symptoms of PCS. The first stage was to explore whether differences in mental health profiles existed between those we were able to contact for the second stage of data collection and those we were not. The next stage of the analysis was to restrict the sample to those participants who had been contacted for the second stage of the data collection, where information had been collected in reference to PCS and brain injury. Following this, the demographic characteristics and the rates of the mental health difficulties that were recorded at assessment were presented. In addition, prevalence rates of TBI and symptoms of PCS were calculated. Given that only six participants met the criteria for an acquired brain injury as a result of an illness affecting the brain it was decided to exclude these individuals from the remaining analyses and focus on the differences between those reporting a history of TBI and those not reporting a brain injury. Logistic regression models were fitted to examine the relationship between TBI and PCS symptoms. These models were adjusted for PTSD and depression scores. Univariate and multivariate logistic regression models were fitted to explore the relationships between TBI and health outcomes. The models were adjusted for age and sex. Analyses were repeated for PCS symptoms and health outcomes. Analyses were conducted using Stata13 (StataCorp, College Station, TX).

### **Results**

One hundred and eighty four individuals were assessed and deemed to be active clients to Combat Stress within the six month data collection period in the southern region of the UK. Of these, 123/184 (67%) were successfully contacted again during the second phase of data collection and recruited into this study. Table 1 reports the differences in health outcomes at assessment between the 123 individuals who participated in the current study and the 61 individuals who were non-responders. It was observed that non responders were more likely to meet case criteria for generalised anxiety than responders. No other significant differences were observed between these groups.

Table 2 describes the sample. The majority were male, aged over 50 and had served in the Army. In addition, Table 2 reports the high burden of mental health difficulties within this sample. For example, 80% of the sample met case criteria for depression and 73% for PTSD. Sixty three percent of the sample reported exposure to a head injury that met criteria for TBI and 5% for acquired brain injury. An example of the types of acquired brain injuries reported was having had a cerebral thrombosis. Twenty six percent of the sample reported between one and three symptoms of PCS and 71% reported four or more. Whilst not reported within a table, no significant association was observed between reporting a TBI and reporting an increased number of PCS symptoms (Odds Ratio 1.13: 95% Confidence Interval 0.88-1.43).

Table 1

*Comparison of Health Outcomes Cases Between Individuals Who Responded and Those Who Did Not*

	Non responder <sup>1</sup>	Responder <sup>1</sup>	<i>p</i> -value
	<i>N</i> %	<i>N</i> %	
	61/184 (33%)	123/184 (67%)	
Depression			
PHQ-9	34/39 (87%)	96/120 (80%)	0.31
Generalised anxiety			
GAD-7	34/39 (87%)	83/120 (69%)	0.02*
PTSD			
IES-R	28/23 (76%)	85/117 (73%)	0.72
Anger problems			
DAR-5	16/35 (46%)	64/120 (53%)	0.43
Alcohol problems			
AUDIT	18/36 (50%)	57/117 (49%)	0.89

Notes. <sup>1</sup> Numbers may not add up to 184 because of missing data; \* =  $p \leq 0.05$ .

Table 2

*Describing the Characteristics and Health Outcomes for the Sample*

	<i>N</i> (%)
Sex	
Male	121/123 (98%)
Female	2/123 (2%)
Age Group	
< 35	21/123 (17%)
35-45	41/123 (33%)
> 45	61/123 (50%)
Service	
Royal Navy	21/123 (17%)
Army	95/123 (77%)
RAF	7/123 (6%)
Depression	
PHQ-9	96/120 (80%)
Generalised Anxiety	
GAD-7	83/120 (69%)
PTSD	
IES-R	85/117 (73%)
Anger problems	
DAR-5	64/120 (53%)
Alcohol problems	
AUDIT	57/117 (49%)
PCS symptoms	
None	4/123 (3%)
1-3	32/123 (26%)
4+	87/123 (71%)
Brain Injury (BI)	
None	39/123 (32%)
TBI	78/123 (63%)
Acquired BI	6/123 (5%)

Note. Numbers may not add up to 123 because of missing data.

Table 3

*Associations Between History of TBI and Mental Health Difficulties*

	No TBI	TBI	Unadjusted model		Adjusted model <sup>1</sup>	
	Cases %	Cases %	Odds ratio	(95% CI)	Odds ratio	95% CI
Depression						
PHQ-9	27/38 (71%)	66/76 (87%)	2.69	(1.03-7.07)*	2.87	(1.06-7.79)*
Generalised anxiety						
GAD-7	27/38 (71%)	53/76 (70%)	0.94	(0.40-2.21)	1.01	(0.42-2.44)
PTSD						
IES-R	24/38 (63%)	56/73 (77%)	1.91	(0.82-4.51)	2.13	(0.86-5.25)
Anger problems						
DAR-5	15/38 (39%)	46/76 (61%)	2.35	(1.06-5.22)*	2.80	(1.19-6.60)*
Alcohol problems						
AUDIT	14/37 (38%)	42/74 (57%)	2.16	(0.96-4.84)	2.05	(0.89-4.72)

Notes. <sup>1</sup>Model adjusted for age group and sex; \* =  $p \leq 0.05$ .

Table 4

*Associations Between Being a Case on a Range of Mental Health Outcomes and PCS Symptoms (Grouped Into 0, 1-3, and 4+)*

	Mean PCS scores		Unadjusted model		Adjusted model <sup>1</sup>	
	Not case	Case	Odds ratio	95% CI	Odds ratio	95% CI
Depression						
PHQ-9	3.38	4.65	2.04	(1.06-3.92)*	2.05	(1.07-3.94)*
Generalised anxiety						
GAD-7	3.68	4.70	1.80	(0.99-3.29)	1.82	(0.99-3.33)
PTSD						
IES-R	3.97	4.54	1.41	(0.75-2.62)	1.41	(0.75-2.64)
Anger problems						
DAR-5	3.88	4.91	2.40	(1.24-4.64)*	2.42	(1.24-4.69)*
Alcohol problems						
AUDIT	4.56	4.33	0.82	(0.45-1.51)	0.81	(0.44-1.49)

Notes. <sup>1</sup>Model adjusted for age group and sex; \* =  $p \leq 0.05$ .

Associations between reporting a TBI and meeting case criteria on a range of mental health outcomes were explored in Table 3. It was observed that participants reporting TBI were also significantly more likely to meet case criteria for depression (OR 2.87: 95% CI 1.06-7.79) and problems with anger (OR 2.80: 95% CI 1.19-6.60). Table 4 explored the relationship between mental health and symptoms of PCS. A similar pattern as seen above was observed. Significant associations were observed between symptoms of PCS and depression (OR 2.05: 95% CI 1.07-3.94) and problems with anger (OR 2.42: 95% CI 1.24-4.69).

## Discussion

In this paper, we reported rates of TBI and symptoms of PCS within a help-seeking population of UK ex-service personnel. Sixty three percent of our sample reported having experienced a TBI. The majority of the sample reported symptoms of PCS, with 71% reporting four or more symptoms. No relationship was observed between reporting a TBI and reporting increased numbers of PCS symptoms. Significant relationships were

observed between reporting a TBI and suffering from depression and problems with anger. A similar pattern of findings was seen between symptoms of PCS and depression and problems with anger.

Previous research has indicated that there is a paucity of information about the mental health needs of UK service personnel once they leave the military (Iversen et al., 2010; Iversen et al., 2005; Iversen et al., 2009). Whilst not an explicit aim of the current study, we have been able to describe the high burden of mental health difficulties within a sample of help seeking veterans. Our findings highlight the differences between the wider veteran population and those seeking help for mental health difficulties. In general, those who seek help for mental health problems appear more likely to be male, have served in the Army and report higher rates of TBI (Fear et al., 2010; Jones et al., 2014). Given that this is a sample of help-seekers for mental health difficulties, it is not surprising that high rates of mental health difficulties were observed. Previous research of the wider UK military population has reported that problems related to anxiety and depression are the most prevalent, whilst rates of PTSD are relatively modest (Iversen et al., 2009; Fear et al., 2010). However, this contrasts with the current study that observed rates of PTSD to be roughly equivalent to rates of depression within help-seekers.

We reported higher prevalence rates of TBI than previous studies of UK military personnel (Hoge et al., 2008; Rona et al., 2012b; Rona et al., 2012a; Jones et al., 2014). Care needs to be taken when interpreting these differences. This is because it could be argued that previous research reported incidence rates over the period of a deployment (for example over a six month period), rather than the prevalence rate. In turn, our results could then be interpreted as reporting life time incidence rates. This is supported by previous research that has demonstrated that prevalence rates of TBI increased as length of deployment increased (Rona et al., 2012b). The authors of this previous study discussed the importance of considering the length of time that prevalence rates of TBI have been recorded over when making comparisons. With this in mind, it is maybe not surprising that we reported higher rates of TBI. The rates of TBI reported within this paper were equivalent to life time rates of TBI reported prior to deployment within a sample of active serving US personnel (59%) (Yurgil et al., 2014). This is encouraging as it suggests that when life time prevalence rates of TBI are considered, the rates we have reported within this study are roughly consistent with previous research. An alternative explanation is that given we asked about lifetime prevalence this could have increased the chances of recall bias in the reporting of TBI, a finding that has been observed previously (Polusny et al., 2011). Whilst this may explain the high rates of TBI it is hard to understand how recall bias could explain why TBI was only associated with certain mental health difficulties rather than all our outcomes measures. However, the influence of recall bias cannot be excluded.

Important differences exist between the sample used in this study and previous research. Participants within this study were drawn from a clinical population accessing Combat Stress for support with mental health difficulties. The rates of mental health difficulties reported within this sample demonstrate that these were higher than within the wider UK armed forces. For example, we reported rates of depression to be 80% and PTSD to be 73%, compared to rates 20% and 4% that been reported for a sample representative of the wider UK military population (Fear et al., 2010).

The relationship between TBI and PCS has been questioned, with researchers suggesting that PCS symptoms may not be related to TBI, but rather to psychological distress (Schneiderman, Braver, & Kang, 2008; Fear et al., 2009; McCrea, 2008; Friedland, 2015). This is because PCS symptoms within a deployed sample of UK service personnel have been observed to be non-specific to TBI, but also associated with events that had no

possible link to head injury (for example, aiding the wounded or being exposed to depleted uranium) (Fear et al., 2009). In the current study, no association was found between TBI and symptoms of PCS. Ninety seven percent of the sample reported at least one symptom of PCS. Given the lack of association between TBI and PCS this could be interpreted to support previous research by suggesting that symptoms of PCS within this population appear to indicate psychological distress rather than resulting from a TBI.

In the current study, significant associations were observed between reporting a TBI and suffering from depression and suffering from problems with anger. Our findings support previous work conducted post-deployment that noted evidence of combat-exposure being associated with TBI (Cooper et al., 2011) and significant associations between TBI and adverse health (Cooper et al., 2011; Hoge et al., 2008; Jones et al., 2014; Rona et al., 2012a). A longitudinal study that explored TBI and symptoms of PTSD, before and after US soldiers deployed to Iraq observed that pre-deployment PTSD was a significant predictor of post-deployment TBI (Polusny et al., 2011). This appears to indicate that being exposed to traumatic events increases the likelihood of reporting TBI.

### **Limitations**

A limitation of this study was the reliance on self reported measures of brain injury and PCS, and therefore the possibility of recall bias exists. Within military populations it has been noted that the measurement of TBI incidents may be influenced by memory distortions (Rona, 2012). In contrast, work within an Australian prison population has reported evidence to suggest that self-reported brain injury could be reliably confirmed by medical records (Schofield, Butler, Hollis, & D'este, 2011). The BISI was used to assess for TBI which may have introduced bias due to the broad diagnostic overlap between TBI and PTSD. For example, gaps in memory could be common to both disorders and the BISI would not have allowed us to distinguish between the two. Though in the current study PTSD was found not to be associated with TBI, which suggests any bias due to overlap between common symptoms may have been minimal. As discussed above, the BISI is reliant on self-report of TBI. Reassuringly, Pitman and colleagues have validated the BISI against both a more probing clinical interview and objective neuropsychological tests (Pitman et al., 2014). Further, a recent study using hospital records of admission confirmed the higher prevalence of brain injury amongst the homeless (McMillan et al., 2015), which had been suggested in previous studies using self-report methodologies (Hwang et al., 2008; Oddy, Moir, Fortescue, & Chadwick, 2012).

Previous research has demonstrated a link between PCS and psychological distress and given that this sample was drawn from a clinical population where psychological distress was high, this could have introduced bias into the sample. An attempt was made to control for this by adjusting analyses that explored associations between TBI and PCS symptoms for PTSD and depression scores.

It was not possible to contact every participant who completed an initial assessment within our sample to collect data in TBI and PCS symptoms. We found that non-responders were more likely to meet criteria for generalised anxiety at their initial assessment than individuals who participated in the study. This could have introduced bias into our study as this suggests that those with higher levels of anxiety were under-represented. It is difficult to hypothesise why this difference occurred because we were unable to explore possible reasons for non-response.

### **Conclusions**

To our knowledge this is the first study in the UK to explore rates of brain injury within a sample of



ex-service personnel seeking help for difficulties related to mental health problems. Within our sample a high prevalence of TBI was observed, and associations reported between TBI and higher rates of depression and problems with anger. We found no relationship between TBI and PCS. This could suggest that TBI has not resulted in longer term difficulties related to PCS. Previous research has suggested that PCS is a predictor of psychological distress rather than neurological impairment resulting from TBI. The lack of relationship between TBI and PCS in this study appears to support the notion that PCS symptoms are indicators of generalised psychological distress rather than directly related to TBI.

Further research is needed to explore the longer term implications of self-reported TBI. Since it is accepted that the vast majority of those suffering a mild TBI make a full recovery (McCrea, 2008), it will be important to establish what proportion have had a moderate or severe TBI. Whilst limitations exist, this study suggests that rates of brain injury within UK veterans with mental health difficulties may be higher than expected based on previous research conducted within the wider UK military population. Evidence has been presented to demonstrate the high rates of mental health difficulties and co-morbidity within this population and that within ex-service help-seekers prevalence rates of PTSD are similar to rates of depression. These findings suggest that routine screening for brain injury during assessment may be advantageous in order to enhance the psychological therapeutic outcomes of those presenting with TBI. Further work is needed, in particular, to explore the proportion of TBIs which are severe enough to be related to longer term neurological impairment and how this impacts on the individual's outcomes following treatment for mental health difficulties within this population of ex-service personnel.

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