

## ORIGINAL RESEARCH

# A service evaluation on the impact of brain injury linkworker (BIL) interventions on the anxiety and depression of men in prison and on probation

Elorm Boglo<sup>1,†</sup>, Ryan Jones<sup>1</sup>, Sara da Silva Ramos<sup>1</sup>, Annmarie Burns<sup>1,\*†</sup><sup>1</sup>Brainkind (formally The Disabilities Trust), RH15 9NP Burgess Hill, UK**\*Correspondence**annmarie.burns@brainkind.org  
(Annmarie Burns)

† These authors contributed equally.

**Abstract**

It is well established that the prevalence of Traumatic Brain Injury (TBI) is higher in offender populations than the general population. Men in prison and probation services also have many of the risk factors that place them at higher risk of developing neuropsychiatric complications following a TBI (e.g., low socioeconomic backgrounds, previous history of substance misuse). The BIL service, developed in 2013 by Brainkind (formally The Disabilities Trust) delivers brain injury rehabilitation to men engaged with South Wales (United Kingdom) Prison and Probation Services. As part of a wider service evaluation, we reviewed the levels of anxiety (Generalised Anxiety Disorder assessment, GAD-7) and depression (Patient Health Questionnaire, PHQ-9) of 50 men in prison or on probation pre- and post-BIL intervention. Results showed a significant decrease in the scores reported on the GAD-7 between the start (Mean—M = 15.38, Standard Deviation—SD = 4.64) and end (M = 11.84, SD = 5.15) of the intervention ( $t(49) = 2.01, p = 0.00000733$ ). Additionally, there was a significant decrease in self-reported depression symptoms as observed by the scores on the PHQ-9 between the start (M = 17.08, SD = 5.55) and end (M = 12.42, SD = 6.55) of the intervention ( $t(49) = 2.01, p = 0.0000125$ ). These results indicate that overall there was an improvement in the men's levels of anxiety and depression following the BIL intervention. This service evaluation provides a clear rationale for the development of a more rigorous research protocol to explore the relationship between brain injury interventions and the impact on mental health in this population.

**Keywords**

Acquired brain injury; Neurorehabilitation; Offender population

## 1. Introduction

It is well documented that the prevalence of TBI in offender populations is far higher than in the general population [1]. A systematic review of the literature [2] found TBI prevalence rates in offenders to be, on average 46%, a stark contrast to prevalence rates in the general population, which are estimated to be around 12% [3, 4]. It should be acknowledged that there are large discrepancies in estimates for offender populations, likely due to the different definitions of brain injury (i.e., the inclusion or exclusion of non-traumatic brain injuries), the populations studied, sample sizes and methodology. Most studies use self-report questionnaires to measure brain injury, and questions have been raised about the reliability of this with offender populations [5]. Official diagnosis of brain injury in this population is, however, often hard to obtain and self-report measures such as the Brain Injury Screening Index (BISI) [6] have been found to be consistent with information from medical records [7] and the results of neuropsychological tests [6].

Traumatic Brain Injuries are one of the leading causes of death and disability in young people [8, 9]. Incidence of TBI peaks in late adolescence and early adulthood (16–25 years), with young men more likely to engage in activities associated with brain injury risk, such as contact sports or jobs with industrial risk [10]. Most common in all populations are mild TBIs, which are estimated to account for around 80% of all TBIs, followed by moderate TBI accounting for 10% and severe TBI also accounting for 10% [2]. It is likely that mild TBIs are even more common than is captured by the data, since many people, particularly those from offender populations, do not present to hospital for fear of repercussions or a lack of awareness of the potential seriousness.

The effects of brain injury are wide ranging, and whilst common perception of TBI is often associated with physical or mobility issues, the most debilitating difficulties are often the cognitive, behavioral and emotional consequences. Commonly experienced, are somatic (e.g., fatigue [11] and headaches [12]), cognitive (memory, slowed information processing, impaired attention [13]), behavioral (disinhibition,

impulsivity, aggression [14] and emotional difficulties [15]. In mild TBI, many of these symptoms will resolve over time, but for some people (especially those with multiple mild TBI) they will endure and result in a range of persistent difficulties that make day-to-day life challenging [16, 17]. Furthermore, research has also shown that TBI-related cognitive and social impairments are associated with higher levels of previous convictions and higher recidivism rates [18, 19].

Frontal and temporal lobe damage is common following the type of brain injury experienced by men in prison [20]. Damage to the frontal lobes affects behavioral and emotional regulation [14, 15], as well as the ability to cope with new or unfamiliar situations [21]. Damage to the temporal lobes can lead to difficulties with language and memory [13]. Diffuse axonal injuries (commonly seen after road traffic accidents) can impair the speed of information processing [22]. Together, these difficulties can result in a range of behavioral, emotional and personality changes, all of which contribute to impaired social cognition, reduced tolerance to frustration and increased aggression. Links between TBI and “uncontrollable anger” have been identified in men with TBI in prison [17]. Williams *et al.* [19], in their review of the evidence surrounding TBI and crime, conclude “neuropsychological dysfunction is linked to violence, infractions in prison, poorer treatment gains and reconviction” (p. 842). It has further been shown that TBI is associated with offences being committed at a younger age, longer sentences, increased rates of reoffending and more violent crime [19]. Piccolino and Solberg [23] demonstrated that men with TBI were more frequent users of medical and psychological services whilst in custody. Taken together, this evidence provides a clear rationale for providing brain injury interventions to men in prison who have experienced a TBI.

The prevalence of serious mental health problems in offender populations is far higher than the general population [24]. Furthermore, we know that TBI can often lead to a range of neuropsychiatric sequelae, including behavioral, emotional and personality difficulties [16, 17, 25]. Risk factors for developing these problems include low educational attainment, psychosocial stress, previous psychiatric illness, substance misuse and recurrent TBI [26, 27]. These are all risk factors common to men in the criminal justice system, placing them at significant risk of ongoing mental health issues following a TBI.

Schofield *et al.* [24] studied men in the New South Wales (Australia) criminal justice system. They found that the relative risks of any psychiatric illness in the six months post-TBI were significantly higher for those with mild and severe TBI. The same study also found an association between TBI characteristics (*e.g.*, multiple TBIs, TBI with loss of consciousness) and screening positive for “major depression”. Rates of major depressive disorder (as measured by the Referral Decision Scale—RDS [28]) in those with a TBI were high at 52%. A United Kingdom based study of a male prison population [6] also found higher levels of anxiety and depression (as measured by the Beck Anxiety Inventory (BAI) and Beck Depression Inventory (BDI)) in participants with TBI when compared to those without.

The issue of co-occurring problems for men with TBI in the criminal justice system (CJS) is one that has been repeatedly

demonstrated, *e.g.*, [16, 17]. There is a complex intersection between TBI related issues, such as increased aggression, reduced inhibition, personality change and mental health issues, such as anxiety, depression and substance misuse. Given the complexity of their difficulties (cognitive, emotional and behavioral) it is often difficult for men to access standard treatments or offender rehabilitation programs [19]. It is hypothesized that TBI and its associated difficulties contribute to poorer engagement in offender rehabilitation programs and consequently, higher recidivism rates [2, 29, 30].

The high prevalence of TBI in offender populations, and associated high levels of behavioral, personality and emotional issues, has been key to the development of our Brain Injury Linkworker (BIL) service. The BIL service delivers brain injury screening as well as low and high intensity interventions (three and six sessions, respectively). Ramos, Oddy, Liddement and Fortescue [5] described a series of case studies outlining the foundations and successful application of the BIL approach. Given the difficulty that men with ABI (Acquired Brain Injury) in the criminal justice system (CJS) experience in accessing and making use of standard mental health support (*e.g.*, due to cognitive difficulties and lack of adaptations), we sought to understand the impact of our BIL service on the mental health of the men we work with. As such, we measured anxiety (Generalized Anxiety Disorder assessment, GAD-7; [31]) and depression (Patient Health Questionnaire, PHQ-9; [32]) on entry to the service and after intervention. These measures are commonly used by the UK National Health Service (NHS) and therefore widely understood by a range of professionals. We were interested to explore whether the BIL intervention would result in the men who completed their intervention demonstrating improved anxiety and depression scores as measured by the GAD-7 and PHQ-9, respectively. Whilst our interventions are not focused on anxiety and depression specifically, we wanted to explore whether our brain injury interventions (*e.g.*, psychoeducation and compensatory strategies) have an indirect impact on the men’s psychological wellbeing.

## 2. Materials and methods

### 2.1 BIL service delivery model

The BIL role, initially described by Ramos *et al.* [5], has evolved over time, so a further description is given here. Linkworkers (Assistant Psychologists) are psychology graduates who, under the supervision of a consultant clinical neuropsychologist, work within His Majesty’s Prison and Probation services (HMPPS) in South Wales. All referrals to the BIL service are screened using the Brain Injury Screening Index (BISI), and those that screen positive for a history indicative of an acquired brain injury (ABI; traumatic and non-traumatic brain injuries) are accepted for further assessment and intervention. Following discussion with the consultant clinical neuropsychologist, men are allocated to low intensity (three sessions) and high intensity (six sessions) interventions based on clinical need. Sessions last 45 to 60 minutes. The division of low and high intensity interventions is a contractual requirement with the Ministry of Justice. Low intensity

interventions provide information about brain injury, including “Tips and Tricks” self-help leaflets and signposting to other appropriate services or resources. High intensity interventions additionally include sessions focused on particular difficulties (e.g., memory, executive dysfunction, emotional regulation) and an opportunity to practice strategies in session. The linkworkers work with the men to develop a comprehensive support plan based on difficulties they report and goals they would like to achieve (e.g., get a job in the prison). The linkworkers work collaboratively to provide psychoeducation, cognitive rehabilitation and compensatory strategies to help mitigate the difficulties these men face within the criminal justice system (CJS). The specific interventions delivered are informed by the neurobehavioral therapy model of brain injury rehabilitation [33] (Table 1).

Aside from providing rehabilitation and developing compensatory strategies, a large part of the linkworker role involves liaising with other members of staff, both internal (e.g., healthcare staff, educational staff and wing officers) and external to the prison (e.g., housing, employment and drug and alcohol teams). Linkworkers advocate for the men by explaining the consequences of brain injuries and how these

may affect the men’s cognitive abilities, behavior and emotional regulation. Regular training sessions with HMPPS staff provide information about brain injury and practical advice on how best to adapt their standard practice to support men with ABI in the CJS. Linkworkers also liaise with family and friends to provide them with information and advice on how to support the individual when released into the community.

Linkworkers also offer “through the gate” [5] sessions for prison leavers and residents with their probation officers in the community. These consultations involve identifying areas in which the individual requires support to allow them to adequately integrate back into the community. “Moving on” sessions focus on working with the individual to practice and encourage generalization of compensatory strategies into community settings.

## 2.2 Service evaluation protocol

All men referred to the BIL service are screened for brain injury using the BISI [6]. A range of outcome measures are also administered (see Table 1 for a detailed listed) including the GAD-7; [31] and the PHQ-9; [32]. The GAD-7 and PHQ-9 were selected as outcome measures of anxiety and

**TABLE 1. BIL service intervention plan.**

Phases	Activities
Phase 1: Identifying history and consequences of brain injury	Clinical interview encompassing: <ul style="list-style-type: none"> <li>• Administration of the Brain Injury Screening Index: BISI [6]</li> <li>• Generalised Anxiety Disorder: GAD-7 [31]</li> <li>• Patient Health Questionnaire: PHQ-9 [32]</li> <li>• Mental Health Interview</li> <li>• Impression of Change Questionnaire</li> <li>• Offence history interview</li> <li>• Review of medical notes for ABI/TBI history</li> </ul> Individual: <ul style="list-style-type: none"> <li>• Setting of personal goals</li> <li>• Developing adaptive ways to cope with difficulties (psychoeducation, development and practice of compensatory strategies for identified goals, psychological support for mood issues)</li> </ul>
Phase 2: Intervention (person-centred and tailored to individual needs)	Environmental: <ul style="list-style-type: none"> <li>• Brain injury awareness training to staff</li> <li>• Written behaviour support guidelines</li> <li>• Linking with specific services to provide support where needed</li> <li>• Liaising with family and friends</li> <li>• Brain injury champions—additional support for staff members who express specific interest in supporting men with ABI</li> <li>• Prison Listeners—prisoners who advocate the BIL to other prisoners</li> </ul>
Phase 3: Follow-up after release	<ul style="list-style-type: none"> <li>• Establishing a relationship with relevant agencies (e.g., probation, employment, housing)</li> <li>• Assessment and intervention reports and letters to probation officers, agencies, general practitioner and next of kin, as required</li> <li>• Consultations in probation delivery units for person management and strategies to support reintegration</li> </ul>

*Adapted and updated from Ramos et al. [5]. ABI: Acquired Brain Injury; TBI: Traumatic Brain Injury; BIL: Brain Injury Linkworker.*

depression as they are commonly used tools within the UK National Health Service (NHS) and therefore support referrals to other services (e.g., community mental health teams). The use of these tools was further viewed as facilitating integration across services as the scores would be understood by a broad range of professionals. Practical considerations were that the selected measures are quick to administer and score and are well established in UK research protocols.

Following the full assessment, if an individual screens positive for having experienced a brain injury (either *via* the BISI or previous diagnosis) and they identify goals they would like to work on, they are accepted by the BIL service for intervention. They are then assigned based on clinical need (following discussion with the consultant clinical neuropsychologist) to either a low or high intensity intervention (three sessions or six sessions respectively). The only exclusion criterion is that the individual's primary problem, for which they would like support, is unrelated to their brain injury (e.g., the person is currently experiencing a mental health crisis such that they could not engage with the BIL intervention).

Fifty participants completed the GAD-7 and PHQ-9 pre- and post-BIL interventions to assess whether there had been improvements in self-reported symptoms of anxiety and depression. The GAD-7 [31] is a seven question self-report questionnaire with answers ranging from 0 = not at all, 1 = several days, 2 = more than half the days and 3 = nearly every day. The scores on each response are added, with a possible maximum score of 21. Classifications are identified as follows, scores of 0–4 indicating minimal/no anxiety; 5–9: mild anxiety; 10–14: moderate anxiety and greater than 15: severe anxiety. The PHQ-9 [32] is a nine question self-report using the same rating scale as the GAD-7. The maximum possible score is 27, with scores of 0–4 indicating minimal/no depression; 5–9: mild depression; 10–14: moderate depression; 15–19: moderately severe depression and 20–27: severe depression.

### 3. Results

At the time of writing, 233 men had been screened by the BIL service across South Wales HMPPS between March 2022 and April 2023. Written consent for their data to be used in the service evaluation was obtained for 171 (73%), and the data relating to those who did not consent were excluded. Only 50 (29%) complete datasets (pre- and post-intervention) were available for analysis. The BIL service is delivered in remand prisons (individuals are held in prison prior to sentencing or for short-term sentencing) and approved premises (hostels for prison leavers who are still deemed as being high risk); as a result, individuals are frequently released or relocated with little or no warning. Interventions may not be completed before moving on, and there is often no opportunity to collect their end-of-intervention outcome data.

Table 2 provides a breakdown of the demographics of the individuals who were screened by the BIL service. Of the 171 men that were assessed, the service was not deemed suitable for 24 (e.g., main presenting issue would be better addressed by a different service), and 14 declined treatments. Of the 133 that were offered further intervention, 83 were either relocated to another prison or released back into the

community before treatment was completed. Therefore, the sample comprises of the remaining 50 men who completed the intervention. The groups have broadly similar demographic characteristics (Table 2). All groups were of similar ages except those who declined intervention who were slightly older, although this was not statistically significant against the group average. The majority of participants had less than 10 years of formal education (*i.e.*, left school before sitting public exams at sixteen) in comparison to those who completed the intervention, who had a mode of either less than 10 years of education (46% of group) or ten years or greater (46% of group) *i.e.*, stayed in education until sixteen to eighteen years old). The assessed but declined group however, showed the highest number for TBI severity classification (marginally significant at  $p = 0.023353559$ ) and greater number of blows to the head compared with all other groups.

All data were entered and analyzed using Microsoft Excel (Microsoft Corporation, 2018, Redmond, WA, USA). Paired samples *t*-tests were carried out to compare the average self-reported anxiety (GAD-7) and depression (PHQ-9) scores before and after the BIL intervention. Results showed a significant decrease in the scores reported on the Generalised Anxiety Disorder assessment (GAD-7) between the start ( $M = 15.38$ ,  $SD = 4.64$ ) and end ( $M = 11.84$ ,  $SD = 5.15$ ) of the intervention ( $t(49) = 2.01$ ,  $p = 0.00000733$ ). Additionally, there was a significant decrease in self-reported depression symptoms as observed by the scores reported on the Patient Health Questionnaire (PHQ-9) between the start ( $M = 17.08$ ,  $SD = 5.55$ ) and end ( $M = 12.42$ ,  $SD = 6.55$ ) of the intervention ( $t(49) = 2.01$ ,  $p = 0.0000125$ ).

The qualitative and clinical significance of the changes observed within individuals were explored through an analyses of individuals' classifications of anxiety and depression before and after intervention. Classifications for anxiety showed an improvement, with most of the sample being classed as having minimal/no to moderate anxiety at the end of intervention. Results showed that post-intervention 66% of the sample were classed within this range in comparison to only 36% being classed as having mild to moderate anxiety at the start of intervention ( $\chi^2(1, 2) = 9.12$ ,  $p = 0.01$ , Fig. 1). In summary, participants were observed to have moved from more severe to milder categories of anxiety by the end of the intervention.

Change scores also indicated that most participants either decreased or maintained their levels of anxiety (Fig. 2), further evidencing the movements observed in the classification changes. The average change score was  $-3.54$  ( $SD = 6.78$ ,  $Min = -21$ ,  $Max = 5$ ). A reduction in anxiety levels was observed for 40 (80%) participants. Anxiety decreases ranged from  $-21$  to  $-1$ . Ten participants showed an increase in anxiety scores, with an average increase of  $2.60$  ( $SD = 1.51$ ), ranging from  $+1$  to  $+5$ .

Results also showed that there had been movement in classifications for depression, with 62% being classed as having minimal/no depression or moderate depression at the end of the intervention in comparison with no one falling under the minimal/no depression class and 40% classed as having mild to moderate depression at the start of intervention ( $\chi^2(1, 3) = 9.87$ ,  $p < 0.01$ ) (Fig. 3).

Individual depression score changes showed an average

**TABLE 2. Demographics of individuals assessed by the BIL service.**

	Assessed	Assessed but not suitable	Assessed but declined	Accepted	Accepted but released/relocated	Completed treatment
Number of participants	171	24	14	133	83	50
Average age	41.29 SD = 10.94	41.72 SD = 14.74	43.25 SD = 10.54	41.01 SD = 10.29	41.17 SD = 11.13	40.77 SD = 9.05
Ethnicity	93% White 4.46% Black 1.2% Arab 0.64% Asian 0.64% Mixed	100% White	100% White	90.83% White 5.83% Black 1.66% Arab 0.83% Asian 0.83% Mixed	90.41% White 5.48% Black 2.74% Arab 1.37% Mixed	92% White 6% Black 2% Asian
Years of formal education	<10 yr	<10 yr	<10 yr	<10 yr	<10 yr	<10 yr 10–12 yr
TBI severity	3.32 SD = 1.57	2.95 SD = 1.75	4.16 SD = 1.11	3.31 SD = 1.56	3.24 SD = 1.59	3.40 SD = 1.53
Number of blows to the head	2.84 SD = 1.61	2.90 SD = 2.26	3.83 SD = 1.85	2.73 SD = 1.42	2.73 SD = 1.40	2.72 SD = 1.46

All scores displayed in Table 2 are average scores, bar the number of participants and ethnicity.

Formal education was grouped in categories of <10 years, 10–12 years and 12+ years; with the mode for each group presented in the table.

The TBI Severity Index ranges from a classification of 1–5. This score is calculated by multiplying the number of injuries by the length of unconsciousness in minutes (TBI Index = No. of injuries × Greatest length of LOC (in minutes)). A classification of 1 = Mild (score; 1–10), 2 = Moderate (score; 11–30), 3 = Severe (score; 31–60), 4 = Very Severe (score; 61–300), and 5 = Extremely Severe (score; ≥301).

TBI: Traumatic Brain Injury; SD: Standard Deviation.

decrease of 4.66 points (SD = 6.78) by the end of intervention, compared to their pre-intervention scores (Fig. 4). Thirty-nine of the 50 in this sample, (78%) had score decreases post-intervention which ranged from –21 to –1. The remaining 11 (22%) participants showed an average increase of 3.75 (SD = 3.62), with a range of +1 to +11.

## 4. Discussion

The BIL service has been running in prison and probation services across the UK since 2015. When the service was first developed, the original aim was to provide low-cost, low intensity neurorehabilitation that would support men with ABI while being sustainable within an overstretched criminal justice system. Ramos *et al.* [5] demonstrated the potential value of a BIL service through a series of detailed case studies. Through our continued work, we observed that the men often reported improvements in mood and a sense of relief at sharing their story. In the words of one of the people supported, “really enjoyed the sessions, making me feel a lot better”. This was further evidenced by observations that our service users were more engaged in the prison regime (*e.g.*, having and maintaining jobs) and attending probation appointments. We wondered if our brain injury interventions were having a wider impact and contributing to improved mental health in these men.

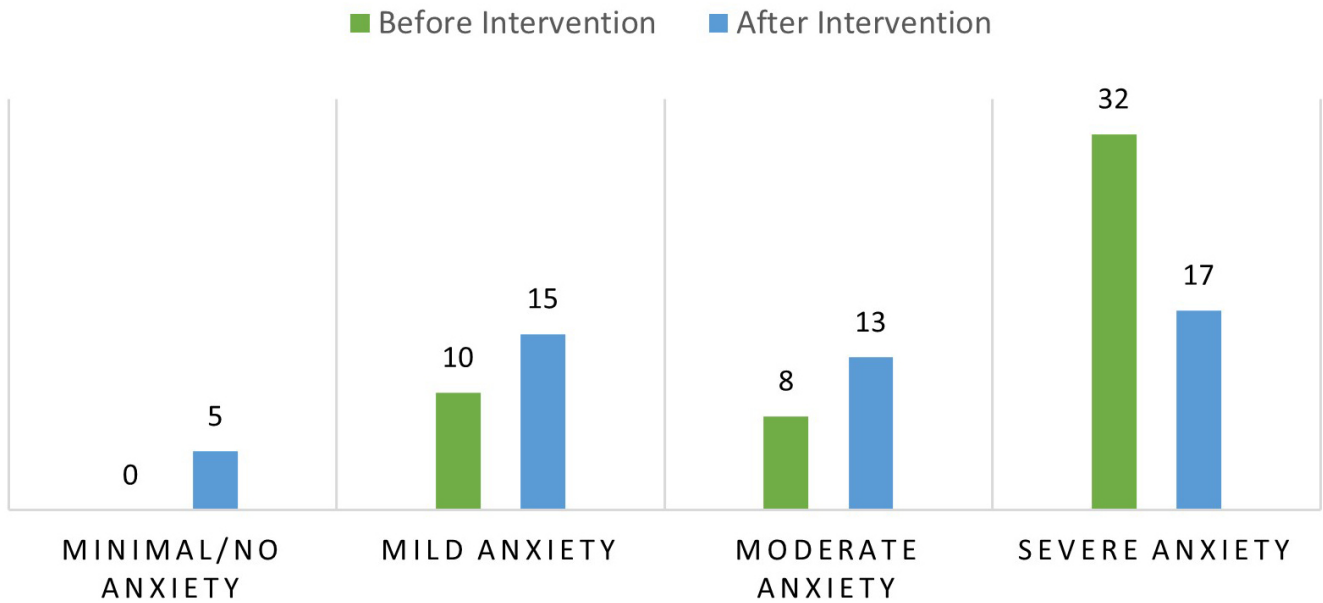
As part of our service evaluation, we looked at men’s self-

reported anxiety and depression symptoms, as measured by the GAD-7 and PHQ-9. We found significant improvements in average scores pre- and post-BIL intervention. To understand the clinical significance of this, we looked at the average change scores and found majority of men moved from more severe to milder classifications on both the GAD-7 and PHQ-9 (*e.g.*, from the moderate to mild depression classification). Further research to explore the link between the BIL intervention and improved mood is needed.

Outside of prison, these men often lead unpredictable lives, with difficulties such as homelessness, social isolation and financial constraints making it hard for them to engage in health or other support services. A BIL session is often the first time that a professional has sat down with the men, and either explained that they have a history which is suggestive of brain injury or, if they were already aware that they have a brain injury, has taken the time to discuss what this means for them. The men often expressed a sense of relief at having an opportunity to speak with a professional who understands what they are experiencing and has the time to make sense of it with them: “Grateful for helping me understand myself...100% grateful”. The power of sharing one’s story in the context of ABI has been well documented [34] and the improved GAD-7 and PHQ-9 scores after BIL intervention indicate that feeling listened to and improved understanding of brain injury [35] may contribute to improved mood.

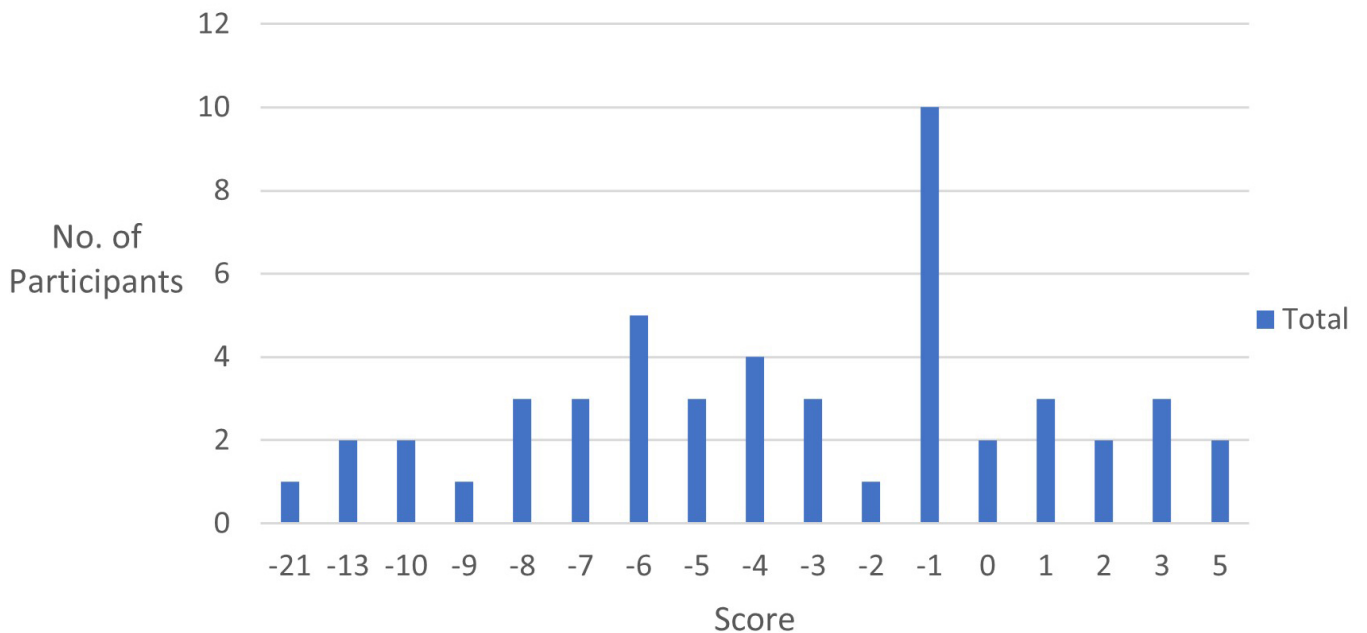
This study is a service evaluation and as such has several

## NUMBER OF INDIVIDUALS IN EACH GAD-7 CLASSIFICATION PRE & POST INTERVENTION



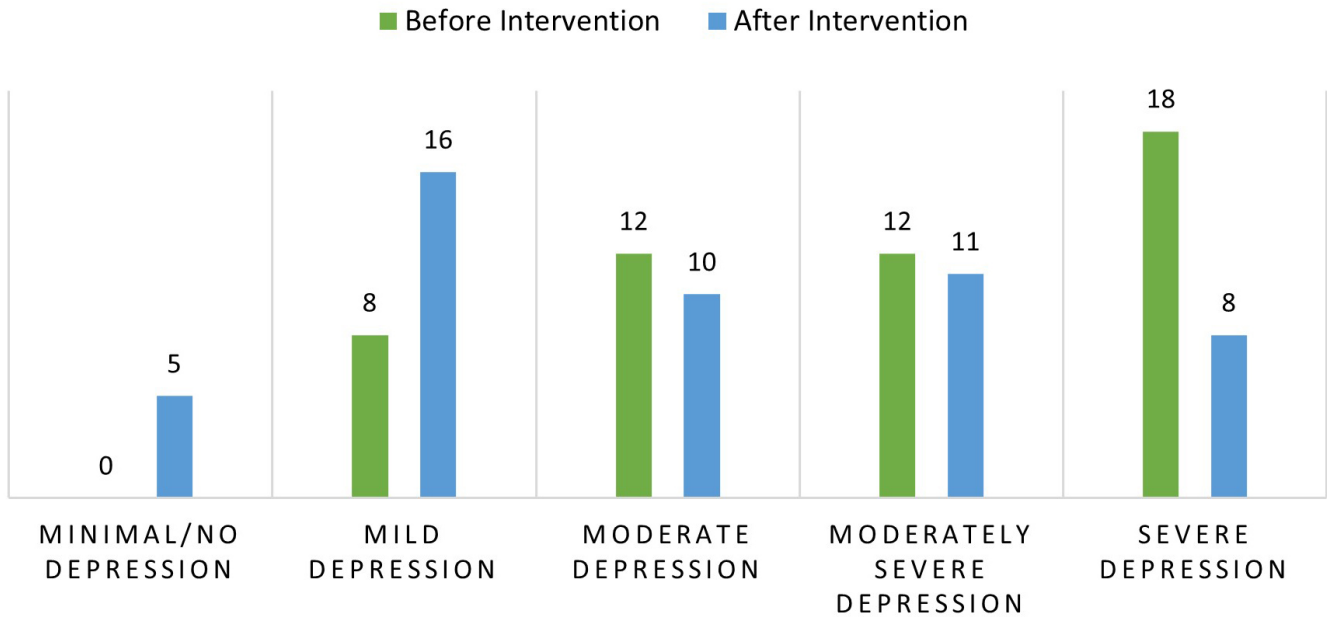
**FIGURE 1. GAD-7 classification movement.** The number of individuals in each severity classification for GAD-7 before and after intervention. This figure demonstrates that at the start of intervention 32 (64%) individuals were classed having severe anxiety, in comparison to only 17 (34%) individuals by the end of intervention. GAD-7: Generalised Anxiety Disorder.

## GAD-7 CHANGE SCORE



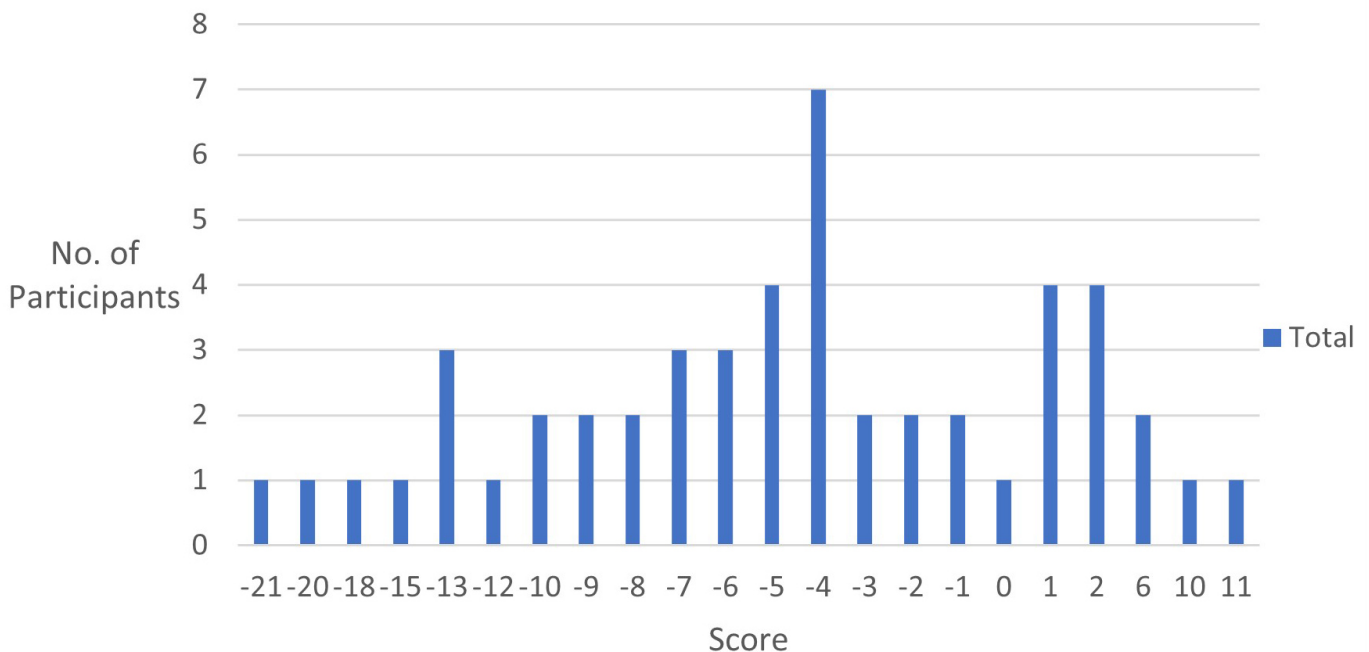
**FIGURE 2. GAD-7 change scores.** Counts of anxiety score changes for the 50 participants in the sample; calculated by subtracting the pre intervention score from the post intervention (pre intervention – post intervention = change score). This figure shows that on average, individual anxiety scores decreased by 4 (SD = 4.99), with a range of –21 to –1. Although, some participant scores increased post intervention, with a range of +1 to +5. GAD-7: Generalised Anxiety Disorder.

## NUMBER OF INDIVIDUALS IN EACH PHQ-9 CLASSIFICATION PRE & POST INTERVENTION



**FIGURE 3. PHQ-9 classification movement.** The number of individuals in each classification for PHQ-9 before and after intervention. This figure indicates movement from severe depression, to mild to moderate depression, with 62% of the sample classified on the lower severity ranges at the end of the BIL intervention. PHQ-9: Patient Health Questionnaire.

## PHQ-9 CHANGE SCORE



**FIGURE 4. PHQ-9 change score.** Counts of depression score changes for the 50 participants in the sample. This figure shows that on average, individual depression scores decreased by 5 (SD = 6.78), with a range of -21 to -1. Although, some participant scores increased post intervention, with a range of +1 to +11. PHQ-9: Patient Health Questionnaire.

limitations: one, is that of the 171 who consented to take part, complete data was only available for 50 men. The group who declined the service ( $n = 14$ ) were found to have significantly greater TBI severity. Although significance was marginal, and these are small numbers, it is clinically interesting to consider why this might occur. A possible explanation is that more severe TBI is often associated with poorer insight [36] into one's condition and this may mean the men are less likely to accept support [37]. Alternatively, those with more severe TBI might have more associated difficulties. Future analyses could focus on those that do not complete treatment by exploring other factors such as degree of cognitive impairment, concurrent mental health diagnoses, substance misuse, offence history and length of incarceration. Better understanding these issues would hopefully enable us to adapt our service and make it more accessible to this group.

Another challenge we have been unable to address with these data, is the wide range of difficulties that the men experience, in order to differentiate which may be caused by brain injury, and which may be the result of other issues. There is a significant overlap in symptoms of brain injury and mental health [15, 16, 24]. Slow information processing, low mood and poor initiation, can all be explained by TBI but also by depression. Impulsivity and poor attention can be explained by frontal lobe damage but also by Attention Deficit Hyperactivity Disorder (ADHD). Furthermore, many of the men we work with have concurrent diagnoses of learning difficulties, ADHD or substance misuse. With the delivery of any non-pharmacological intervention, it is often hard to know what exactly is benefiting the individual and how. Furthermore, this study has no control group, therefore it is not possible to ascertain whether these improvements could have resulted from a different intervention or spontaneous remission. In addition, we do not know whether the men were receiving other interventions concurrently and what impact that could have had.

Several studies refer to the role of brain injury in rates of reoffending [5, 15, 38]. The combination of difficulties experienced by men with TBI (cognitive, behavioral, emotional), are likely to result in poorer engagement with the prison regime and rapport with staff, resulting in less preparedness for release back to the community. The likelihood of reoffending in this context is much greater, as they are far less likely to access and engage with the support they need. One of the strengths of our intervention is that, though brief, it focuses on the specific needs of the individual and, as has been demonstrated here, may have indirect impact on issues such as anxiety and depression. The intersection between mental health, TBI and offending provides a clear context for the ongoing delivery and development of the BIL service. Currently very few brain injury intervention services are described [1, 5, 35] but we hope this paper provides a context for future research and service development.

Finally, our evaluation does not allow us to explore the experience of mental health and TBI in the men from Black, Asian and Minoritized Ethnic backgrounds. Although our sample is representative of the diversity in Welsh populations, it is important for us to reflect on what greater effort we can make to deliver services to people from these backgrounds. Research

shows that black men in the UK are likely to be treated more harshly by the criminal justice system [39]. We also know people from Black, Asian and Minoritized Ethnic backgrounds are likely to receive less provision of neurorehabilitation than their white counterparts [40]. Taken together, with the evidence on recidivism and brain injury, this highlights that it is imperative that services like the BIL are equally available and accessible to all.

## 5. Conclusions

This service evaluation demonstrated that men's self-reported anxiety and depression symptoms improved following the BIL intervention. This is encouraging and consistent with the qualitative feedback from the men we work with and the staff that support them within South Wales HMPPS. We acknowledge, that as a service evaluation project, there are limitations (*e.g.*, no control group, inability to rule out confounding variables) but we hope we have demonstrated the importance and value of specialist support for men with ABI in prison and probation services and provided directions for future research.

## AVAILABILITY OF DATA AND MATERIALS

The participants of this study did not give written consent for their data to be shared publicly, so the data cannot be made available.

## AUTHOR CONTRIBUTIONS

AB, SDSR and EB—designed the service evaluation. EB and RJ—collected the outcome measures and delivered the BIL interventions. AB—clinical supervision. EB and SDSR—analyzed the data. AB and EB—wrote the manuscript. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval for the service evaluation was sought from the National Research Committee of the Ministry of Justice; reference number 2021-252. All participants were provided with an information sheet and consented to their anonymized data being used in the service evaluation and write-up.

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## CONFLICT OF INTEREST

The authors declare the following potential conflicts of interest with respect to the publication of this article: The authors are employed by Brainkind (Formally The Disabilities Trust), the charitable organization that developed and delivers the BIL service. This manuscript was written as part of a service evaluation.

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