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# Mental disorder in limb reconstruction: prevalence, associations and impact on work disability

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Abstract

**Objective:** This cross-sectional survey aimed to assess the prevalence of depression, anxiety, post-traumatic stress disorder (PTSD), and drug and alcohol dependence in a limb reconstruction population and examine associations with demographic and functional variables.

**Methods:** As part of routine clinical care, data were collected from 566 patients attending a tertiary referral centre for limb reconstruction between April 2012 and February 2016. Depression, anxiety, post-traumatic stress disorder (PTSD), and alcohol and drug dependence were measured using standardised self-report screening tools.

**Results:** 173 patients (30.6% CI 26.7-34.4) screened positive for at least one of the mental disorders assessed. 110 (19.4% CI 16.2-22.7) met criteria for probable major depression; 112 (19.9% CI 16.6-23.2) patients met criteria for probable generalised anxiety disorder; and 41 (7.6% CI 5.3-9.8) patients met criteria for probable PTSD. The prevalence of probable alcohol dependence and probable drug dependence was 1.6% (CI 0.6-2.7) and 4.5% (CI 2.7-6.3), respectively. Patients who screened positive for depression, anxiety and PTSD reported significantly higher levels of pain, fatigue, and functional impairment. Depression and anxiety were independently associated with work disability after adjustment for covariates (OR 1.98 (CI 1.08-3.62) and OR 1.83 (CI 1.04-3.23), respectively).

**Conclusion:** The high prevalence and adverse associations of probable mental disorder in limb reconstruction attest to the need for routine psychological assessment and support. Integrated screening and management of mental disorder in this population may have a positive impact on patients' emotional, physical and occupational rehabilitation. A randomised controlled trial is needed to test this hypothesis.

**Keywords:** limb reconstruction; mental disorder; depression; anxiety; post-traumatic stress disorder; work disability

## Introduction

The process of limb reconstruction is often prolonged, painful and disabling, with functional outcomes equivalent to those of amputation.[1] It is surprising therefore that the mental health of patients undergoing this procedure has seldom been studied. Research conducted in other orthopaedic trauma populations suggests that mental health problems are common. In general orthopaedic trauma, high levels of depression and anxiety have been reported. Crichlow et al assessed 161 patients 3-12 months after injury and found that 45% met criteria for moderate to severe depression[2]. De Morales et al assessed 70 orthopaedic trauma inpatients and found that 46% met criteria for anxiety and 34% met criteria for depression [3]. Wiseman et al also measured trauma patients' mental health during hospital admission (n=201) and showed that 37% had symptoms of depression above the normal range and 59% had symptoms of anxiety [4]. Among patients who have undergone limb amputation, estimates of the prevalence of depression range from 28%-63%, and estimates of the prevalence of anxiety range from 25%-57%. [5-7]

To our knowledge, only one study has assessed mental disorder specifically in patients undergoing limb reconstruction. Scott et al conducted a cross-sectional survey of patients receiving limb reconstruction as a result of accidental injury and found that 43% of patients met criteria for possible anxiety, 36% met criteria for possible depression, and 8% met criteria for post-traumatic stress disorder (PTSD).[8] Time since injury was not reported, but the authors presented mean depression, anxiety and PTSD scores in three subgroups at different stages of treatment: patients who currently had a fixator (a frame fixed to the bone using wires and

screws to bring a fracture into alignment) (n=48); patients who had the fixator removed for 2-12 months (n=48); and patients who had the fixator removed for 18-36 months (n=41). Scott et al reported no significant differences in depression, anxiety and PTSD symptomatology between these groups. The study suggests that levels of mental disorder among limb reconstruction patients are high. However, the results are undermined by methodological weaknesses: the sample size was small (n=107) and the authors did not report the threshold for defining cases of depression and anxiety.

Besides causing emotional suffering, mental disorders may exacerbate patients' physical symptoms and impair functioning. For example, depression is associated with increased pain, fatigue and disability,[9] poorer treatment adherence,[10] and adverse health behaviours[11] in patients accessing physical healthcare services. There is also good evidence from orthopaedic populations that poor mental health negatively impacts key physical outcomes following surgery, including pain severity and physical functioning.[12-14]. Prolonged work absence incurs considerable personal and societal costs and is another important rehabilitation outcome following surgery[15]. Poor mental health has been linked to reduced occupational functioning [16, 17], however, the causal pathway from injury to work disability is complex, and more research is needed to determine whether the observed association between mental disorder and work is independent of injury severity. As well as being a significant risk factor for traumatic injury[18], there is evidence that alcohol and drug misuse can impede the potential for fractures to heal (particularly open fractures with bone loss), resulting in poorer outcomes post-surgery[19]

Though effective treatments for mental disorders in medical populations exist,[20] the rate of detection and intervention remains low. To determine the need for investment in mental

health training and resources for limb reconstruction services, data are needed on the prevalence and impact of mental disorder in this population. We assessed levels of probable mental disorder in a large cross-sectional sample of limb reconstruction patients using standardised screening tools. The aims of the study were 1) to determine the prevalence of depression, anxiety, PTSD, and alcohol and drug dependence in a limb reconstruction population, 2) to assess the associations of mental disorders with demographic and functional variables, and 3) to test the hypothesis that mental disorders are associated with work disability, independent of the physical burden of injury.

## Materials and Methods

### *Setting*

The sampling frame included all adults attending the Limb Reconstruction Service at King's College Hospital (KCH) in London, UK, between April 2012 and February 2016. This service is one of the busiest tertiary limb reconstruction units in the UK, receiving referrals from south-east England and the armed forces. The most common mechanism of injury is road traffic accidents, with motor car accidents being the largest subset. A typical patient seen in this unit is one with a long bone fracture that has failed to heal after multiple interventions. Referral to the KCH Limb Reconstruction Service is a critical juncture at which the patient must often decide whether to proceed with reconstruction or accept amputation.

### *Procedure*

The data used in this study were collected as part of the *Integrating Mental & Physical healthcare: Research Training and Services (IMPARTS)* initiative [21], implemented by King's Health Partners, an academic health sciences centre, in 2011. IMPARTS is an integrated

mental healthcare package designed to support physical healthcare teams in embedding mental health assessment and management into clinical care. The package consists of: 1) a web-based patient reported questionnaire enabling routine measurement of mental and physical health outcomes, with real-time feedback to clinicians; 2) development of mental health care pathways; 3) training in core mental health skills for physical healthcare teams; 4) a portfolio of self-help materials tailored to specific conditions. Since 2011 IMPARTS has been embedded in 25 clinical specialties across King's Health Partners.

IMPARTS was implemented in the KCH Limb Reconstruction Service in April 2012. Upon arriving at the clinic, patients were given an information sheet inviting them to complete a questionnaire on a touch-screen e-tablet. This explained that completing the questionnaire was voluntary and responses would be confidential. IMPARTS establishes routine outcome measurement as a service development rather than as a research project. Therefore formal consent was not required, but patients were informed that their anonymised data might be used for research or audit purposes. There were no exclusion criteria - all patients over the age of 18 were eligible for the routine outcome assessment. The questionnaire was administered in the clinic waiting room or an adjacent office prior to the patient's consultation, and took most patients 5-10 minutes to complete. Assistance was provided to patients unable to complete the questionnaire on their own. The questionnaire results populated the electronic patient record in real-time, enabling clinicians to review patients' responses, discuss results, and make appropriate referrals during the consultation. Patients who screened positive for probable mental disorder were automatically flagged and guidance on appropriate care pathways provided. A liaison psychiatrist and a cognitive behavioural therapist were recruited to confirm estimated diagnoses identified via screening and provide care to patients with mental health needs.

IMPARTS has generic research ethics approval from the National Research Ethics Service Research Database Committee (NRES Ref: 12/SC/0422), which permits the use of de-identified data collected via IMPARTS for research purposes, with the added safeguard that each project was approved by an oversight committee with two patient representatives, one of whom chaired the committee.

*Measures*

Critical to the ethos of IMPARTS is that the measures selected are salient to the patients' condition and capture relevant physical and functional patient-reported outcomes as well as mental disorders. Measures for the limb reconstruction questionnaire were selected by the IMPARTS team in collaboration with the limb reconstruction team, based on clinical experience and appraisal of the existing literature. Two measures were added to the questionnaire after the initial implementation of screening. Questions about smoking were added in response to Making Every Contact Count, an NHS mandate to improve support for health behaviour change. Questions on drug dependence were added at the request of the limb reconstruction team who felt that substance misuse was a prevalent problem in this patient group.

Pain and fatigue were assessed using visual analogue scales (VAS), which asked patients to select a number from 0 to 100 to depict the severity of their symptoms. Patients were asked "Overall, how would you rate your pain/fatigue today?".

Depression was assessed using the Patient Health Questionnaire-9 (PHQ-9), a self-report screening tool, which has been shown to have good validity and reliability in a variety of medical populations. A meta-analysis of 113 studies conducted in patients with chronic illness found that the PHQ-9 has high sensitivity (0.84; CI 0.69-0.91) and specificity (0.88; CI 0.83-0.91) compared to other commonly used depression screening tools.[22] Suicidal ideation was assessed by PHQ-9 item 9 and defined as having "thoughts that you would be better off dead or of hurting yourself in some way" more than half the days in the past two weeks. Criteria for probable Major Depressive Disorder (MDD) were met if the patient reported at least one of the two core items of the PHQ-9 (low mood or loss of interest) and at least five out of nine items in total, for more than half the days in the past two weeks. Item 9 (suicidal thoughts) counted towards the diagnosis of probable MDD if present at all.

Anxiety was assessed using the Generalised Anxiety Disorder Questionnaire-7 (GAD-7), with criteria for probable generalised anxiety disorder (GAD) met if the patient scored ≥10. A cut-off score of 10 has been shown to yield high sensitivity (0.89) and specificity (0.82) in primary care[23].

PTSD was defined as a score of 4 on the Primary Care PTSD (PC-PTSD), a brief four-item screen shown to have good sensitivity (0.78) and specificity (0.87) among Veteran's Affairs primary care patients, using the Clinician Administered Scale for PTSD (CAPS) as the reference standard[24].

Alcohol dependence was assessed using the Alcohol Use Disorders Identification Test (AUDIT): a 10-item questionnaire covering alcohol consumption, drinking behaviour, and alcohol-related problems[25], which has demonstrated excellent sensitivity and specificity in diagnosing

alcohol misuse (0.97 and 0.88, respectively)[26]. We used the World Health Organisation cut-off of ≥20 to define probable alcohol dependence.[25]

Drug dependence was assessed using a bespoke measure, since a suitably brief, validated tool was not available. Probable drug dependence was defined as an affirmative response to the question "In the past year have you used any drug or medication to the extent that you felt that you needed it or were dependent on it?" Patients were then asked "Would you like help to stop using any drug or medication?"

Smoking status was assessed with the question "Do you currently smoke?"

To assess work disability patients were asked "How would you describe your current occupational status?" and invited to select from the following options: (i) unemployed; (ii) unable to work due to ill health (iii) working full-time; (iv) working part-time; (v) student; (vi) home-maker/carer; (vii) retired; (viii) retired early due to ill health. Those who reported working or studying were then asked approximately how many days sickness absence they had taken in the past year.

Patients who reported being treated for a leg injury completed the Lower Extremity Functional Scale (LEFS). This 22 item scale measures lower-extremity related functional impairment on a 5-point response scale and has been shown to have good reliability and sensitivity to change.[27]

*Data analysis*

The prevalence of probable depression, anxiety, PTSD, alcohol dependence, drug misuse and smoking was expressed as the percentage of cases determined by the PHQ-9, GAD-7, PC-

PTSD, AUDIT, drug dependence and smoking questionnaires, respectively, with 95% CI. The sociodemographic and clinical characteristics of patients with and without mental disorder were compared using the Chi-square test for categorical data and the Mann-Whitney U test for continuous data that were not normally distributed. For ordinal data, test for trend was calculated using logistic regression, with p-values derived from the Wald test. Logistic regression models were created to examine the relationship between mental disorder and work disability in limb reconstruction patients. The purpose of the regression analysis was to test the hypothesis that mental disorders are predictive of work disability, independent of the degree of physical disability (LEFS score) and severity of physical symptoms (pain and fatigue). Only patients with a lower limb injury completed the LEFS. The regression analysis was therefore restricted to patients with a lower limb injury who completed the work disability questionnaire (383 of the total sample of 566). Work disability was defined as a response of either 'unable to work due to ill health' or 'retired early due to ill health'. To examine how selection of adjustment variables affected the relationship between mental disorder and work disability, we computed three models with varying levels of adjustment: model 1, unadjusted; model 2, adjusted for age and sex; model 3, additionally adjusted for pain (VAS score), fatigue (VAS score) and lower limb functionality (LEFS score). Statistical analyses were performed using Stata 11. The level of statistical significance was set to $p<0.05$. The questionnaire did not permit patients to proceed to the next measure if any questions were uncompleted; therefore there were no missing items.

## Results

### *Prevalence of mental disorder*

Five hundred and sixty-six limb reconstruction patients completed all or part of the IMPARTS questionnaire. Almost three quarters were male (74.0%) and the mean age was 45 (range 18-89). The large majority of patients were undergoing reconstruction of a lower limb (85.4%). Twenty-eight per cent reported being unable to work due to ill health and 5% had retired early due to ill health. Table 1 shows the prevalence and severity of MDD, GAD, PTSD, alcohol dependence, drug dependence and smoking in patients attending the KCH Limb Reconstruction Service. One hundred and seventy-three patients (30.6%) met criteria for at least one mental disorder. 19.4% met criteria for probable MDD, whilst 6.9% met criteria for severe depression. 19.9% screened positive for probable GAD and 12.6% met criteria for severe GAD. Seventy-six patients (13.5%) met criteria for comorbid MDD and GAD. The prevalence of probable PTSD was 7.6%. Fewer than 2% of the sample met AUDIT criteria for alcohol dependence and 4.5% reported drug or medication dependence.

*Demographic and clinical associations of mental disorder*

Table 2 compares the characteristics of patients who met criteria for probable mental disorder and those who did not. There was no association between age and MDD, GAD or drug/alcohol dependence. Patients with PTSD were younger than those without PTSD (41 versus 45), but the difference was not statistically significant. A greater proportion of males were depressed than females, though again this difference was not statistically significant. There was no association between gender and GAD, PTSD or drug/alcohol dependence. Patients with MDD reported significantly higher levels of pain, as did those with GAD, and those with PTSD. MDD, GAD and PTSD were also significantly associated with higher levels of fatigue. Patients receiving treatment for a lower limb injury were at no greater risk of mental disorder than those receiving treatment for an upper limb injury. Patients who met criteria for MDD reported significantly poorer lower limb function than those who did not. This was also

true for patients with GAD and PTSD. Drug/alcohol dependence was not associated with pain, fatigue or lower limb function. Patients with MDD, GAD or PTSD were more likely to be unable to work due to ill health. There was also an association between sickness absence due to illness and MDD. A similar trend was observed for GAD but did not reach statistical significance.

Table 3 presents the impact of mental disorder on work disability in patients with lower limb injury. The odds of being unable to work due to ill health were significantly greater for patients with depression compared to those without, and this association persisted after adjustment for potential confounders. In model 2, adjusted for age and gender, the relationship between MDD and work disability remained unaltered. In model 3, the addition of pain, fatigue and LEFS score (markers of injury severity), attenuated but did not eliminate the observed effect (OR 1.98; CI 1.08-3.62). A similar pattern was observed for anxiety. GAD was associated with increased odds of work disability (OR I.83; CI 1.04-3.23), even after adjustment for pain, fatigue and limb functionality. The odds of work disability due to ill health were also greater for patients who screened positive for drug/alcohol dependence, though after full adjustment (model 3), the effect did not reach statistical significance.

*Feasibility of routine patient-reported outcome measurement*

To assess the feasibility of routinely measuring patient-reported outcomes in a busy orthopaedic clinical setting, we conducted an audit of the proportion of patients completing the questionnaire, and the reasons for non-completion. Due to resource constraints, these data were only collected for the first four months following implementation of IMPARTS. Two hundred and seventy-two patients attended the limb reconstruction service during this period and all were eligible to complete the routine outcome assessment. Of these, 170 (62.5%)

participated. The most common reason for patients not completing the assessment was a lack of time (24.3%), resulting in the limb reconstruction team not approaching patients to take part. A lack of space for patients to complete the assessment (6.6%), and staff shortages (3.3%), also accounted for some patients not being approached (3.3%). Two patients (0.7%) did not understand English well enough to complete the assessment. Only seven patients (3.6%) declined to take part.

## Discussion

### *Prevalence of mental disorder*

In this sample, the prevalence of probable MDD was 19.4%, the prevalence of probable GAD was 19.9%, and the prevalence of comorbid MDD and GAD was 14.5%. These estimates are approximately twice those found in the general population, and are similar to estimates in other populations with a high symptom burden, such as palliative care.[28] The prevalence of depression and anxiety in our sample was lower than reported in Scott and colleagues' 2001 survey (36% and 43%, respectively), but because this study did not report the thresholds used to define depression and anxiety, it is difficult to draw meaningful comparisons. In both our study and Scott's the prevalence of PTSD was approximately 8.0%, indicating an increased risk compared to the general population (estimated at 5.5% in the south-east London population).[29] The prevalence of hazardous drinking and alcohol dependence in our sample were 10.0% and 1.6%, respectively, which is similar to findings in the local population.[30] The prevalence of self-reported drug or medication dependence in our sample was 4.5%, compared to 6% in combat amputees,[31] and 3.4% in the general population.[32] The proportion of patients in our sample who reported being a smoker was 20.5%, compared to 18.7% in local population.[33]

*Associations of mental disorder*

Comparison of patients with and without probable mental disorder revealed an association between severity of physical symptoms and poor mental health. Depression, anxiety and PTSD were associated with higher levels of pain and fatigue and poorer lower limb functionality, echoing previous research in patients with severe lower limb injury.[34] In contrast to earlier findings, depression and anxiety were not associated with younger age in our sample.[34] The median age of patients with PTSD was lower than those without, but the difference did not reach statistical significance (p=0.08). Studies in amputation populations have reported higher levels of psychological distress among women,[7] which our study did not replicate. Our finding that patients who screen positive for depression, anxiety or PTSD are more likely to be unemployed or unable to work mirrors previous findings in general orthopaedic trauma patients.[35]

Earlier studies investigating whether the relationship between mental disorder and work disability persists independent of injury severity have yielded differing results. MacKenzie and colleagues found that depression and anxiety were significant predictors of return to work after lower limb injury only when pain and physical functioning were not included in the regression analysis[36], whilst Zatzick et al found that depression and PTSD were associated with elevated odds of work absence (OR 2.98 and 3.56, respectively), even after adjustment for demographic and clinical variables[16]. Richmond et al also found that depression significantly increased functional impairment post-injury, including work absence (OR 2.37), after controlling for covariates[37]. Our regression analysis shows that in patients undergoing limb reconstruction, associations between depression and anxiety and work disability were robust to adjustment for physical symptoms and functioning (OR 1.98 and OR 1.83,

respectively). The persistence of these effects indicates that depression and anxiety impact ability to work independently of the physical burden of injury. Though no longer statistically significant after full adjustment (probably a result of inadequate power owing to the small number of cases), the increased odds of work disability among alcohol/drug dependent patents is also notable (OR 2.31).

*Strengths and limitations*

This is the largest analysis to date of mental disorder in a limb reconstruction population and therefore provides more precise estimates of prevalence than previous work [8]. Data collection was conducted under service conditions and facilitated by clinic staff rather than a research team. As a consequence there was not sufficient resource to record participation and reasons for non-participation for the entire cohort and we were not able to compare the characteristics of participants versus non-participants. However, the audit we conducted in the first four months following implementation found that 63% of 272 patients attending clinic took part in the assessment. This participation rate is high compared to that achieved in previous studies undertaken in orthopaedic trauma populations [4, 5]. Because the assessment process was integrated into routine care and there were no exclusion criteria, it is likely our sample is more representative than many research cohorts. It is possible that the participation rate and reasons for non-participation during the audit period are not representative of the total cohort. However, the number of patients assessed in the unit per month has remained stable since implementation of IMPARTS, suggesting a similar level of participation. The very low proportion of patients declining to complete the assessment during the audit period (3.6%) indicates that routine outcome assessment using e-tablets is acceptable to patients. The most common reason for non-completion was patients not being approached by clinic staff due to a lack of time. Participation might be improved by a modest increase in investment in staffing

to ensure the nursing team are able to invite every patient attending the unit to complete the assessment.

Whilst routine health data tend to yield more representative research samples, there are ethical issue to consider. Due to resource constraints, formal consent procedures and capacity assessment are seldom practicable for data collected routinely in the course of everyday care. Patients completing the IMPARTS questionnaire are informed that their anonymised data may be used for research purposes and are given the opportunity to opt-out. However, because formal informed consent is not sought, there is a risk that some patients may not fully understand the possibility that their data might be used for research. This risk may be increased in limb reconstruction, where some patients might have cognitive impairment resulting from their injury, and reduced capacity to understand information relevant to deciding whether to complete the questionnaire. There is also a risk that patients with acquired brain injury may not fully understand all questions included in the questionnaire, thus jeopardising the validity of the data collected. The limb reconstruction team at KCH does not routinely assess cognitive impairment; therefore we do not know the prevalence of acquired brain injury in our sample. Approval for this study was granted by the National Research Ethics Service and the IMPARTS Research Oversight Committee, who balanced the potential for harm resulting from inclusion of patients with impaired capacity to consent against the benefits of new knowledge derived from research using routinely collected data.

We used brief, self-report screening tools to define probable mental disorder, necessarily so, as the routine assessment needed to be short. Whilst effective in identifying patients with probable disorder, screening tools are not diagnostic. They yield estimated diagnoses only and cannot confirm caseness. They lack the depth of the gold standard clinical interview and

both miss cases and identify cases erroneously. We acknowledge that there are limitations to our approach. Mental disorders exist on a continuum of severity and categorising samples based on screening thresholds risks reifying an essentially arbitrary distinction. Dichotomisation reduces statistical power and may conceal substantial variation between groups. However, categorical cut-offs are used routinely in clinical practice to communicate the key features of a presentation and determine the need for intervention. Arguably, findings based on categorical data are more easily interpreted and implemented than those based on continuous data and may thus have greater clinical utility.

Our study was cross-sectional, and therefore cannot comment on questions of causality. We found that mental disorder in limb reconstruction was strongly associated with severity of physical symptoms, disability, and being out of work. Whether these factors are causes or consequences of mental disorder remains a moot point. It is probable that there is a bi-directional relationship between mental disorder and work disability.[38] The study was also limited by the single-centre design in specialised tertiary unit. It is possible that the results would be different in a less well-established service, or might vary geographically. Further study is needed to test the reliability of our results and their applicability to other settings.

The primary purpose of the IMPARTS assessment is to inform clinical care. We were mindful of the risk of over-burdening patients and clinic staff by including too many measures in the questionnaire, and as a result, a limited number of variables were assessed. Potentially, there are other important psychosocial risk factors for mental disorder in limb reconstruction patients, such as health beliefs, socioeconomic status and social support. The analysis would also have benefited from additional clinical data, for example, whether the patient had been

fitted with a frame, whether they had scarring or disfigurement resulting from their injury or treatment, or a comorbid chronic medical condition. Further, we did not have data on mechanism of injury or time since injury and were not able to investigate whether these factors predict mental disorder in this patient group. Another key limitation is that the prevalence estimates we report encompass patients at different stages in their treatment trajectory, and we were not able to compare levels of mental disorder among new referrals to the service versus those attending follow-up appointments. The absence of these data also limits the extent to which we can characterise the sample and comment on the generalisability of the results.

*Conclusions*

Patients undergoing limb reconstruction surgery are at high risk of mental disorder, most commonly depression and anxiety. Mental disorder in this population is not however inevitable and should not be normalised. We have shown that most limb reconstruction patients are resilient to mental disorder – 59.4% of our sample did not meet criteria for clinically significant symptoms on any screening measure. Our study found that mental disorder in limb reconstruction is associated with greater pain, fatigue and functional impairment, and that patients with depression and anxiety are at increased risk of work disability, independent of the physical burden of injury. Further research is needed to investigate determinants of resilience in this patient group, for example, health beliefs and coping strategies.

Routine assessment of patient-reported outcome measures (PROMS) in this setting is feasible and acceptable to patients and has the potential to transform patient care. Integration of

PROMS into routine practice offers a means to capture and monitor outcomes that are directly relevant to patients – supplementing purely clinical metrics with data on mental and physical symptoms and functioning. 'Integrated' or 'collaborative care' approaches, which combine mental health screening with evidence-based stepped care pathways for mental disorder, have been shown to improve mental and physical health and reduce healthcare costs in a range of medical settings[39, 40]. There is less evidence in orthopaedic populations, but recent trials in surgical trauma settings have shown that integrated mental healthcare ameliorates PTSD, depression and alcohol misuse and improves physical function[41, 42]. We suggest that routine, integrated screening and management of mental disorder in limb reconstruction would have a positive impact on patients' physical, emotional and occupational functioning, reducing the burden of injury on both the individual and society. There is a striking lack of provision of mental health services for patients undergoing limb reconstruction. Through implementation of IMPARTS at KCH we have demonstrated a high level of psychological morbidity in this population. Identification of clinical need has enabled a successful business case for specialist mental health input (liaison psychiatry and CBT therapy) to simultaneously support patients' mental and physical health and optimise their functional rehabilitation. The next step will be to assess the impact of screening on mental health referral rates and clinical outcomes in limb reconstruction. A randomised controlled trial is needed to evaluate the cost-effectiveness of integrated mental health care in this setting.

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## Conflict of Interest

The authors declare that they have no conflict of interest.

## Ethical approval

All procedures performed involving human participants were in accordance with the ethical standards of the Institutional and National Research Ethics Service Research Database Committee (NRES Ref: 12/SC/0422) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of study (using routine clinical data) formal consent is not required.

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Table I: Prevalence and severity of common mental disorder and substance misuse in limb reconstruction

| | |
|---|---|
| **Depression (PHQ-9)** | n=566 |
| None | 374 (66.1) |
| Some symptoms | 82 (14.5%) |
| Probable MDD | 110 (19.4% CI 16.2-22.7) |
| Severe depression (score 20-27) | 39 (6.9%) |
| Moderate depression (score15-19) | 47 (8.3%) |
| Mild depression (score<15) | 24 (4.2%) |
| Suicidal ideation | 28 (5.0%) |
| **Anxiety (GAD-7)** | n=564[a] |
| None | 426 (75.5%) |
| Some symptoms | 26 (4.6%) |
| Probable GAD | 112 (19.9% CI 16.6-23.2) |
| Severe GAD (score≥15) | 65 (11.5%) |
| **Depression AND Anxiety** | n=564 |
| MDD AND GAD | 76 (13.5% CI 10.6-16.3) |
| **PTSD (PCL-4)** | n=544 |
| Probable PTSD | 41 (7.6% CI 5.3-9.8) |
| **Alcohol misuse (AUDIT)** | n=552 |
| Probable alcohol dependence (AUDIT ≥20) | 9 (1.6% CI 0.6-2.7) |
| Harmful drinking (AUDIT 16-19) | 3 (0.5%) |
| Hazardous drinking (AUDIT 8-15) | 55 (10.0%) |
| **Drug misuse** | n=493[b] |
| Probable drug dependence | 22 (4.5% CI 2.7-6.3) |
| Would like help to stop using | 15 (3.0%) |
| **Any psychiatric disorder** (Including MDD, GAD, PTSD, alcohol dependence, drug dependence) | n=566<br>173 (30.6% CI 26.8-34.4) |
| **Smoking** | n=549[c] |
| Currently smoke | 116 (21.1% CI 17.7-24.5) |

[a]Two patients stopped completing the IMPARTS questionnaire after the depression measure, hence the different denominator for depression and anxiety.
[b]This measure was introduced after the initial implementation of IMPARTS therefore the denominator is smaller.
[c]This measure was introduced after the initial implementation of IMPARTS therefore the denominator is smaller.

Table II. Demographic and clinical characteristics of patients with mental disorder versus those without

| | **Depression** (n=566) | | | **Anxiety** (n=564) | | | **PTSD** (n=544) | | |
|---|---|---|---|---|---|---|---|---|---|
| | MDD n=110 | No MDD n=456 | | GAD n=112 | No GAD n=452 | | PTSD n=41 | No PTSD n=503 | |
| **Age** (years), Median (IQR) | 43 (33-54) | 45 (33-56) | z= 0.62 p=0.535 | 45 (35-54) | 44 (32-56) | z=-0.01 p=0.991 | 41 (32-49) | 45 (33-56) | z=1.75 p=0.08 |
| **Sex** Frequency (%) | | | | | | | | | |
| Female | 21 (19.1) | 126 (27.6) | $Chi^2$=3.36 | 28 (25.0) | 118 (26.1) | $Chi^2$=0.06 | 11 (26.8) | 127 (25.3) | $Chi^2$=0 |
| Male | 89 (80.9) | 330 (72.4) | p=0.067 | 84 (75.0) | 334 (73.9) | p=0.811 | 30 (73.2) | 376 (74.8) | p=0.82 |
| **Pain** (VAS) Median (IQR) | 54 (31-71) | 28 (10-50) | z=-7.44 p<0.001 | 52.5 (31-71) | 28 (10-50) | z=-7.18 p<0.001 | 50 (39-70) | 30 (11-51) | z=-4.19 p<0.00 |
| **Fatigue** (VAS) Median (IQR) | 60 (49-72) | 30 (11-51) | z=-8.63 p<0.001 | 56 (39.5-70) | 30 (11-51) | z=-7.11 p<0.001 | 59 (31-71) | 36 (12-59) | z=-3.82 p<0.00 |
| **Treatment for lower limb**[a] Frequency (%) | | | | | | | | | |
| Yes | 71 (86.6) | 316 (85.2) | $Chi^2$=0.11 | 81 (90.0) | 306 (84.3) | $Chi^2$=1.88 | 27 (90.0) | 345 (85.2) | $Chi^2$=0 |
| No | 11 (13.4) | 55 (14.8) | p=0.743 | 9 (10.0) | 57 (15.7) | p=0.170 | 3 (10.0) | 60 (14.8) | p=0.47 |
| **Lower Extremity Function**[b] (LEFS) Lower score = poorer limb function Median (IQR) | 18 (8-29) | 27.5 (14-45) | z=3.93 p<0.001 | 17 (8-29) | 28 (15-46) | z=4.79 p<0.001 | 20 (3-26) | 26 (13-45) | z=2.88 p=0.00 |
| **Occupational status**[c] Frequency (%) | | | | | | | | | |
| Unemployed | 20 (20.2) | 37 (9.2) | | 21 (20.2) | 36 (9.1) | | 6 (16.7) | 51 (11.3) | |
| Working full-time | 14 (14.1) | 139 (34.5) | | 16 (15.4) | 137 (34.4) | | 8 (22.2) | 141 (31.2) | |
| Working part-time | 3 (3.0) | 42 (10.4) | | 4 (3.9) | 41 (10.3) | | 2 (5.6) | 43 (9.5) | |
| Student | 2 (2.0) | 17 (4.2) | | 3 (2.9) | 16 (4.0) | | 1 (2.8) | 17 (3.8) | |
| Homemaker/carer | 1 (1.0) | 14 (3.5) | | 1 (1.0) | 14 (3.5) | | 0 | 14 (3.1) | |
| Retired | 6 (6.1) | 43 (10.7) | | 6 (5.8) | 43 (10.8) | | 0 | 46 (10.2) | |
| Retired early due to health | 5 (5.1) | 20 (5.0) | | 6 (5.8) | 19 (4.8) | | 1 (2.8) | 22 (4.9) | |
| Unable to work due to health | 48 (48.5) | 91 (22.6) | $Chi^2$=47.8 P<0.001 | 47 (45.2) | 92 (23.1) | $Chi^2$=41.6 P<0.001 | 18 (50.0) | 118 (26.1) | $Chi^2$=1 P=0.04 |
| **Sickness absence**[d] (days off due to illness in past year) Frequency (%) | | | Test for | | | Test for | | | Test fo |
| 0 | 4 (21.1) | 72 (36.4) | trend | 6 (26.1) | 70 (36.1) | trend | 2 (18.2) | 73 (36.3) | trend |
| 1-10 | 3 (15.8) | 70 (35.4) | z=2.46 | 5 (21.7) | 68 (35.1) | z=1.82 | 3 (27.3) | 68 (33.8) | z=1.64 |
| 11 or more | 12 (63.2) | 56 (28.3) | p=0.014 | 12 (52.2) | 56 (28.9) | p=0.068 | 6 (54.6) | 60 (29.9) | p=0.10 |

[a]This question was introduced after the initial implementation of screening therefore the denominator is smaller n=453 [b]Only patients receiving treatment for a leg completed the LEFS therefore the denominator is smaller n=387 [c]This questionnaire was introduced after the initial implementation of screening therefore the denominator is smaller n=502 [d]Only patients currently working or studying were asked this question therefore the denominator is smaller n=217

Table III: Logistic regression analysis showing the relationship between mental disorder (independent variable) and ability to work (dependent variable), in subset of patients with lower limb injury

| | | Depression (n=383*) | | | Anxiety (n=383*) | | | PTSD (n=372*) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | OR | 95% CI | p | OR | 95% CI | p | OR | 95% CI | p |
| Model 1[a] | Not working due to health | 2.84 | 1.67-4.83 | p<0.001 | 2.66 | 1.61-4.41 | p<0.001 | 2.15 | 0.98-4.74 | p=0.057 |
| Model 2[b] | Not working due to health | 2.84 | 1.66-4.84 | p<0.001 | 2.68 | 1.61-4.44 | p<0.001 | 2.10 | 0.95-4.64 | p=0.066 |
| Model 3[c] | Not working due to health | 1.98 | 1.08-3.62 | p=0.026 | 1.83 | 1.04-3.23 | P=0.036 | 1.32 | 0.57-3.03 | p=0.519 |

*Only patients who completed the LEFS and the occupational functioning questionnaire were included in the regression analysis, hence the denominators are smaller than the total sample [a]Model 1 – unadjusted

[b]Model 2 – adjusted for age and gender

[c]Model 3 – adjusted for age, gender, lower extremity function (LEFS), pain and fatigue

Highlights

- Mental disorders, particularly depression and anxiety, are prevalent in patients undergoing limb reconstruction.
- Depression, anxiety and post-traumatic stress disorder are associated with significantly higher levels of pain, fatigue and functional impairment.
- Depression and anxiety independently impact ability to work after adjustment for the physical burden of injury.