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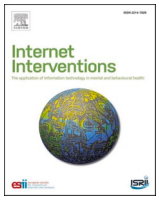

# Predictors of functional impairment at assessment and functional improvement after treatment at a national digital mental health service

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ABSTRACT

Mental disorders are associated with impairment to daily functioning, which affects both the individual and society. Despite this, most research on treatment outcome only report symptom change. Self-reported days out of role (DOR) is a simple measure of functional impairment used in many population studies. The current study sought to report on the degree of functional impairment measured by DOR in a clinical sample at assessment, the factors associated with this impairment, the predictors of functional improvement after treatment and the relationship between symptomatic and functional change. Using a prospective uncontrolled observational cohort study design with a sample of 17,813 patients accessing a digital mental health service (DMHS), we examined self-reported demographic, psychosocial and clinical data. Using a series of univariate regression models and multivariate classification algorithms, we found that baseline DOR was associated with age, employment and relationship status, symptom severity, symptom chronicity and with the presence of several psychosocial difficulties. Baseline DOR was best predicted by older age, disability payments, higher symptom severity and increasing number of endorsed psychosocial difficulties ($R^2 = 32.7$ %). Forty-one per cent of the sample experienced a >50 % or greater reduction in DOR following treatment. Those who were separated, unemployed or on disability payments, or with severe and chronic depression, experienced the greatest reductions in DOR after treatment. Changes in functioning were independent of changes in symptoms, highlighting the importance of functional impairment as a treatment outcome. This study found that many of the patients who access DMHS have significant levels of functional impairment, a large proportion obtain functional improvement after treatment, and improvement in function after treatment was independent of improvement in symptoms.

## 1. Introduction

Numerous population surveys and clinical cohort studies have shown that mental disorders are associated with significant disability and impairment to function. The 2013 Global Burden of Disease Study, for example, found that mental and substance use disorders are the leading cause of years lived with disability (YLDs) (Whiteford et al., 2013), accounting for 21.1 % of all YLDs and 11 % of all disability-adjusted life years (DALYs) (Vos et al., 2017). A recent Australian Government report highlighted that despite the large public investment in mental health services, mental disorders still result in significant loss of productivity, estimated at AUD$39 billion/year (Productivity Commission, 2020).

There are a number of ways to measure functional impairment, the simplest and most used of which is self reported 'days out of role' (DOR). The DOR measure asks a person how many days they have been unable to perform their usual daily occupational, caregiving, and other social roles due to poor physical or mental health in the past month (McCallum et al., 2019). DOR has been reported to be higher in people with common mental disorders, indicating greater disability (Alonso et al., 2011). Although it relies on retrospective self-report, DOR has good concordance with payroll records of employed people (Revicki et al., 1994), and prospective daily diary reports (Kessler et al., 2004).

A multi-centre international study of 62,971 respondents conducted by the World Health Organization (WHO) reported that mental disorders were among the most strongly associated with productivity loss when measured by average DOR over a year (Alonso et al., 2011). When

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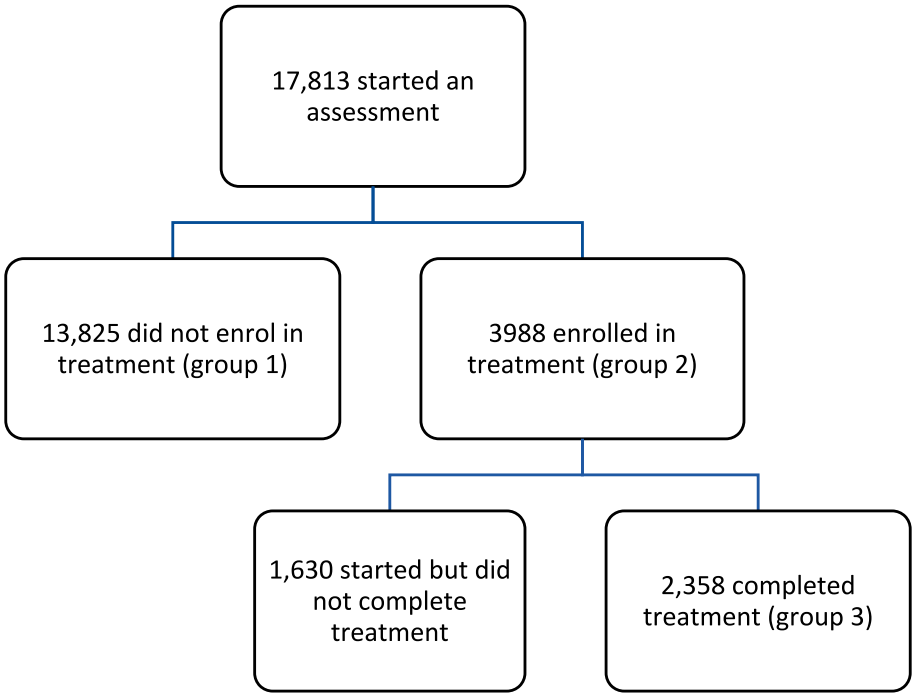


**Fig. 1.** Participant flow from assessment through to treatment completion.

adjusting for comorbid disorders, bipolar disorder, PTSD, panic disorder, generalized anxiety disorder, and social phobia were among the mental health conditions resulting in the greatest impairment (Alonso et al., 2011). The Australian mental health and wellbeing survey (NMHWBS) found that adults with mental disorders had an average of four days in which they reduced or were unable to carry out their normal activities in the past 30 days (Slade et al., 2009). A more recent Australian study with nearly 3000 participants found that adults with diagnosed mental disorders report significantly reduced capacity to carry out normal activities (McCallum et al., 2019) with an average DOR for participants with any disorder of 6.01 days, for those with Major Depressive Disorder (MDD) 11.4, Generalized Anxiety Disorder (GAD) 8.5, and no disorder 0.8.

Despite the established relationship between mental disorders and functional impairment, change in function is rarely reported as a treatment outcome. The most frequently reported treatment outcome metric is group-level symptom reduction (van Os et al., 2019) and an umbrella review of over 90 meta-analyses reported that <5 % of clinical trials in depression report functional outcomes (Lam et al., 2011). Paradoxically, when people with MDD were asked to rate the factors most important to them when defining remission, the most frequently reported were 1) the presence of features of positive mental health such as optimism and self-confidence; 2) a return to one's usual, normal self; and 3) a return to the usual level of function (Zimmerman et al., 2006). Although there is a positive relationship between functional impairment and symptom severity, functioning effect sizes after treatment are typically smaller than symptom effect sizes (de Groot et al., 2022), changes in symptoms and function are distinct outcomes (Becker et al., 2011) that may not change in the same way at the same time together. For example, a pooled analysis of three randomised, double-blind, 8-week acute treatment studies found that for MDD and GAD respectively, 38 % vs 30 % of patients achieved symptomatic remission, defined by the clinical threshold of the Hamilton depression scale, 32 % vs 45 % achieved functional remission defined according to the authors' disability scale, and 23 % vs 25 % achieved both symptomatic and functional remission (Sheehan et al., 2011). Other studies have shown that functional improvement lags behind the symptomatic improvement, suggesting that treatment specifically focused on functional impairments may be necessary to achieve both symptomatic and functional remission (Sheehan et al., 2017). Moreover, persistent impairment in function despite recovery from symptoms of depression has been shown to be a predictor of subsequent relapse (IsHak et al., 2013).

There are also few reports of functional outcome in psychological treatments delivered remotely by digital mental health services (DMHS). Most studies of internet-delivered cognitive behavioural therapy (iCBT) report symptom severity and symptom change as the primary, or only, outcomes. For example, in a recent meta-analysis and systematic review of 19 studies reporting the outcomes of iCBT treatment in routine care, not one reported on functional outcomes (Etzelmueller et al., 2020). Hence, despite large improvements in self-reported symptoms of both anxiety and depression achieved by DMHS delivering iCBT as part of routine care (Titov et al., 2018; Etzelmueller et al., 2020; Titov et al., 2020), questions still remain about the real world effectiveness of digital treatments, in particular, whether the improvement in symptoms translates to improvement in functional outcomes. Therefore, there is a clear need for the evaluation of functional outcomes from DMHS to overcome continuing scepticism about the functional benefit of this form of care.

The purpose of this study was to report on the levels of functional impairment and improvement across the natural service flow in a large sample of patients seeking assessment or treatment from a national DMHS. Our specific aims were to:

1. Describe baseline levels of functional impairment and compare to large scale community studies.
2. Identify predictors of functional impairment at assessment (baseline).
3. Identify predictors of functional impairment after iCBT treatment and identify treatment specific predictors compared to baseline.
4. Determine the relationship between symptom change and functional change.

## 2. Methods

### 2.1. Design and participants

This study was designed as a prospective uncontrolled observational cohort study and is reported according to STROBE guidelines (Erik von Elm et al., 2007). It includes all patients who registered for assessment, or enrolled in a transdiagnostic treatment course at the MindSpot Clinic from 1st January 2019 to 31st December 2019. As a naturalistic study, we aimed to follow the observed service flow through the pathway during that period, which resulted in three 'pathway' groups and one outcome group (Fig. 1). The 'assessment' group comprised all who started the online assessment to enter the service and did not enrol in treatment. The 'enrolment' group completed the assessment and elected to enrol in a treatment course, while the 'completion' group is a subset of the 'enrolment' group who completed the treatment, defined as reading four of the five lessons of the course. The outcome group was labelled the 'improvement' group, a subset of the treatment completion group reporting a 50 % reduction in DOR, as described below. A similar grouping model examining factors predicting treatment uptake, completion and symptom outcome has been previously reported (Cross et al., 2022). Ethical approval for the collection and use of the data was obtained from the Macquarie University Human Research Ethics Committee (5201200912) and registered on the Australian and New Zealand Clinical Trials Registry (ACTRN12613000407796). All included patients consented to their non-identifiable, aggregated data being used for research purposes.

### 2.2. Procedure

MindSpot is a high volume, Australian Government funded Australian DMHS launched in December 2012, that has provided services at no cost to >160,000 Australian adults and enrolled >30,000 people in one of its 8-week iCBT-based treatment courses (Titov et al., 2016; Titov et al., 2020). MindSpot serves a highly diverse group of patients, obtains high treatment outcome effects (Titov et al., 2020) and is highly cost-effective (Lee et al., 2017). People self-refer or are referred by health professionals. After registering with MindSpot, they provide answers to questions seeking demographic and clinical information, including about symptoms, suicidal thoughts and plans and current psychosocial difficulties. People who complete the online assessment are invited to discuss their results and treatment options with a MindSpot therapist. Depending on preference and suitability, participants can enrol into one of seven online treatment courses, unless they are considered unsuitable for digital treatment due to concerns about their immediate safety or the severity and complexity of their conditions. Four of the seven courses are 'transdiagnostic', in that they aim to treat symptoms of both depression and anxiety, adapted to suit different patient characteristics. Given the similarity in content, patients enrolled in the four transdiagnostic courses (Mood Mechanic for 18 to 25-year-olds (Dear et al., 2018), Wellbeing for 26–65-year-olds (Dear et al., 2016), Wellbeing Plus for 60+ (Staples et al., 2016) and the Indigenous Wellbeing course (Titov et al., 2019) were included in the current analysis.

### 2.3. Measures

Standardised and validated symptom questionnaires were administered to patients during assessment and treatment with the clinic. These included the Patient Health Questionnaire-9 (PHQ-9), Generalized Anxiety Disorder 7-item Scale (GAD-7) and the Kessler Psychological Distress 10-Item Scale (K10).

#### 2.3.1. Patient Health Questionnaire — 9 item

The PHQ-9 consists of nine items measuring symptoms of major depressive disorder according to criteria of the Diagnostic and Statistical Manual of Mental Disorders, 4th edition (Kroenke et al., 2001). Scores range from 0 to 27, with a score of 10 or more considered indicative of a diagnosis of depression, although this cut-off has been recently challenged (Titov and Andersson, 2022).

#### 2.3.2. Generalized Anxiety Disorder — 7 item

The GAD-7 consists of seven items and is sensitive to the presence of generalized anxiety disorder, social phobia, and panic disorder (Spitzer et al., 2006). Scores range from 0 to 21, with a score of 8 or more indicating the probable presence of an anxiety disorder. For both the PHQ-9 and the GAD-7, patients were also asked a 'functional interference' question: "*How much have the above problems interfered with your ability to do your work, take care of things at home, or get along with other people?*"

#### 2.3.3. Kessler Psychological Distress 10-item

The Kessler Psychological Distress 10-Item Scale (K-10) scores range from 10 to 50 and scores of 21 or more are associated with the presence of anxiety and depressive disorders (Kessler et al., 2002). The K10 also contained four additional disability and service utilisation questions, known as the K10+.

#### 2.3.4. Functional impairment

The functional impairment question from the K10+ used in this study was measured as Days Out of Role (DOR): "*In the last four weeks, how many days were you totally unable to work, study or manage your day-to-day activities because of these feelings*?". Patients were also asked about the cause of DOR: "*in the last 4 weeks, how often have physical health problems been the main cause of these feelings*?". Functional improvement was defined as a 50 % or more reduction in DOR between assessment and treatment completion, as this definition allowed a comparison to the mean functional improvement reported in the larger national sample (Titov et al., 2020).

#### 2.3.5. Psychosocial difficulties

Patients were asked, "*are you having significant difficulties with any of the following*?" and were required to endorse at least one of the 14 options listed in Table 2, which included an option for 'none of these'. Culminative difficulties were simply the total number of difficulties indicated.

### 2.4. Statistical analysis

Analysis and identification of participant characteristics that influence DOR in the three groups were explored in three steps. In the first step, a series of univariate logistic regression models examined the association of each variable (predictor) as a single (univariate) model against each outcome group. These models employed a binomial distribution with a logit link function to determine and test the event rate (% proportion) across the different groups. Power analyses were determined using a power analysis package that uses a binomial distribution and a sequence of Bernoulli trials.

The second step employed a classification algorithm to develop a multivariate model for each group. These models specified exhaustive Chi-square Automatic Interaction Detection classification algorithms (CHAID), which identify subgroups that are characterised with more than one variable (higher-order interactions), and without parametric assumptions (Bi et al., 2019; Aafjes-van Doorn et al., 2021). This multivariate analysis groups variables that characterise a more complex pattern of combined (multivariate profile) prediction against each of the groups, with variables that don't feature in the multivariate model redacted to emphasise the importance of variables over one another. The model evaluates the list of possible predictors and selects a combined, parsimonious model from a larger list of alternatives. The multivariate classification tree employed the decision tree procedure to classify cases into groups or predict values of a dependent (target) variable based on values of independent (predictor) variables. The assessment of predictor

**Table 1**
Demographic characteristics of the assessment and treatment sample of patients.

| Variable | | Group 1: Assessment group | Group 2: Treatment enrolment group | Group 3: Treatment complete group |
|---|---|---|---|---|
| | Total | 13,825 (100 %) | 3988 (100 %) | 2358 (100 %) |
| Age group | 18–24 | 4228 (30.6 %) | 491 (12.3 %) | 229 (9.7 %) |
| | 25–34 | 4180 (30.2 %) | 1074 (26.9 %) | 553 (23.5 %) |
| | 35–44 | 2556 (18.5 %) | 920 (23.1 %) | 552 (23.4 %) |
| | 45–54 | 1620 (11.7 %) | 726 (18.2 %) | 467 (19.8 %) |
| | 55–64 | 873 (6.3 %) | 513 (12.9 %) | 373 (15.8 %) |
| | 65+ | 368 (2.7 %) | 264 (6.6 %) | 184 (7.8 %) |
| Gender | Female | 10,382 (75.1 %) | 2729 (68.4 %) | 1606 (68.1 %) |
| | Male | 3331 (24.1 %) | 1248 (31.3 %) | 745 (31.6 %) |
| | Other | 112 (0.8 %) | 11 (0.3 %) | 7 (0.3 %) |
| Locality | Capital city or surrounding suburbs | 8403 (61.4 %) | 2223 (56.2 %) | 1314 (56.2 %) |
| | Other urban region | 2801 (20.5 %) | 812 (20.5 %) | 490 (21 %) |
| | Rural or remote region | 2480 (18.1 %) | 922 (23.3 %) | 533 (22.8 %) |
| Born in Australia | Born Australia | 10,542 (76.3 %) | 3024 (75.8 %) | 1780 (75.5 %) |
| | Born overseas | 2862 (20.7 %) | 862 (21.6 %) | 520 (22.1 %) |
| | Not specified | 421 (3 %) | 102 (2.6 %) | 58 (2.5 %) |
| Aboriginal and Torres Strait Islander | Other Australian | 9972 (95.2 %) | 2924 (97.3 %) | 1727 (97.8 %) |
| | Aboriginal and Torres Strait Islander | 507 (4.8 %) | 82 (2.7 %) | 38 (2.2 %) |
| Employment status | Employed (full time, part time) | 8218 (59.9 %) | 2433 (61.3 %) | 1492 (63.7 %) |
| | Student (full time, part time) | 2439 (17.8 %) | 334 (8.4 %) | 169 (7.2 %) |
| | Home duties/ parenting | 900 (6.6 %) | 297 (7.5 %) | 162 (6.9 %) |
| | Disability support payment | 356 (2.6 %) | 185 (4.7 %) | 99 (4.2 %) |
| | Unemployed | 1411 (10.3 %) | 410 (10.3 %) | 191 (8.2 %) |
| | Retired | 391 (2.9 %) | 310 (7.8 %) | 230 (9.8 %) |
| Education | Other (education) | 5381 (38.9 %) | 1823 (45.7 %) | 1189 (50.4 %) |
| | University degree | 8444 (61.1 %) | 2165 (54.3 %) | 1169 (49.6 %) |
| Relationship status | Married de facto | 4725 (34.5 %) | 1818 (45.9 %) | 1181 (50.5 %) |
| | Never married | 7372 (53.9 %) | 1468 (37.1 %) | 776 (33.2 %) |
| | Separated | 1453 (10.6 %) | 610 (15.4 %) | 342 (14.6 %) |
| | Widowed | 122 (0.9 %) | 63 (1.6 %) | 37 (1.6 %) |

robustness was analysed using the Categorical Regression Regularization package within SPSS.

In a third step, the roles of depressive, anxiety, and psychological distress symptoms were explored as potential mediators of the change in DOR that occurred within the treatment period. Mediation analysis was conducted with the Hayes bootstrapping approach using the PROCESS macro (Montoya and Hayes, 2017) and serial mediation models. These models enable a test of the indirect effects (mediation effects) of pre-post change in DOR via pre-post symptom change pathways. A statistical summary of the serial mediation and the indirect effects of changes in

**Table 2**
Clinical characteristics of the assessment and treatment sample of patients.

| | | Group 1: Assessment only group | Group 2: Treatment enrolment group | Group 3: Treatment complete group |
|---|---|---|---|---|
| | Total | 13,825 (100 %) | 3988 (100 %) | 2358 (100 %) |
| Baseline K10 severity categories | Mild (10–24) | 2491 (18 %) | 871 (21.8 %) | 596 (25.3 %) |
| | Moderate (25–29) | 2661 (19.2 %) | 971 (24.3 %) | 602 (25.5 %) |
| | Severe (30+) | 8673 (62.7 %) | 2146 (53.8 %) | 1160 (49.2 %) |
| Baseline PHQ9 severity categories | Mild (0–9) | 3043 (22 %) | 1072 (26.9 %) | 728 (30.9 %) |
| | Moderate (10–14) | 3605 (26.1 %) | 1171 (29.4 %) | 709 (30.1 %) |
| | Severe (15+) | 7177 (51.9 %) | 1745 (43.8 %) | 921 (39.1 %) |
| Degree of interference depression | No interference | 942 (9 %) | 207 (7.2 %) | 135 (7.6 %) |
| | Mild interference | 4643 (44.6 %) | 1274 (44.4 %) | 828 (46.8 %) |
| | Moderate interference | 4833 (46.4 %) | 1390 (48.4 %) | 807 (45.6 %) |
| Baseline GAD7 severity categories | Mild (0–9) | 4201 (30.8 %) | 1343 (33.7 %) | 855 (36.3 %) |
| | Moderate (10–14) | 4210 (30.8 %) | 1289 (32.3 %) | 777 (33 %) |
| | Severe (15+) | 5238 (38.4 %) | 1356 (34 %) | 726 (30.8 %) |
| Degree of interference anxiety | No Interference | 997 (9.6 %) | 268 (9.2 %) | 171 (9.5 %) |
| | Mild interference | 4509 (43.6 %) | 1267 (43.5 %) | 824 (45.9 %) |
| | Moderate interference | 4844 (46.8 %) | 1377 (47.3 %) | 799 (44.5 %) |
| Physical health as cause of DOR | None of the time | 6443 (46.6 %) | 1716 (43 %) | 1035 (43.9 %) |
| | A little of the time | 3420 (24.7 %) | 835 (20.9 %) | 489 (20.7 %) |
| | Some of the time | 2361 (17.1 %) | 746 (18.7 %) | 424 (18 %) |
| | Most of the time | 1117 (8.1 %) | 487 (12.2 %) | 282 (12 %) |
| | All of the time | 484 (3.5 %) | 204 (5.1 %) | 128 (5.4 %) |
| Chronicity of depression | 2 weeks or less | 369 (3.7 %) | 104 (3.7 %) | 63 (4 %) |
| | >2 weeks <6 months | 1756 (17.8 %) | 463 (16.5 %) | 272 (17.2 %) |
| | >6 month <1 year | 1388 (14.1 %) | 341 (12.1 %) | 196 (12.4 %) |
| | 1 to 5 years | 3109 (31.5 %) | 776 (27.6 %) | 429 (27.1 %) |
| | 6 to 10 years | 1247 (12.6 %) | 356 (12.7 %) | 183 (11.6 %) |
| | >10 years | 2006 (20.3 %) | 767 (27.3 %) | 439 (27.7 %) |
| Chronicity of anxiety | 2 weeks or less | 320 (2.7 %) | 77 (2.2 %) | 36 (1.8 %) |
| | >2 weeks <6 months | 1724 (14.4 %) | 508 (14.5 %) | 301 (14.8 %) |
| | >6 month <1 year | 1560 (13 %) | 378 (10.8 %) | 213 (10.5 %) |
| | 1 to 5 years | 4216 (35.2 %) | 1078 (30.9 %) | 644 (31.7 %) |
| | 6 to 10 years | 1628 (13.6 %) | 439 (12.6 %) | 236 (11.6 %) |
| | >10 years | 2513 (21 %) | 1014 (29 %) | 604 (29.7 %) |
| Relationship difficulties | Endorsed | 8240 (59.6 %) | 2101 (52.7 %) | 1160 (49.2 %) |
| Parenting difficulties | Endorsed | 1875 (13.6 %) | 549 (13.8 %) | 280 (11.9 %) |
| Vocational difficulties | Endorsed | 7156 (51.8 %) | 1935 (48.5 %) | 1070 (45.4 %) |
| | Endorsed | | | 919 (39 %) |

(continued on next page)

**Table 2** (*continued*)

| | | Group 1: Assessment only group | Group 2: Treatment enrolment group | Group 3: Treatment complete group |
|---|---|---|---|---|
| Physical difficulties | Endorsed | 5562 (40.2 %) | 1652 (41.4 %) | |
| Financial difficulties | Endorsed | 4123 (29.8 %) | 1060 (26.6 %) | 510 (21.6 %) |
| Housing difficulties | Endorsed | 1617 (11.7 %) | 325 (8.1 %) | 143 (6.1 %) |
| Alcohol difficulties | Endorsed | 1314 (9.5 %) | 354 (8.9 %) | 183 (7.8 %) |
| Drug difficulties | Endorsed | 990 (7.2 %) | 167 (4.2 %) | 64 (2.7 %) |
| Religion difficulties | Endorsed | 575 (4.2 %) | 143 (3.6 %) | 71 (3 %) |
| Cultural difficulties | Endorsed | 360 (2.6 %) | 73 (1.8 %) | 39 (1.7 %) |
| Sexual difficulties | Endorsed | 598 (4.3 %) | 117 (2.9 %) | 60 (2.5 %) |
| Grief difficulties | Endorsed | 567 (4.1 %) | 160 (4 %) | 82 (3.5 %) |
| Carer difficulties | Endorsed | 168 (1.2 %) | 69 (1.7 %) | 31 (1.3 %) |
| No difficulties | Endorsed | 1957 (14.2 %) | 619 (15.5 %) | 415 (17.6 %) |
| Total number of difficulties | 0 | 1957 (14.5 %) | 619 (15.8 %) | 415 (18.1 %) |
| | 1 | 2500 (18.5 %) | 879 (22.5 %) | 573 (24.9 %) |
| | 2 | 2977 (22 %) | 867 (22.2 %) | 548 (23.8 %) |
| | 3 | 2646 (19.5 %) | 714 (18.3 %) | 383 (16.7 %) |
| | 4 | 1757 (13 %) | 424 (10.9 %) | 201 (8.7 %) |
| | 5 | 954 (7 %) | 240 (6.1 %) | 109 (4.7 %) |
| | 6+ | 748 (5.5 %) | 163 (4.2 %) | 70 (3 %) |

DOR is presented in Table 4. To determine evidence for a causal relationship, total indirect effects, specific indirect effects, and reverse pathways were explored (Valente and MacKinnon, 2017). All estimates were estimated using a bootstrap procedure from models that resampled 2000 cases from the treatment sample.

Missing cases in all three samples were not imputed to avoid uncertain, and potentially artificial, influences on the testing of large and specific models related to the natural clinical flow. Statistical analyses were performed using SPSS version 27. Alpha was set at 0.05, to balance the possibility of a type I error within the multiple contrasts and the need to detect possible marginal trends within more nuanced subgroups (as well as higher-order interactions). Statistical power was determined at 0.8.

## 3. Results

### 3.1. Sample characteristics

Within the recruitment period of one year, of the 17,813 participants who started the assessment 13,825 participants completed the assessment but did not enrol in treatment, forming the total 'assessment sample' (group 1) (Fig. 1). Of the participants that completed an assessment, 3988 (28.8 %) started treatment ('enrolment sample'/group 2). Post-treatment data were available for 2358 participants ('treatment sample'/group 3). Statistical power analyses confirmed that the sample was adequately powered to detect small subgroup differences in the rate of improvement events (min ORgroup$\Delta > 1.093$), or differences in the mean rate of DOR (Means SMDsubgroup$\Delta > 0.025$).

The sample characteristics are presented in Tables 1 and 2. The mean age of participants for the entire sample was 33.7 years. More females than males completed an assessment (75.1 % vs 24.1 %), with the ratio of males increasing in the treatment uptake (68.4 % vs 31.3 %) and treatment completed (68.1 % vs 31.6 %) groups. Most of the assessment group lived in capital cities or surrounding urban areas (61.4 %), were single or never married (53.9 %) and had a university-level education (61.1 %). The majority scored in the severe range on the K10 (62.7 %), PHQ9 (51.9 %) and GAD7 (38.4 %). Only 14.2 % of the assessment group reported having no psychosocial difficulties. Most patients reported moderate functional interference associated with their depressive (46.4 %) and anxiety (46.8 %) symptoms respectively. Patients reported 5.5 days out of role (DOR) in the last month. A minority (11.6 %) of the sample reported that their impairment (DOR) was mostly caused by physical health problems.

### 3.2. Univariate analyses

Results from the series of univariate logistic regressions models, testing the joint association of each predictor to the DOR at assessment, treatment completion and functional improvement, are presented in Table 3 under "Univariate models". Tables 3, 4 and 5 show baseline DOR differences between the assessment group and those who complete treatment (5.49 vs 3.79) for each of the predictor variable types (demographic, clinical and psychosocial) with the treatment completion group experiencing 1.7 fewer DOR than the assessment group. DOR varied significantly within and across variables within each of the groups. For the assessment group, age shows that those aged between 25 and 34 years experience 3.74 DOR, compared to those aged between 55 and 64 years who experience 6.33 DOR with the variation in the group being statistically significant ($p < 0.001$). Similar large variations are also observed for employment status (3.4 employed vs 15.47 disability payments vs 11.49 unemployed, $p < 0.001$), being Aboriginal or Torres Strait Islander (10.45 vs 4.82; $p < 0.001$) and relationship status (7.17 separated vs 4.07 married, $p < 0.001$). Clinical variables including all baseline symptom scores (K10, GAD7 and PHQ9, all $p < 0.001$) and chronicity (depression and anxiety, $p < 0.001$) were positively related to DOR, as was the total number of reported psychosocial difficulties ($p < 0.001$). Employment status ($R^2 = 0.18$), baseline PHQ9 ($R^2 = 0.15$), and baseline K10 ($R^2 = 0.17$) had the highest degree of explained variance. DOR increased between assessment and treatment for those with mild symptoms (e.g. K10 mild severity at assessment 1.8 DOR vs post-treatment 3.5 DOR) and no reported interference due to anxiety or depressive symptoms (e.g. 'no interference' depression at assessment 0.4 DOR vs post-treatment 3.1 DOR). Appendix Table 1 shows similar relationships in both baseline DOR for treatment enrolment and treatment complete groups.

Regarding post-treatment DOR, 41 % of the post-treatment group achieved a >50 % reduction in DOR. Age was again significant ($p < 0.001$), but with less variability across groups. Chronicity of anxiety and depression were also predictive of lack of functional improvement ($p < 0.001$). The variables most predictive of a >50 % reduction in DOR were relationship status (married 37 % reduction versus separated 53 %; $p < 0.001$, AUC 0.55), employment status (employed 36 % reduction vs disability payments 66 %; $p < 0.001$, AUC 0.57), baseline symptom scores (for example PHQ9 mild severity 28 % reduction versus severe severity 61 %; $p < 0.001$, AUC 0.63), and chronicity of depression (2 weeks or less 35 % reduction versus >10 years 57 %; $p < 0.001$, AUC 0.54).

### 3.3. Multivariate analyses

In the second step, the multivariate analyses of DOR at assessment, DOR at treatment completion, and functional improvement were conducted, with the results collated in Table 3, under the column "multivariate models". Outcomes for baseline DOR for the treatment enrolment and treatment completion groups are outlined in Appendix Table 1. The multivariate analyses of DOR at assessment identified a combined list of patient features, including age, employment status, baseline symptom severity categories (PHQ-9, GAD7 and K10) and the total number of endorsed psychosocial difficulties ($R^2 = 32.7$ %). The

**Table 3**
Univariate and multivariate estimates of DOR at assessment, treatment completion and significant improvement for demographic predictors.

| Variable | Variable sub-group | Univariate estimates | | | Multivariate estimates | | |
|---|---|---|---|---|---|---|---|
| | | Assessment DOR (N = 13,825) | Post-treatment DOR (N = 3988) | DOR 50 % improvement* (N = 2358) | Assessment DOR (N = 13,825) | Post-treatment DOR (N = 3988) | DOR 50 % improvement (N = 2358) |
| | Total sample estimate | 5.49 (5.36 to 5.61) | 3.79 (3.5 to 4.09) | 41 % (39 to 43.1) | 5.49 (5.42 to 5.56) | 3.79 (3.74 to 3.83) | 45.9 % (45.3 to 46.4) |
| Demographic | | | | | | | |
| Age group | 18–24 | 4.64 (3.71 to 5.56) | 4.46 (3.54 to 5.39) | 0.51 (0.46 to 0.56) | 6.15 (6.04 to 6.25) | 4.39 (4.23 to 4.54) | – |
| | 25–34 | 3.74 (3.14 to 4.33) | 3.92 (3.33 to 4.52) | 0.44 (0.41 to 0.47) | 5.17 (5.04 to 5.29) | 4.07 (3.96 to 4.17) | – |
| | 35–44 | 4.13 (3.53 to 4.73) | 3.08 (2.48 to 3.67) | 0.43 (0.39 to 0.46) | 4.89 (4.72 to 5.06) | 3.27 (3.21 to 3.34) | – |
| | 45–54 | 5.2 (4.55 to 5.85) | 4.34 (3.68 to 5) | 0.48 (0.45 to 0.52) | 5.35 (5.11 to 5.59) | 4.26 (4.17 to 4.35) | – |
| | 55–64 | 6.33 (5.6 to 7.06) | 3.54 (2.82 to 4.27) | 0.47 (0.43 to 0.52) | 5.73 (5.39 to 6.07) | 3.08 (3.02 to 3.14) | – |
| | 65+ | 5.32 (4.29 to 6.35) | 3.89 (2.84 to 4.94) | 0.45 (0.39 to 0.52) | 5.64 (5.18 to 6.11) | 3.96 (3.86 to 4.06) | – |
| | *p*-Value | ***p < 0.001*** $R^2 = 0.006$ | ***p < 0.001*** $R^2 = 0.005$ | *p = 0.044* AUC 0.52 (0.49, 0.54) | 5.49 (5.42 to 5.56) | 3.79 (3.74 to 3.83) | – |
| Gender | Female | 4.53 (4.18 to 4.88) | 3.78 (3.43 to 4.13) | 0.46 (0.44 to 0.48) | – | – | – |
| | Male | 5.15 (4.64 to 5.67) | 3.85 (3.34 to 4.37) | 0.46 (0.43 to 0.49) | – | – | – |
| | Other | 9.14 (3.81 to 14.48) | 0.71 (−4.39 to 5.81) | 0.64 (0.34 to 0.86) | – | – | – |
| | *p*-Value | *p = 0.039* $R^2 = 0.001$ | *p = 0.483* $R^2 = 0.001$ | *p = 0.51* AUC 0.50 (0.48, 0.52) | | | |
| Relationship status | Married de facto | 4.07 (3.66 to 4.48) | 3.52 (3.1 to 3.93) | 0.37 (0.34 to 0.4) | – | 3.46 (3.42 to 3.51) | – |
| | Never married | 4.67 (4.17 to 5.17) | 4.41 (3.91 to 4.91) | 0.42 (0.38 to 0.46) | – | 4.34 (4.26 to 4.43) | – |
| | Separated | 7.17 (6.41 to 7.92) | 3.28 (2.51 to 4.04) | 0.53 (0.47 to 0.59) | – | 3.56 (3.45 to 3.67) | – |
| | Widowed | 4.73 (2.43 to 7.03) | 5.09 (2.71 to 7.48) | 0.38 (0.23 to 0.55) | – | 4.19 (3.84 to 4.55) | – |
| | *p*-Value | ***p < 0.001*** $R^2 = 0.024$ | *p = 0.16* $R^2 = 0.005$ | ***p < 0.001*** AUC 0.55 (0.53, 0.57) | | | |
| Employment status | Employed (full time, part time) | 3.40 (3.27 to 3.53) | 3.67 (3.30 to 4.04) | 0.36 (0.33 to 0.39) | 3.35 (3.31 to 3.39) | 3.67 (3.63 to 3.72) | 40.3 (39.7 to 40.8) |
| | Student (full time, part time) | 6.30 (6.05 to 6.55) | 4.38 (3.31 to 5.44) | 0.46 (0.38 to 0.54) | 6.45 (6.35 to 6.56) | 4.23 (4.08 to 4.39) | 51.7 (49.6 to 53.9) |
| | Home duties/ parenting | 7.98 (7.61 to 8.36) | 3.53 (2.44 to 4.62) | 0.42 (0.35 to 0.50) | 8.52 (8.19 to 8.84) | 3.58 (3.44 to 3.72) | 45.8 (44.2 to 47.3) |
| | Disability support payment | 15.47 (14.9 to 16.03) | 4.17 (2.77 to 5.58) | 0.66 (0.56 to 0.75) | 16.05 (15.52 to 16.57) | 3.69 (3.49 to 3.9) | 64 (62 to 66) |
| | Unemployed | 11.49 (11.18 to 11.79) | 3.99 (2.97 to 5.02) | 0.61 (0.53 to 0.68) | 11.34 (11.14 to 11.54) | 4.62 (4.33 to 4.91) | 65.1 (63.3 to 66.8) |
| | Retired | 6.11 (5.61 to 6.6) | 4.11 (3.18 to 5.05) | 0.41 (0.35 to 0.48) | 6.16 (5.71 to 6.6) | 3.64 (3.54 to 3.73) | 47.1 (45 to 49.2) |
| | *p*-Value | ***p < 0.001*** $R^2 = 0.181$ | *p = 0.745* $R^2 = 0.001$ | ***p < 0.001*** AUC 0.57 (0.54, 0.59) | | | |
| Aboriginal, Torres Strait Islander | No | 4.82 (4.47 to 5.17) | 3.69 (3.36 to 4.02) | 0.46 (0.44 to 0.48) | – | – | 46.5 (45.8 to 47.1) |
| | Yes | 10.45 (8.1 to 12.79) | 4.89 (2.66 to 7.11) | 0.67 (0.56 to 0.77) | – | – | 52.3 (48.7 to 55.9) |
| | *p*-Value | ***p < 0.001*** $R^2 = 0.010$ | *p = 0.297* $R^2 = 0.001$ | ***p < 0.001*** AUC 0.51 (0.50, 0.52) | | | |
| Education | Other (education) | 5.95 (5.54 to 6.36) | 3.93 (3.52 to 4.35) | 0.51 (0.49 to 0.53) | – | 3.75 (3.68 to 3.81) | 49.3 (48.6 to 50.1) |
| | University degree | 3.55 (3.14 to 3.95) | 3.69 (3.27 to 4.1) | 0.39 (0.37 to 0.42) | – | 3.82 (3.76 to 3.87) | 41.8 (41 to 42.5) |
| | *p*-Value | ***p < 0.001*** $R^2 = 0.033$ | *p = 0.407* $R^2 = 0.000$ | ***p < 0.001*** AUC 0.55 (0.53, 0.57) | | | |
| Locality | Capital city/ suburbs | 4.39 (4 to 4.78) | 3.64 (3.25 to 4.03) | 0.45 (0.43 to 0.48) | – | – | – |
| | Other urban region | 5.21 (4.57 to 5.85) | 4.5 (3.87 to 5.13) | 0.47 (0.44 to 0.51) | – | – | – |
| | Rural or remote region | 5.21 (4.6 to 5.83) | 3.51 (2.9 to 4.13) | 0.46 (0.42 to 0.49) | – | – | – |
| | *p*-Value | *p =0.023* $R^2 = 0.001$ | *p =0.046* $R^2 = 0.003$ | *p = 0.608* AUC 0.51 (0.49, 0.53) | | | |
| Born in Australia | Born Australia | | | 0.44 (0.4 to 0.47) | – | – | – |

(*continued on next page*)

**Table 3** (*continued*)

| Variable | Variable sub-group | Univariate estimates | | | Multivariate estimates | | |
|---|---|---|---|---|---|---|---|
| | | Assessment DOR (N = 13,825) | Post-treatment DOR (N = 3988) | DOR 50 % improvement* (N = 2358) | Assessment DOR (N = 13,825) | Post-treatment DOR (N = 3988) | DOR 50 % improvement (N = 2358) |
| | | 4.07 (3.45 to 4.69) | 3.79 (3.17 to 4.41) | | | | |
| | Born overseas | 4.98 (4.65 to 5.32) | 3.77 (3.43 to 4.1) | 0.47 (0.45 to 0.48) | – | – | – |
| | Not specified | 3.29 (1.44 to 5.15) | 4.61 (2.77 to 6.45) | 0.44 (0.35 to 0.55) | – | – | – |
| | *p*-Value | *p = 0.012* $R^2 = 0.001$ | *p = 0.676* $R^2 = 0.000$ | *p = 0.319* AUC 0.51 (0.49, 0.52) | | | |

* Cox and Snell R squared. Significance set at $p < 0.001$, significant values in bold.

**Table 4**
Univariate and multivariate estimates of DOR at assessment, treatment completion and significant improvement for clinical predictors.

| Variable | Variable sub-group | Univariate estimates | | | Multivariate estimates | | |
|---|---|---|---|---|---|---|---|
| | | Assessment DOR (N = 13,825) | Post-treatment DOR (N = 3988) | DOR 50 % improvement* (N = 2358) | Assessment DOR (N = 13,825) | Post-treatment DOR (N = 3988) | DOR 50 % improvement (N = 2358) |
| | Total sample estimate | 5.49 (5.36 to 5.61) | 3.79 (3.5 to 4.09) | 41 % (39 to 43.1) | 5.49 (5.42 to 5.56) | 3.79 (3.74 to 3.83) | 45.9 % (45.3 to 46.4) |
| Baseline PHQ9 severity categories | Mild (0–9) | 1.82 (1.33 to 2.31) | 3.27 (2.75 to 3.79) | 0.28 (0.25 to 0.31) | 1.96 (1.91 to 2.01) | – | 28 (27.4 to 28.6) |
| | Moderate (10–14) | 3.48 (2.99 to 3.97) | 3.89 (3.36 to 4.42) | 0.39 (0.36 to 0.42) | 3.08 (3.02 to 3.14) | – | 39 (38.4 to 39.6) |
| | Severe (15+) | 8.01 (7.58 to 8.45) | 4.14 (3.67 to 4.6) | 0.61 (0.59 to 0.64) | 8.19 (8.1 to 8.28) | – | 61.4 (60.9 to 62) |
| | *p*-Value | ***p < 0.001*** $R^2 = 0.153$ | *p = 0.049* $R^2 = 0.003$ | ***p < 0.001*** AUC 0.63 (0.61, 0.66) | | | |
| Chronicity of depression | 2 weeks or less | 2.9 (0.99 to 4.82) | 4.25 (2.46 to 6.03) | 0.35 (0.27 to 0.45) | – | – | – |
| | >2 weeks <6 months | 4.99 (4.07 to 5.91) | 3.5 (2.61 to 4.4) | 0.47 (0.42 to 0.52) | – | – | – |
| | >6 month <1 year | 5.45 (4.37 to 6.54) | 3.8 (2.74 to 4.85) | 0.46 (0.41 to 0.52) | – | – | – |
| | 1 to 5 years | 5.52 (4.79 to 6.26) | 3.91 (3.21 to 4.61) | 0.48 (0.45 to 0.52) | – | – | – |
| | 6 to 10 years | 6.27 (5.14 to 7.39) | 4.39 (3.31 to 5.48) | 0.54 (0.48 to 0.59) | – | – | – |
| | >10 years | 7.07 (6.34 to 7.79) | 4.48 (3.78 to 5.18) | 0.57 (0.53 to 0.6) | – | – | – |
| | *p*-Value | ***p < 0.001*** $R^2 = 0.027$ | ***p < 0.001*** $R^2 = 0.003$ | ***p < 0.001*** AUC 0.54 (0.51, 0.57) | | | |
| Interference depression | None of these | 0.38 (−0.38 to 1.14) | 3.13 (1.96 to 4.3) | 0.1 (0.07 to 0.15) | – | – | – |
| | Mild interference | 1.77 (1.46 to 2.08) | 3.63 (3.15 to 4.11) | 0.31 (0.28 to 0.33) | – | – | – |
| | Moderate interference | 4.1 (3.79 to 4.41) | 3.71 (3.22 to 4.19) | 0.48 (0.45 to 0.51) | – | – | – |
| | *p*-Value | ***p < 0.001*** $R^2 = 0.091$ | *p = 0.674* $R^2 = 0.000$ | ***p < 0.001*** AUC 0.64 (0.61, 0.66) | | | |
| Baseline GAD7 severity categories | Mild (0–9) | 3.04 (2.56 to 3.51) | 3.51 (3.03 to 4) | 0.35 (0.32 to 0.38) | 3.2 (3.11 to 3.29) | 3.43 (3.37 to 3.48) | – |
| | Moderate (10–14) | 4.55 (4.05 to 5.04) | 3.43 (2.93 to 3.94) | 0.45 (0.42 to 0.48) | 5.16 (5.04 to 5.27) | 3.53 (3.46 to 3.59) | – |
| | Severe (15+) | 6.95 (6.44 to 7.46) | 4.51 (3.99 to 5.03) | 0.58 (0.55 to 0.6) | 7.63 (7.51 to 7.75) | 4.49 (4.4 to 4.58) | – |
| | *p-value* | ***p < 0.001*** $R^2 = 0.080$ | *p = 0.005* $R^2 = 0.005$ | ***p < 0.001*** AUC 0.58 (0.56, 0.61) | | | |
| Chronicity of anxiety | 2 weeks or less | 2.5 (0.1 to 4.9) | 3.97 (1.65 to 6.29) | 0.38 (0.28 to 0.49) | – | – | – |
| | >2 weeks <6 months | 4.12 (3.29 to 4.95) | 3.83 (3.01 to 4.65) | 0.42 (0.38 to 0.47) | – | – | – |
| | >6 month <1 year | 5.05 (4.06 to 6.04) | 2.97 (1.98 to 3.97) | 0.5 (0.44 to 0.55) | – | – | – |
| | 1 to 5 years | 5.22 (4.65 to 5.78) | 4.21 (3.65 to 4.78) | 0.48 (0.44 to 0.51) | – | – | – |
| | 6 to 10 years | 4.79 (3.85 to 5.73) | 4.33 (3.39 to 5.28) | 0.46 (0.41 to 0.51) | – | – | – |
| | >10 years | 5.15 (4.57 to 5.74) | 3.8 (3.22 to 4.38) | 0.49 (0.46 to 0.52) | – | – | – |

(*continued on next page*)

**Table 4** (*continued*)

| Variable | Variable sub-group | Univariate estimates | | | Multivariate estimates | | |
|---|---|---|---|---|---|---|---|
| | | Assessment DOR (N = 13,825) | Post-treatment DOR (N = 3988) | DOR 50 % improvement* (N = 2358) | Assessment DOR (N = 13,825) | Post-treatment DOR (N = 3988) | DOR 50 % improvement (N = 2358) |
| | *p*-Value | ***p < 0.001*** $R^2 = 0.013$ | ***p < 0.001*** $R^2 = 0.003$ | *p = 0.069* AUC 0.50 (0.48, 0.53) | | | |
| Interference anxiety | None of these | 1.19 (0.44 to 1.94) | 3.58 (2.54 to 4.61) | 0.14 (0.1 to 0.19) | – | – | – |
| | Mild interference | 2.01 (1.67 to 2.35) | 3.33 (2.86 to 3.8) | 0.33 (0.3 to 0.35) | – | – | – |
| | Moderate interference | 4.49 (4.14 to 4.84) | 3.76 (3.28 to 4.24) | 0.49 (0.46 to 0.51) | – | – | – |
| | *p*-Value | ***p < 0.001*** $R^2 = 0.065$ | *p = 0.451* $R^2 = 0.001$ | ***p < 0.001*** AUC 0.61 (0.59, 0.64) | | | |
| Baseline K10 severity categories | Mild (10–24) | 1.75 (1.2 to 2.3) | 3.47 (2.89 to 4.04) | 0.25 (0.22 to 0.28) | 1.61 (1.55 to 1.66) | – | – |
| | Moderate (25–29) | 3.26 (2.71 to 3.8) | 3.47 (2.9 to 4.05) | 0.42 (0.38 to 0.45) | 3.5 (3.39 to 3.6) | – | – |
| | Severe (30+) | 7.04 (6.65 to 7.44) | 4.13 (3.72 to 4.55) | 0.56 (0.54 to 0.59) | 7.21 (7.12 to 7.3) | – | – |
| | *p*-Value | ***p < 0.001*** $R^2 = 0.116$ | *p = 0.082* $R^2 = 0.002$ | ***p < 0.001*** AUC 0.62 (0.60, 0.64) | | | |
| Physical health as cause | None of the time | 3.3 (2.88 to 3.73) | 3.87 (3.43 to 4.31) | 0.34 (0.31 to 0.37) | – | – | – |
| | A little of the time | 3.97 (3.35 to 4.59) | 3.74 (3.1 to 4.38) | 0.41 (0.36 to 0.45) | – | – | – |
| | Some of the time | 5.58 (4.92 to 6.24) | 4 (3.31 to 4.68) | 0.45 (0.4 to 0.5) | – | – | – |
| | Most of the time | 7.78 (6.97 to 8.6) | 3.69 (2.86 to 4.52) | 0.54 (0.48 to 0.6) | – | – | – |
| | All of the time | 9.81 (8.61 to 11.02) | 2.97 (1.73 to 4.22) | 0.56 (0.47 to 0.65) | – | – | – |
| | *p*-Value | ***p < 0.001*** $R^2 = 0.051$ | *p = 0.696* $R^2 = 0.001$ | ***p < 0.001*** AUC 0.58 (0.56, 0.60) | | | |

* Cox and Snell R squared. Significance set at $p < 0.001$, significant values in bold.

association of each of the listed predictors to DOR at assessment can be evaluated both in the table, as a total effect, as well as graphically, as a classification tree "node", describing subgroups that are characterised by more than one predictor. A visualisation of the assessment DOR classification algorithm is presented in Appendix Figs. 1, 2, and 3.

Regarding post-treatment DOR, the strongest predictors from the list of all possible predictors were age, relationship status, education, employment status, GAD7 severity, and the total number of psychosocial difficulties ($R^2$ = 2.6 %). A visualisation of the post-treatment DOR classification algorithm is presented in Appendix Fig. 4.

The multivariate analyses of functional improvement events, as defined by a >50 % reduction in DOR scores, resulted in a model where employment status, being Aboriginal or Torres Strait Islander, education status, baseline PHQ9 severity, experiencing difficulties with grief and physical health as well as the total number of endorsed psychosocial difficulties were the greatest predictors of significant DOR improvement events (AUC, 69.9 %). A visualisation of the symptom improvement classification algorithm is presented in Appendix Fig. 5.

### *3.4. Relationship between changes to functional impairment (DOR) with changes to symptoms (K10, PHQ9 and GAD7)*

Results from the three bootstrap serial mediation models are presented in Table 6, detailing indirect effects (noting a mediation effect), symptom change pathway (causal pathway), and symptom baseline pathway (reverse pathway). These results demonstrate that the pre-post change in depression, anxiety, and psychological distress symptom scores did not fully mediate the time-related change in DOR. Similarly, the three causal pathways were not statistically significant. These results suggest no clear causal link between change scores in symptoms and change in DOR. In contrast to these non-significant results, a reverse pathway between baseline anxiety, psychological distress and DOR was identified, suggesting that baseline severity of anxiety and distress is associated with a change in function with treatment.

## 4. Discussion

Mental disorders are associated with significant functional impairment, resulting in large loss of productivity to society (Whiteford et al., 2013; Vos et al., 2017; Productivity Commission, 2020). Mental health services, including DMHS, can play a significant role in reducing the burden of mental health symptoms through effective evidence-based care. However, the impact of treatment on functioning is not as well studied. The current study was to our knowledge the first to report on the degree of functional impairment in a large sample of patients accessing a national DMHS, and the first to report on the effect of treatment on functional recovery and the relationship between symptom and functional improvement in a sample that was large enough to analyse a range of predictors simultaneously, as well as test the relative effect of demographic and symptom patterns on functional impairment and on functional improvement from iCBT provided as part of routine care.

The level of functional impairment defined by self-reported DOR in this large help-seeking sample was similar to levels of impairment seen in other large scale community studies (Slade et al., 2009; McCallum et al., 2019), in which the presence of mental disorder and the DOR were established using semi-structured interviews. The current patient sample reported an average of 5.49 DOR, which is higher than the DOR of 3.9 reported by Slade et al. (2009) but slightly lower than the DOR of 6.0 reported by McCallum et al. (2019).

The factors associated with greater levels of functional impairment at assessment included older age, being separated, being unemployed or on disability payments, longer duration of depressive or anxiety symptoms, the severity of symptoms, and the presence of a higher number of concurrent psychosocial difficulties. Combined, these factors accounted for 32.7 % of the total variance explained. Of interest, the factors found to

**Table 5**
Univariate and multivariate estimates of DOR at assessment, treatment completion and significant improvement for psychosocial predictors.

| Variable | Variable sub-group | Univariate estimates | | | Multivariate estimates | | |
|---|---|---|---|---|---|---|---|
| | | Assessment DOR (N = 13,825) | Post-treatment DOR (N = 3988) | DOR 50 % improvement* (N = 2358) | Assessment DOR (N = 13,825) | Post-treatment DOR (N = 3988) | DOR 50 % improvement (N = 2358) |
| | Total sample estimate | 5.49 (5.36 to 5.61) | 3.79 (3.5 to 4.09) | 41 % (39 to 43.1) | 5.49 (5.42 to 5.56) | 3.79 (3.74 to 3.83) | 45.9 % (45.3 to 46.4) |
| Relationship difficulty | Not endorsed | 4.15 (3.75 to 4.56) | 3.52 (3.11 to 3.93) | 0.41 (0.39 to 0.43) | – | – | – |
| | Relationships with friends/family | 5.34 (4.93 to 5.76) | 4.08 (3.66 to 4.49) | 0.5 (0.48 to 0.52) | – | – | – |
| | *p*-Value | ***p < 0.001*** $R^2 = 0.014$ | *p = 0.062* $R^2 = 0.002$ | ***p < 0.001*** AUC 0.54 (0.52, 0.56) | | | |
| Vocational difficulty | Not endorsed | 4.08 (3.69 to 4.48) | 3.39 (3 to 3.79) | 0.4 (0.38 to 0.43) | – | – | – |
| | Work/study/ vocational activities | 5.53 (5.1 to 5.96) | 4.27 (3.84 to 4.7) | 0.52 (0.49 to 0.54) | – | – | – |
| | *p*-Value | ***p < 0.001*** $R^2 = 0.021$ | *p = 0.003* $R^2 = 0.004$ | ***p < 0.001*** AUC 0.54 (0.52, 0.56) | | | |
| Grief difficulty | Not endorsed | 4.62 (4.32 to 4.91) | 3.75 (3.45 to 4.04) | 0.45 (0.44 to 0.47) | – | – | 45.3 (44.7 to 45.8) |
| | Grief | 8.09 (6.53 to 9.64) | 5.16 (3.59 to 6.73) | 0.58 (0.5 to 0.66) | – | – | 59.9 (56.9 to 63) |
| | *p*-Value | ***p < 0.001*** $R^2 = 0.007$ | *p = 0.082* $R^2 = 0.001$ | *p = 0.003* AUC 0.51 (0.50, 0.52) | | | |
| Financial difficulty | Not endorsed | 3.96 (3.63 to 4.28) | 3.68 (3.35 to 4.01) | 0.41 (0.39 to 0.43) | – | – | – |
| | Finances | 7.57 (6.96 to 8.19) | 4.21 (3.58 to 4.83) | 0.59 (0.56 to 0.62) | – | – | – |
| | *p*-Value | ***p < 0.001*** $R^2 = 0.045$ | *p = 0.146* $R^2 = 0.001$ | ***p < 0.001*** AUC 0.55 (0.54, 0.57) | | | |
| Housing difficulty | Not endorsed | 4.56 (4.26 to 4.86) | 3.75 (3.45 to 4.05) | 0.44 (0.43 to 0.46) | – | – | – |
| | Indicated | 7.57 (6.39 to 8.74) | 4.44 (3.26 to 5.62) | 0.63 (0.57 to 0.68) | – | – | – |
| | *p*-Value | ***p < 0.001*** $R^2 = 0.032$ | *p = 0.266* $R^2 = 0.001$ | ***p < 0.001*** AUC 0.52 (0.51, 0.53) | | | |
| Physical difficulty | Not endorsed | 3.34 (2.98 to 3.71) | 3.78 (3.41 to 4.15) | 0.38 (0.36 to 0.4) | – | – | 40.2 (39.5 to 41) |
| | Physical health | 6.92 (6.47 to 7.38) | 3.82 (3.36 to 4.28) | 0.57 (0.54 to 0.59) | – | – | 53.8 (53.1 to 54.5) |
| | *p*-Value | ***p < 0.001*** $R^2 = 0.055$ | *p = 0.898* $R^2 = 0.000$ | ***p < 0.001*** AUC 0.58 (0.56, 0.60) | | | |
| Alcohol difficulty | Not endorsed | 4.59 (4.29 to 4.89) | 3.82 (3.52 to 4.13) | 0.45 (0.43 to 0.47) | – | – | – |
| | Alcohol use | 6.54 (5.49 to 7.58) | 3.45 (2.42 to 4.48) | 0.56 (0.5 to 0.61) | – | – | – |
| | *p*-Value | ***p < 0.001*** $R^2 = 0.001$ | *p = 0.498* $R^2 = 0.000$ | ***p < 0.001*** AUC 0.52 (0.50, 0.53) | | | |
| Religion difficulty | Not marked | 4.67 (4.37 to 4.96) | 3.78 (3.49 to 4.08) | 0.45 (0.44 to 0.47) | – | – | – |
| | Religion/ spirituality | 7.03 (5.35 to 8.7) | 4.23 (2.5 to 5.96) | 0.56 (0.48 to 0.65) | – | – | – |
| | *p*-Value | *p = 0.007* $R^2 = 0.003$ | *p = 0.617* $R^2 = 0.000$ | *p = 0.017* AUC 0.51 (0.50, 0.51) | | | |
| Drug difficulty | Not endorsed | 4.59 (4.3 to 4.88) | 3.78 (3.49 to 4.08) | 0.45 (0.43 to 0.46) | – | – | – |
| | Drug or substance use | 10.09 (8.34 to 11.85) | 4.16 (2.44 to 5.89) | 0.71 (0.64 to 0.78) | – | – | – |
| | *p*-Value | ***p < 0.001*** $R^2 = 0.026$ | *p = 0.671* $R^2 = 0.000$ | ***p < 0.001*** AUC 0.51 (0.51, 0.52) | | | |
| Sexual difficulty | Not endorsed | 4.71 (4.41 to 5) | 3.8 (3.51 to 4.1) | 0.45 (0.44 to 0.47) | – | – | – |
| | Sexual identity or orientation | 5.93 (4.11 to 7.76) | 3.51 (1.69 to 5.33) | 0.59 (0.49 to 0.68) | – | – | – |
| | *p*-Value | *p = 0.194* | *p = 0.755* | ***p = 0.007*** | | | |

(*continued on next page*)

**Table 5** (*continued*)

| Variable | Variable sub-group | Univariate estimates | | | Multivariate estimates | | |
|---|---|---|---|---|---|---|---|
| | | Assessment DOR (N = 13,825) | Post-treatment DOR (N = 3988) | DOR 50 % improvement* (N = 2358) | Assessment DOR (N = 13,825) | Post-treatment DOR (N = 3988) | DOR 50 % improvement (N = 2358) |
| | | $R^2 = 0.003$ | $R^2 = 0.000$ | AUC 0.51 (0.450, 0.51) | | | |
| Cultural difficulty | Not endorsed | 4.71 (4.42 to 5.01) | 3.77 (3.47 to 4.06) | 0.46 (0.44 to 0.47) | – | – | – |
| | Cultural identity | 6.18 (3.92 to 8.44) | 5.5 (3.25 to 7.75) | 0.5 (0.38 to 0.62) | – | – | – |
| | *p*-Value | *p = 0.208* $R^2 = 0.002$ | *p = 0.134* $R^2 = 0.001$ | *p = 0.49* AUC 0.50 (0.496, 0.51) | | | |
| Carer difficulty | Not endorsed | 4.72 (4.43 to 5.02) | 3.79 (3.5 to 4.09) | 0.46 (0.44 to 0.47) | – | – | – |
| | Carer responsibilities | 5.97 (3.43 to 8.51) | 3.93 (1.38 to 6.48) | 0.58 (0.46 to 0.7) | – | – | – |
| | *p*-Value | *p = 0.34* $R^2 = 0.001$ | *p = 0.918* $R^2 = 0.000$ | *p = 0.054* AUC 0.50 (0.497, 0.51) | | | |
| Parenting difficulty | Not endorsed | 4.75 (4.44 to 5.06) | 3.8 (3.49 to 4.11) | 0.46 (0.44 to 0.48) | – | – | – |
| | Parenting/ childcare responsibilities | 4.66 (3.82 to 5.51) | 3.77 (2.92 to 4.62) | 0.46 (0.42 to 0.5) | – | – | – |
| | *p*-Value | *p = 0.846* $R^2 = 0.001$ | *p = 0.952* $R^2 = 0.000$ | *p = 0.901* AUC 0.50 (0.49, 0.52) | | | |
| No difficulty | Not endorsed | 5.16 (4.84 to 5.48) | 3.88 (3.56 to 4.2) | 0.49 (0.47 to 0.5) | – | – | – |
| | None of these | 2.76 (2.07 to 3.45) | 3.39 (2.69 to 4.1) | 0.31 (0.27 to 0.35) | – | – | – |
| | *p*-Value | ***p < 0.001*** $R^2 = 0.019$ | *p = 0.222* $R^2 = 0.001$ | ***p < 0.001*** AUC 0.53 (0.52, 0.55) | | | |
| Total number of difficulties | 0 | 2.76 (2.08 to 3.44) | 3.39 (2.69 to 4.1) | 0.31 (0.27 to 0.35) | 3.69 (3.54 to 3.84) | 3.21 (3.11 to 3.31) | 32.3 (31 to 33.5) |
| | 1 | 3.96 (3.39 to 4.54) | 3.77 (3.19 to 4.36) | 0.41 (0.38 to 0.44) | 4.11 (3.99 to 4.23) | 3.74 (3.67 to 3.81) | 43.1 (41.9 to 44.3) |
| | 2 | 4.3 (3.71 to 4.89) | 3.74 (3.13 to 4.34) | 0.43 (0.39 to 0.46) | 5.04 (4.91 to 5.17) | 3.83 (3.75 to 3.91) | 43.7 (42.8 to 44.5) |
| | 3 | 5.63 (4.93 to 6.34) | 3.58 (2.87 to 4.29) | 0.51 (0.47 to 0.54) | 5.63 (5.49 to 5.77) | 3.81 (3.72 to 3.91) | 48.3 (47.3 to 49.4) |
| | 4 | 7.56 (6.59 to 8.54) | 4.11 (3.13 to 5.09) | 0.61 (0.56 to 0.66) | 6.85 (6.65 to 7.05) | 4.26 (4.09 to 4.44) | 58.5 (56.9 to 60) |
| | 5 | 8.46 (7.14 to 9.78) | 5.42 (4.07 to 6.77) | 0.63 (0.56 to 0.69) | 8.19 (7.84 to 8.53) | 4.4 (4.12 to 4.68) | 62.7 (60.7 to 64.8) |
| | 6+ | 9.64 (7.99 to 11.29) | 4.93 (3.16 to 6.7) | 0.7 (0.62 to 0.77) | 9.82 (9.41 to 10.23) | 4.59 (4.24 to 4.94) | 62 (60 to 63.9) |
| | *p*-Value | ***p < 0.001*** $R^2 = 0.083$ | *p = 0.164* $R^2 = 0.004$ | ***p < 0.001*** AUC 0.60 (0.58, 0.62) | | | |
| Multivariate model diagnostics (including all three demographic, clinical and psychosocial predictors) | | | | | $R^2$ 32.7 % (31.4 to 34) | $R^2$ 2.6 % (1.4 to 4) | *AUC* 69.9 % (68.2 to 71.6) |

* Cox and Snell R squared. Significance set at $p < 0.001$, significant values in bold.

be significant at baseline did not predict post-treatment levels of impairment. While age, relationship status, employment status, anxiety severity, and culminative psychosocial factors remained significant in the multivariate model, they only accounted for 2.6 % of the total variance in DOR after treatment. Treatment, therefore, appears to reduce the influence of these factors on functioning.

Nearly half the sample who completed treatment (45.9 %) experienced a 50 % or more reduction in DOR following treatment. This is comparable to the 42.2 % who experienced a 50 % or more symptom reduction in the K10 previously reported in a similar patient sample from the same service (Cross et al., 2022). The greatest gains in functional improvement came from those who reported the highest levels of functional and symptomatic impairment at initial assessment, and those who were unemployed or on disability payments reported significant functional improvement after treatment (65.1 % and 64 % respectively), as did those with severe levels of depression on the PHQ9 (61.4 %) and those with four or more psychosocial difficulties (>58.5 %). These results suggest that the greatest functional gains may be made from psychological treatment in those with significant levels of impairment at service entry. On average, 8.5 DORs for those on disability payments and 5.6 DORs for those unemployed were returned to patients after treatment. The results add support to the recommendation from the Australian Government's Productivity Commission inquiry into mental health, that further investment in online supported psychological treatment would result in a 'net benefit' in terms of cost savings and productivity gains (Productivity Commission, 2020).

The study also found that changes in function were independent of changes in psychological symptoms, consistent with findings published elsewhere (Becker et al., 2011; Sheehan et al., 2011; Sheehan et al., 2017) which suggests that symptom improvement and measures of

**Table 6**
Indirect (mediation) effect sizes associated with the serial mediation of each symptom outcome on DOR.

| | | Bootstrapped ES (with 95 % confidence interval) | Conclusion implied |
|---|---|---|---|
| Indirect DOR to symptom (meditation) pathways (*a*1 * *b*1; X → M2 → Y) | PHQ9 (depression) symptoms | 0.06 (−0.002 to 0.014) | No identified mediation |
| | GAD7 (anxiety) symptoms | 0.002 (−0.05 to 0.01) | No identified mediation |
| | K10 (psychological distress) symptoms | 0.001 (−0.007 to 0.008) | No identified mediation |
| Direct DOR to symptom change pathway (*b*2; M2\| M1 → Y) | PHQ9 (depression) symptoms | 0.058 (−0.007 to 0.123) | No identified pathway over baseline |
| | GAD7 (anxiety) symptoms | 0.025 (−0.046 to 0.097) | No identified pathway over baseline |
| | K10 (psychological distress) symptoms | 0.006 (−0.038 to 0.049) | No identified pathway over baseline |
| Symptom-baseline (reverse) to DOR pathway (*adj*2; M1 → Y) | PHQ9 (depression) symptoms | 0.028 (−0.035 to 0.092) | Non-significant pathway |
| | GAD7 (anxiety) symptoms | 0.088 (0.022 to 0.153)* | Association to baseline severity |
| | K10 (psychological distress) symptoms | 0.063 (0.010 to 0.116)* | Association to baseline severity |

Note. GAD-7 = Generalized Anxiety Disorder-7; PHQ-9 = Patient Health Questionnaire-9; K10 = Kessler 10 Psychological Distress Questionnaire; 95%CI of the effect size estimates are shown in rounded parentheses; all estimates were derived from models that resampled 5000 cases from the treatment samples to create bootstrapped estimates of the effects. * $p < 0.01$

functional recovery should be reported as independent outcomes, especially given the increased interest in the role of mental health care in improving productivity.

### 4.1. Limitations and strengths

A key strength of this study is the use of a large community-based sample of patients accessing a DMHS as part of routine care, and consequently the relationships and findings are likely to reflect those in real-world clinical care. However, the absence of a control group means the observed changes in DORs should be interpreted with caution. The examination of variables at baseline and during and after treatment enabled us to identify and examine factors associated with impairment across the service 'flow' or 'journey'. This resulted in 'missing cases' between the groups as a result of the natural service flow, which was partly overcome by a high sample number, and statistical methods that were powerful enough to detect differences within sample groups of different sizes. Further, we set the rate of functional improvement at 50 %, which is comparatively high, and which may have underestimated the degree of functional improvement for the whole sample. An additional limitation was use of a single measure of functional impairment. Other measures such as the World Health Organization Disability Assessment Schedule (WHODAS) (Üstün et al., 2010) could be used to replicate these findings. Further, there is no commonly accepted statistical approach to report on change in the days out of role, and further psychometric research is required to understand the strengths and weaknesses of the approach taken in the current paper. Replication of these findings in both face to face and DMHS, using other measures of disability, and incorporating health economic analyses is recommended.

## 5. Conclusions

This study shows that the patients who access a high volume national DMHS providing effective treatment for high prevalence mental disorders have significant levels of functional impairment, and achieve significant functional gains from treatment. However, changes in symptom scores did not fully match the changes in DOR, which suggests that treatment related changes in symptoms and function are independent. Further research linking measures of symptomatic recovery with functional recovery could help confirm the results of this study. Linking subjective outcomes to objective measures of function, such as physical activity, sleep, welfare, income, health care usage and educational outcomes might provide a more complete account of the effect of psychological treatment on the lives of the patients under our care.

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## Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: N. Titov and B. Dear are authors and developers of the treatment courses used at the MindSpot Clinic but derive no personal or financial benefit from them. All other authors declare they have no competing interests.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.invent.2023.100603.

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