The Uptake and Effectiveness of a Multidisciplinary Online Program for Managing Chronic Pain before and During the COVID-19 Pandemic

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Abstract

Objectives. Societal and health system pressures associated with the coronavirus disease 2019 (COVID-19) pandemic exacerbated the burden of chronic pain and limited access to pain management services for many. Online multidisciplinary pain programs offer an effective and scalable treatment option, but have not been evaluated within the context of COVID-19. This study aimed to investigate the uptake and effectiveness of the Reboot Online chronic pain program before and during the first year of the COVID-19 pandemic. **Methods.** Retrospective cohort analyses were conducted on routine service users of the Reboot Online program, comparing those who commenced the program during the COVID-19 pandemic (March 2020–March 2021), to those prior to the pandemic (April 2017–March 2020). Outcomes included the number of course registrations; commencements; completion rates; and measures of pain severity, interference, self-efficacy, pain-related disability, and distress. **Results.** Data from 2,585 course users were included (n = 1138 pre-COVID-19 and n = 1,447 during-COVID-19). There was a 287% increase in monthly course registrations during COVID-19, relative to previously. Users were younger, and more likely to reside in a metropolitan area during COVID-19, but initial symptom severity was comparable. Course adherence and effectiveness were similar before and during COVID-19, with moderate effect size improvements in clinical outcomes post-treatment (g = 0.23–0.55). **Discussion.** Uptake of an online chronic pain management program substantially increased during the COVID-19 pandemic. Program adherence and effectiveness were similar pre- and during-COVID. These findings support the effectiveness and scalability of online chronic pain management programs to meet increasing demand.

Key Words: Chronic Pain; Internet Intervention; Digital Health; Telemedicine; COVID-19

Introduction

The coronavirus disease 2019 (COVID-19) global pandemic, and the extreme measures adopted to contain its transmission, have had profound effects on healthcare delivery and public health internationally [1, 2]. This has been pronounced among populations with chronic health conditions, where the pandemic has compromised access to necessary healthcare services and supports [3–5].

Chronic pain is a prevalent condition that affects ~20% of the adult population [6–8] and imposes one of the largest global burdens of disability [9]. The biopsychosocial nature of chronic pain is well recognized [10], with consensus that a coordinated multidisciplinary treatment approach combining physical and psychological interventions is most effective [11, 12]. There is mounting evidence that the individual, societal and healthcare pressures imposed by the COVID-19 pandemic have exacerbated the burden of chronic pain and made it more difficult for individuals to manage their pain [13–16]. Research has demonstrated that social isolation, disconnectedness, and heightened emotional distress associated with the pandemic can worsen the experience of chronic pain and increase the tendency to catastrophize for people living with pain [17–21]. Healthcare uncertainty and physical activity restrictions have also been noted to compound pain-related distress [17, 19] and increase adoption of less effective pain management strategies, such as increased medication usage and excessive rest [17, 22, 23].

As health systems shifted their focus toward acute care capacity and restricted face-to-face service delivery during the pandemic, access to routine pain services was limited [16, 24, 25]. Both patients and healthcare providers identified gaps in chronic pain service delivery as a result of the pandemic; particularly for multidisciplinary interventions and physical therapies which are critical to the management of chronic pain [22, 25–27]. International consensus guidelines have identified the need for accessible and rapidly scalable chronic pain services to respond to the escalating chronic pain burden that is emerging from the pandemic [28–30].

In Australia, the Reboot Online program has been developed as a multidisciplinary, internet-delivered treatment program for chronic pain [31, 32]. It combines psychoeducation on the nature of chronic pain with internet-delivered cognitive behavioral therapy (iCBT) and a tailored physical activity program; delivered in a scalable digital format. Previous studies have demonstrated the effectiveness of the program in clinical trial [31, 33] and routine care settings [32], whereby the program significantly improved pain self-efficiency and reduced pain-related disability, fear of movement, and symptoms of psychological distress. However, the utility and effectiveness of the program within the context of the COVID-19 pandemic has yet to be investigated. Several studies have demonstrated increased demand for similar iCBT programs during the pandemic for a range of anxiety, depressive and sleep disorders [34–38]. Given the known impact of the COVID-19 pandemic on chronic pain, a formal evaluation of the utility and effectiveness of the Reboot Online program in a pandemic context is needed.

This study sought to examine the uptake, user characteristics and outcomes of the Reboot Online program for chronic pain management during the first year of the COVID-19 pandemic in Australia (March 2020–March 2021). Course usage, effectiveness and user demography during the pandemic period were directly compared to prior to the pandemic (April 2017–March 2020). We hypothesized there would be increased uptake of Reboot Online during the COVID-19 pandemic, in line with other digital mental health programs during COVID-19 [34–38]. We anticipated that reported pain severity and distress prior to commencing the program may be worse during the pandemic. However, we anticipated that completion of the course would be associated with clinical improvements, with similar effectiveness prior to and during the COVID-19 pandemic.

Methods

Study Design and Setting

An observational, pre-post treatment study was conducted, with two unmatched retrospective cohorts. The study utilized data routinely collected via the THIS WAY UP service; a not-for-profit digital clinical service, providing evidence-based psychoeducation and treatment programs for a number of mental health conditions and related disorders, including chronic pain (see thiswayup.org.au). All THIS WAY UP courses are offered digitally (via the internet) and are founded on cognitive behavioral therapy (CBT) techniques.

The "Reboot Online" course was developed as a specialist, multidisciplinary program for the management of chronic pain [31, 33]. This course is administered via THIS WAY UP, and is available via a "prescription" from a registered clinician (including general practitioners, specialist doctors, nurses and allied health professionals). The prescribing clinician retains clinical oversight and provides supervision for their patient to undertake the course as part of their routine care. From the time of launch in April 2017, the Reboot Online program was available for a single access fee of $59 AUD for Australian residents; or via a subsidized voucher provided by some state health services in Australia. However, in response to the COVID-19 pandemic, all THIS WAY UP courses were made free to access from March 25, 2020, with the support of the St Vincent's Hospital Inclusive Health Foundation. The service was also briefly promoted nationally via television news programs, print media, and social media during April 2020.

Participants

Study participants were members of the Australia public who registered to undertake the Reboot Online course via THIS WAY UP, between April 19, 2017 (when the program was launched online) and March 12, 2021. To be eligible to register for the course, participants had to be aged ≥18 years, be residents of Australia, and have been prescribed the course for chronic pain management by a registered health professional, as part of their

routine care. Participants self-reported basic demographic information including their age, sex, and geographical place of residence. Where reported, postcode was used to determine participant's rurality according to the Australian Statistical Geography Standards [39], classified as living in a major city, regional and/or remote Australia. Postcode was also mapped to the Australian Socio-Economic Indexes for Areas [40] and used to infer socioeconomic status of participants, via the Index of Relative Socio-Economic Advantage and Disadvantage (ISRAD). This index is derived from data collected in the Australian national census (relating to income, education and occupation) and can be summarized via deciles, whereby decile 1 represents the most disadvantaged individuals and decile 10 represents the most advantaged individuals.

The study sample was comprised of two subgroups, namely, a "pre-COVID" and a "during-COVID" group. The pre-COVID group included all participants who registered for the course between April 19, 2017, and March 11, 2020; prior to confirmation of the COVID-19 global pandemic by the World Health Organization, made on March 11, 2020. Within weeks of this declaration, Australia commenced implementation of strict national containment measures, including international border closures, mandatory quarantine/stay at home orders, social distancing regulations, and cessation of many non-essential activities. The during-COVID group included all participants who registered for the course between March 12, 2020, and March 12, 2021, concurrent to the COVID-19 pandemic in Australia. The pre-COVID group included a subset of data previously examined by Lim et al. in a separate evaluation [32].

Prior to course registration, all participants provided electronic informed consent that their pooled de-identified data would be collected, analyzed, and published for quality assurance and research purposes by THIS WAY UP. This study was conducted as part of routine quality assurance activities of THIS WAY UP and was approved by St Vincent's Hospital Sydney Human Research Ethics Committee (2020/ETH03027).

Intervention

The Reboot Online course is a multidisciplinary online treatment package developed for the management of chronic pain. It consists of eight lessons, completed sequentially over 16 weeks, which incorporate internet-delivered CBT, psychoeducation, guided meditation/relaxation, a physiotherapy exercise program, and multidisciplinary educational videos (specialist medical, nursing, occupational therapy, and dietetics). Previous studies support the efficacy of the program, and its effectiveness in the routine care setting, for reducing symptoms of pain-related disability and distress [31, 32].

The course structure and content have been described in detail previously [31–33]. In brief, the eight core lessons of the program are presented via an illustrated storyline of a fictional character, who engages with a multidisciplinary team and learns how to manage their chronic pain. The lessons have a strong CBT focus and incorporate education on the bio-psycho-social model of chronic pain; acceptance and goal-setting; activity pacing; challenging unhelpful thinking patterns; the interplay between mood and pain; stress management; problem solving; effective communication strategies; sleep hygiene and managing pain flare-ups. Every lesson is accompanied by a compulsory physiotherapy component, whereby participants select guided exercises to target flexibility, strength, and/or stability. There are also compulsory homework activities designed to reinforce lesson content and facilitate the practice of new skills in real-life scenarios.

The compulsory elements of the course are accompanied by a range of supplementary resources. These included expert educational videos from pain management specialists; guided meditation and relaxation exercises; and a graded Tai Chi program (Yang style) with instructions from a physiotherapist.

Outcomes

Course Uptake, Engagement, and Adherence

Uptake of the Reboot Online course was assessed both pre-COVID and during-COVID via the number of users who registered for, and commenced the program. This was quantified monthly for the duration of the study period (April 2017–March 2021). Engagement with the course was estimated via the number of users who completed each lesson of the course (one through eight). Overall course adherence was quantified as the number of people who completed all eight lessons of the course (defined as "completers"), compared to the proportion who completed less than eight lessons ("non-completers").

Clinical Outcome Measures

Participants completed a suite of validated clinical outcome measures to assess program effectiveness. All measures were completed prior to lesson 1 (baseline), lesson 5 (midway through the course), and lesson 8 (post-treatment).

Measures included the:

- *Pain Self-Efficacy Questionnaire (PSEQ)* [41]: a measure of participant's confidence to manage their pain and perform simple daily activities. Scores range from 0 to 60, with higher scores indicating greater confidence or "self-efficacy."
- *Brief Pain Inventory (BPI)* [42, 43]: a measure of pain severity, and the degree to which pain interferes with performing usual daily activities, quantified via two subscales (severity and interference subscales). Each subscale is rated on a scale from 0 to 10, with higher scores indicting more severe pain and greater interference from pain in everyday activities.
- *Pain Disability Index (PDI)* [44, 45]: a measure of the functional disability imposed by pain on participants' daily life, with scores

ranging from 0 to 70 and higher scores indicating greater disability.

- *Tampa scale for Kinesiophobia (Tampa)* [46]: a measure of fear avoidance of movement, with scores ranging from 17-68, and higher scores indicating greater fear/avoidance.
- *Patient Health Questionnaire-9 (PHQ-9)* [47]: a measure of depressive symptoms, where scores range from 0 to 27 and higher scores indicate more prevalent depressive symptoms.
- *Kessler-10 Psychological Distress Scale (K-10)* [48]: a measure of overall psychological distress, with scores ranging from 10 to 50 and higher scores indicating greater levels of distress.

Data Analyses

Statistical analyses were conducted using SPSS software (version 26, IBM computing). Descriptive statistics were used to examine patterns of course uptake (registrations and commencements), adherence and user characteristics over time. Independent samples *t*-tests, and χ^2 analyses were used to compare demographic and clinical characteristics of course users in the pre-COVID and during-COVID groups.

Intention-to-treat linear mixed models were used to estimate treatment effects of the Reboot Online program for pre-COVID and during-COVID groups. Separate models were estimated for each of the clinical outcomes (i.e., PSEQ, BPI, PDI, Tampa, PHQ-9, K-10), using the MIXED procedure. Each model included group (pre-COVID, during-COVID), time (pre-treatment, post-treatment), and a group-by-time interaction as fixed factors; and a random intercept for subject. Models were estimated using a restricted maximum likelihood estimator, and a variance components covariance structure to model the random effects. The relative fit of the residual covariance structure (that is, how closely the sample covariances fit the covariances expected under the model) was evaluated using the Bayesian Information Criterion. It was found that an autoregressive covariance structure provided the closest model fit for all outcomes. This structure accounts for the correlation between repeated observations and assumes a decay in correlation as time increases, and is thus suited to longitudinal data analyses. Pre- to post-treatment effect sizes (Hedges' *g*, adjusted for the correlation between repeated measurements) were calculated based on estimated marginal means and the standard deviation of outcomes at Lessons 1 and 8. Effect sizes were considered to be small (*g* = 0.2–0.49), moderate (*g* = 0.5–0.8), or large (*g* > 0.8) [49]. Study results were considered significant where *P* < .05.

Results

Participant Characteristics

A total of 2,585 individuals registered for the Reboot Online program between April 19, 2017, and March 12, 2021. The sample were predominantly female (n = 1,713, 66%), with a mean age of 48.9 ± 14.4 years (mean ± standard deviation, age range 18–90 years). Approximately half the cohort resided in a major city (n = 1,143, 44%), while the other half resided in a regional or remote area (n = 1,235, 48%) (see Table 1).

The cohort was comprised of 1,138 participants who registered for Reboot Online *prior* to the COVID-19 pandemic (April 19, 2017, to March 11, 2020); and 1,447 participants who registered *during* the first 12 months of the COVID-19 pandemic (March 12, 2020, to March 12, 2021). Table 1 outlines the demographic and clinical characteristics of participants who commenced the Reboot Online course in each time period. Significant demographic differences were observed between users who registered before and during the COVID-19 pandemic. Those who registered during COVID-19 were younger, more likely to be female, more likely to reside in a major Australian city (vs a regional or remote location) and had higher relative indexes of social advantage (suggesting higher socioeconomic status), compared to those who registered pre-COVID-19 (see Table 1). Clinical symptom severity at the time of enrolment did not differ between groups.

Uptake of the Reboot Online Course before and During the COVID-19 Pandemic

Figure 1 illustrates the total number of course registrations and commencements per month from April 2017 until March 2021. A sharp rise in both registrations and commencements was observed in April 2020, the month following the COVID-19 pandemic declaration. Prior to COVID-19, the mean number of monthly course registrations and commencements were 31.7 ± 18.3 and 23.3 ± 13.5, respectively. During COVID-19, monthly course registrations increased to 122.6 ± 50.7 (t_{46}=−9.0, *P* < .001, *g* = 3.1 [95% CI 2.2–3.9]); and monthly commencements increased to 95.4 ± 41.7 (t_{46} = −9.0, *P* < 0.001, *g* = 3.0 [95% CI 2.1–3.9]). This represented a 287% increase in course registrations, and 309% increase in course commencements during COVID-19. Peak course uptake in the COVID-19 period was observed during the first 3 months of the pandemic (April, May and June 2020); when there was a 508% increase in course registrations, and a 555% increase in course commencements, relative to pre-COVID values (see Figure 1).

Adherence to the Reboot Online Course Before and During the COVID-19 Pandemic

Table 2 provides individual lesson completion rates and course adherence for users before and during COVID-19. Approximately three quarters of all those who registered for the Reboot Online course commenced the program during both time periods (74.9% pre-COVID and 77.5% during-COVID; see Table 2). The average number of lessons completed by users was 5.0 ± 3.0 before COVID, and 4.7 ± 3.1 during COVID (*P* = .12). Of those who

Table 1. Demographic and clinical characteristics of course users before and during the COVID-19 pandemic

	All n = 2,585	Pre COVID-19 n = 1,138	During COVID-19 n = 1,447	Between group comparison Significance test
Demographic characteristics				
Age mean ± standard deviation (range)	48.9 ± 14.4 (18–90)	51.0 ± 14.1 (19–90)	47.2 ± 14.5 (18–89)	$t(2,583) = 6.62$, **P<.001**
Sex n (%)				
Female	1,713 (66.3)	733 (64.4)	980 (67.7)	$\chi 2(1) = 24.25$,
Male	794 (30.7)	388 (34.1)	406 (28.1)	**P<.001**
Undisclosed	78 (3.0)	17 (1.5)	61 (4.2)	
Location n (%)				
Major city	1,143 (44.2)	396 (34.8)	747 (51.6)	$\chi 2(2) = 120.14$,
Regional area	1,180 (45.6)	674 (59.2)	506 (35.0)	**P<.001**
Remote area	55 (2.1)	20 (1.8)	35 (2.4)	
Undisclosed	207 (8.0)	48 (4.2)	159 (11.0)	
ISRAD Decile n (%)				
1	205 (7.9)	117 (10.3)	88 (6.1)	$\chi 2 (9) = 86.6$,
2	321 (12.4)	200 (17.6)	121 (8.4)	**P<.001**
3	197 (7.6)	75 (6.6)	122 (8.4)	
4	299 (11.6)	150 (13.2)	149 (10.3)	
5	261 (10.1)	124 (10.9)	137 (9.5)	
6	178 (6.9)	58 (5.1)	120 (8.3)	
7	154 (6.0)	63 (5.5)	91 (6.3)	
8	236 (9.1)	97 (8.5)	139 (9.6)	
9	221 (8.5)	71 (6.2)	150 (10.4)	
10	318 (12.3)	138 (12.1)	180 (12.4)	
Undisclosed	195 (7.5)	45 (4.0)	150 (10.4)	
Baseline clinical characteristics				
K10 (range 10–50)	26.7 ± 8.3	26.4 ± 8.3	27.0 ± 8.3	$t(1960) = -1.58$, $P = .11$
PHQ-9 (range 0–27)	12.2 ± 6.7	12.2 ± 6.8	12.2 ± 6.6	$t(1954) = -0.03$, $P = .98$
BPI-severity (range 0–10)	5.6 ± 1.8	5.5 ± 1.8	5.6 ± 1.8	$t(1954) = -0.67$, $P = .48$
BPI-interference (range 0–10)	6.4 ± 2.3	6.4 ± 2.3	6.5 ± 2.3	$t(1954) = -0.91$, $P = .35$
PSEQ (range 0–60)	25.7 ± 13.7	25.6 ± 13.6	25.7 ± 13.8	$t(1954) = -0.18$, $P = .42$
PDI (range 0–70)	41.0 ± 15.9	41.4 ± 15.9	40.8 ± 15.9	$t(1954) = 0.82$, $P = .41$
Tampa (range 17–68)	40.5 ± 8.5	40.3 ± 8.7	40.7 ± 8.3	$t(1954) = -0.94$, $P = .34$

ISRAD = Index of Relative Socio-economic Advantage and Disadvantage; K-10 = Kessler Psychological Distress Scale; PHQ-9 = Patient Health Questionnaire-9; BPI-severity = Brief Pain Inventory Severity Subscale; BPI-interference = Brief Pain Inventory Interference Subscale; PSEQ = Pain Self Efficacy questionnaire; PDI = Pain Disability Index; Tampa = Tampa Scale of Kinesiophobia.

registered, 32.8% completed the entire course (all 8 lessons) prior to COVID-19, and 30.3% completed the course during COVID-19. This represented 43.8% and 39.1% of those who started the course pre-COVID and during-COVID, respectively. Rates of course commencement, lesson completion and overall adherence did not differ significantly between groups.

Effectiveness of the Reboot Online Course Before and During the COVID-19 Pandemic

Table 3 provides the estimated marginal means, linear mixed model results and effect sizes from pre-to-post treatment for all clinical outcome measures. Both prior to and during the COVID-19 pandemic, Reboot Online course users demonstrated significant improvements in all outcomes measured. This included medium effect-sized improvements in overall psychological distress and fear of movement; and small-to-moderate effect-sized improvements in pain severity, pain interference, pain-related disability, pain-related self-efficacy, and symptoms of depression (Table 3). The time (pre- to post-treatment) by group (pre-COVID vs. during-COVID)

interaction was not significant for any outcome measure; indicating that course effectiveness did not significantly differ between pre-pandemic users and those who used the course during the COVID-19 pandemic (K10: $F(2, 1457)=0.79$, $P = .45$; PHQ-9: $F(2, 1503)=0.45$, $P = .64$; BPI-severity: $F(2, 1535)=1.17$, $P = .31$; BPI-interference: $F(2, 1574)=0.97$, $P = .38$; PSEQ: $F(2, 1555)=0.64$, $P = .53$; PDI: $F(2, 1489)=0.55$, $P = .58$; Tampa: $F(2, 1639)=1.22$, $P = .30$).

Discussion

To our knowledge, this study represents the first evaluation of the uptake and outcomes of a multidisciplinary online pain management program in the context of the COVID-19 pandemic. As hypothesized, a substantial increase in course uptake was observed following the declaration of the COVID-19 pandemic. Uptake was highest during the first 3 months of the pandemic (April–June 2020), when course registrations and commencements increased by >500% compared to pre-pandemic levels. These findings are congruent with a growing body of literature demonstrating the negative impacts of the
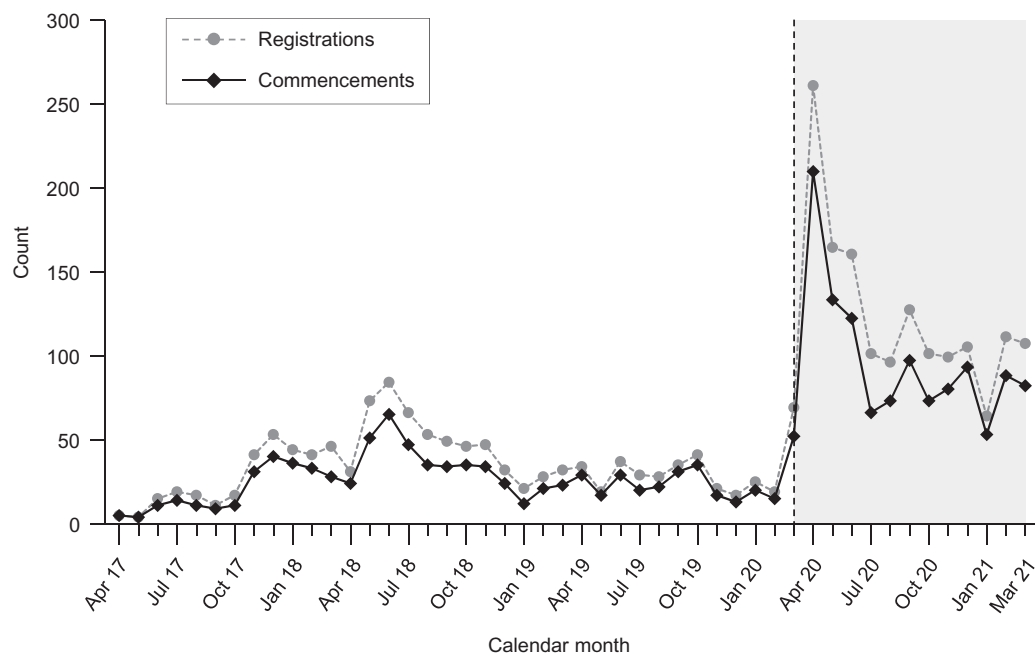
Figure 1. Uptake of the Reboot Online program before and during the COVID-19 pandemic. The number of course registrations and commencements per calendar month are presented from program launch in April 2017 until March 2021. The vertical dashed line in March 2020 corresponds to the World Health Organization Declaration of the COVID-19 global pandemic; and the shaded portion of the graph represents the "during COVID-19 period."

Table 2. Lesson completion rates before and during the COVID-19 pandemic

	Pre COVID-19		During COVID-19	
Course Adherence	n	%	n	%
Registered	1,138	100	1,447	100
Commenced/started program	852	74.9	1,122	77.5
Completed Lesson 1	806	70.8	1,058	73.1
Completed Lesson 2	674	59.2	829	57.3
Completed Lesson 3	581	51.1	701	48.4
Completed Lesson 4	530	46.6	626	43.2
Completed Lesson 5	479	42.1	567	39.2
Completed Lesson 6	446	39.2	518	35.8
Completed Lesson 7	412	36.2	480	33.2
Completed Lesson 8	373	32.8	439	30.3

Percentages are calculated as a proportion of the total number of course registrations, during each time period (Pre COVID-19 and during COVID-19).

pandemic on chronic pain [13, 15, 26, 30, 50], and illustrate a concurrent increase in the demand for remotely delivered pain management services. Course uptake remained elevated above pre-pandemic levels throughout the first year of the pandemic (see Figure 1), while course adherence and clinical effectiveness remained stable (Tables 2 and 3). Together, these findings support the utility of the Reboot Online pain management program as an effective and scalable intervention for responding to the escalating pain burden arising from the COVID-19 pandemic.

There are likely multiple factors that contributed to increased course uptake during the COVID-19 pandemic.

Heightened distress, uncertainty, and poorer overall mental health have been noted by people experiencing chronic pain, as a direct result of the pandemic [17–21, 23]. Restrictions on physical activity and changes to work and social arrangements triggered by the pandemic have also been noted to exacerbate pain [13, 17, 19, 20] and may have influenced help-seeking behaviour. Together with disruptions to traditional face-to-face services [22, 24–26], these factors likely contributed to an increase in the number of people seeking pain management support via alternative means. This finding is congruent with observed increases in the uptake of similar digital services in Australia for a variety of mental health conditions during the pandemic [34, 35, 51]. National media campaigns to promote awareness of THIS WAY UP digital courses and the introduction of a course fee waiver in April 2020 likely also contributed to greater uptake of the program.

Together with increased uptake, differences in the demographic profile of course users were observed during the COVID-19 pandemic. The most notable shift appeared to be an increase in the proportion of users residing in metropolitan areas during the pandemic, with higher relative indices of social advantage (Table 1). This may reflect concurrent changes in the availability of routine face-to-face pain services, which were more readily accessible in metropolitan areas prior to the pandemic, but limited or not available in metropolitan areas during COVID-19. Thus, a greater volume of metropolitan residents and their clinicians may have been prompted to seek alternative online treatment during the pandemic,

Table 3. Clinical effectiveness of the Reboot Online program, before and during the COVID-19 pandemic

Outcome	Pre-treatment EMM (SD)	Post-treatment EMM (SD)	Pre-to-post comparison			
			Df	F	r	Hedge's g (95% CI)
Before COVID-19						
K-10	26.40 (8.49)	22.59 (7.12)	1,162.19	92.35***	0.67	0.49 (0.34 –0.63)
PHQ-9	12.15 (6.64)	9.81 (5.55)	1,203.92	62.51***	0.67	0.38 (0.24 –0.53)
BPI-severity	5.54 (1.85)	5.16 (1.56)	1,226.82	17.20***	0.69	0.23 (0.08 –0.37)
BPI-interference	6.38 (2.40)	5.53 (2.06)	1,427.78	50.56***	0.63	0.38 (0.23 –0.52)
PSEQ	25.59 (13.95)	30.15 (11.71)	1,253.94	43.27***	0.66	0.35 (0.21 –0.50)
PDI	41.39 (16.46)	36.16 (13.60)	1,202.64	53.06***	0.72	0.35 (0.20 –0.49)
Tampa	40.32 (8.66)	35.99 (7.41)	1,308.10	103.92***	0.66	0.54 (0.39 –0.68)
During COVID-19						
K-10	27.00 (8.47)	22.73 (7.00)	1,171.71	139.47***	0.69	0.55 (0.42 –0.69)
PHQ-9	12.16 (6.63)	9.50 (5.45)	1,215.41	90.28***	0.70	0.44 (0.31 –0.57)
BPI-severity	5.59 (1.88)	5.07 (1.53)	1,239.21	37.81***	0.70	0.31 (0.17 –0.44)
BPI-interference	6.47 (2.38)	5.48 (2.04)	1,262.90	85.77***	0.62	0.45 (0.32 –0.58)
PSEQ	25.71 (13.93)	29.71 (11.50)	1,266.21	47.30***	0.72	0.31 (0.18 –0.45)
PDI	40.79 (16.41)	34.88 (13.33)	1,213.53	82.41***	0.73	0.40 (0.26 –0.53)
Tampa	40.68 (8.64)	36.90 (7.30)	1,322.13	117.66***	0.67	0.47 (0.34 –0.61)

K-10 = Kessler Psychological Distress Scale; PHQ-9 = Patient Health Questionnaire-9; BPI-severity = Brief Pain Inventory Severity Subscale; BPI-interference = Brief Pain Inventory Interference Subscale; PSEQ = Pain Self Efficacy questionnaire; PDI = Pain Disability Index; Tampa = Tampa Scale of Kinesiophobia.

r = Pearson correlation coefficient between pre- and post-treatment scores for calculation of within-group effect sizes; EMM = estimated marginal mean; SD = standard deviation.

***$P < .001$.

compared to previously. Restricted travel, limited social activity and flexible working arrangements during the pandemic may also have prompted greater engagement with digital health services among young, working, metropolitan individuals.

The accessibility of digital health interventions is known to vary with age and other social determinants, whereby younger, more advantaged populations typically have greater digital competence and access to internet technologies [52–54]. The demographic shift toward such users during the pandemic may suggest it highlighted or exacerbated a "digital divide" for less advantaged individuals with pain, which warrants careful consideration [55, 56]. It is also worth noting however the broad demographic of users who did successfully engage with the Reboot Online program before and during the pandemic, including those of advanced age (up to 90 years pre-pandemic and 89 years during-pandemic), and across the entire spectrum of relative social advantage/disadvantage in Australia (see Table 1).

Despite demographic differences, the clinical profile of course users remained similar before and during the pandemic. Contrary to predictions, clinical symptom severity at the time of course registration did not differ between groups (see Table 1), with average scores before and during the pandemic comparable to those reported in previous evaluations [31, 32]. This was unexpected and differs from previous studies that observed increased pain severity and pain-related distress during the pandemic [17, 18, 20, 21, 23]. There are a number of possible explanations for these differences. Regional variations in the pandemic experience between Australia and other countries may have contributed (including relatively low rates of COVID-19

throughout much of Australia during the first year of the pandemic). Further, this study focused on data from the first 12 months of the pandemic; it is possible that increased pain symptom severity may have occurred later in the course of the pandemic, when national restrictions became prolonged. It is also worth noting that the present sample was comprised of individuals who were seeking to engage in evidence-based treatment for their pain. This differs from previous published cohorts who completed observational surveys only, where those with deteriorating symptoms and/or maladaptive management strategies may have been more represented.

As hypothesized, the effectiveness of the Reboot Online course was similar before and during the COVID-19 pandemic. Significant improvements in pain, pain-related interference, disability, fear avoidance, distress and self-efficacy were observed for users in both groups (Table 3). In keeping with previous course evaluations, improvements ranged from small to moderate effect sizes [31, 32], with the largest effects observed for measures of psychological distress and fear of movement. The observed effect sizes for pain, disability and distress are also similar in magnitude to those reported in meta-analyses of internet-delivered psychological therapies for pain [57], and more traditional face-to-face pain interventions including face-to-face CBT [58] and multidisciplinary rehabilitation [59]. These findings support the utility of multidisciplinary online pain management programs and suggest they may be a useful tool that could be integrated within the wider model of chronic pain service delivery. Significant reductions in distress, fear avoidance and improved self-efficacy observed following the Reboot Online program suggest it can help people to live more

confidently with chronic pain, even during times of heightened global stress, or when pain itself persists.

The COVID-19 pandemic has radically altered healthcare delivery for many chronic conditions such as chronic pain. It has amplified the need for readily scalable and accessible service models, with growing international consensus that telemedicine and digital service provision have a critical role to play in managing the high demand for chronic pain services [14, 16, 28–30, 55, 60]. It has been noted that the COVID-19 pandemic will likely continue to exacerbate the burden of chronic pain; via the direct impact of COVID-19 infection, the emergence of new persistent pain syndromes among survivors of critical COVID-19 illness, and the exacerbation of pre-existing pain conditions during pandemic circumstances [14, 61, 62]. Thus, the imperative for evidence-based, effective and scalable chronic pain interventions such as Reboot Online remains paramount. It is important to note that impacts of the COVID-19 pandemic on chronic pain to date appear to vary according to social dis/advantage, often exacerbating underlying health inequity in disadvantaged populations [13, 19, 27, 63]. Consequently, there is a clear need to ensure that access to alternative pain services, particularly virtual and digital interventions, is promoted equitably [56].

Study Limitations

As this study evaluated uptake and outcomes of the Reboot Online program in the routine care setting, no control group was included. Thus, changes observed following the program may have been multifactorial and impacted by several factors including natural adjustment to personal circumstances during the pandemic and/or concurrent treatments. Furthermore, this study relied on self-reported routine assessments and brief voluntary surveys. In this context, participant attrition and missing data were inevitable, and may have contributed to biased estimates of the treatment effects.

This study was retrospective and pragmatic in nature; no attempt was made to case-match the pre-COVID and during-COVID subgroups. We acknowledge the limitations of our pre-post study design, where the study groups were separated by time, introducing the potential for confounding bias. We did not collect detailed data on participants clinical history, health status or personal circumstances, nor how they were personally impacted by the COVID-19 pandemic (such as changes to working arrangements, financial circumstances, movement restrictions, and/or active COVID-19 infection). Consequently, we cannot elucidate clear reasons for course uptake at each time period, nor determine the impact of different contextual factors or actual COVID-19 infection on course uptake and outcomes. Finally, it is recognized that the impact and experience of the COVID-19 pandemic in Australia differed from many other global regions; therefore, these results may not generalize directly to other populations.

Conclusion

During the COVID-19 pandemic in Australia, uptake of the Reboot Online multidisciplinary pain management program markedly increased. The demographic profile of users during the pandemic shifted, whereby users were of younger age, more likely to be female, and more likely to reside in metropolitan areas of relative socioeconomic advantage, compared to pre-pandemic users. Despite demographic differences, the clinical symptom profile of users remained stable before and during the pandemic, and course adherence and effectiveness were unchanged. The Reboot Online program was associated with significant improvements in pain, disability, fear of movement, pain-related distress and self-efficacy, which were comparable before and during the pandemic. These findings illustrate that digital pain management programs like Reboot Online are accessible, effective and scalable interventions that can be utilized to support the management of chronic pain, particularly at times of health system stress.

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