Therapist assisted iCBT for posttraumatic stress: Accessible, low-intensity treatment is effective for severe symptoms and across a wide range of traumas

Authors

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Key results:

- Between January 2020 and June 2022, 4,236 people consented to CloudMD's treatment for symptoms of posttraumatic stress, and 3,689 of those completed at least one post assessment outcome measure.
- Clients reported clinically significant symptoms: 96% reported symptoms of posttraumatic stress that exceeded the threshold for being a clinical case and 68% also reported clinically severe symptoms of depression and anxiety, as well as impaired functioning in day-to-day activities.
- Clients reported a range of trauma histories: 68% reported 'other unwanted or uncomfortable sexual experience', 59% reported physical assault, 56% reported sexual assault, 36% reported a transportation accident, and 54% reported 'other very stressful event'.
- Women reported unwanted sexual experiences (73%) and assaults (both physical (58%) and sexual (61%)) as the most common traumatic events. Men reported physical assaults (62%), other stressful experiences (52%) or a transportation accident (41%) as the most common traumatic events.
- On average, clients started treatment within 7 calendar days of submitting an assessment, with 55% of treatment content completed outside of standard work hours.
- The CloudMD treatment had a large and statistically significant effect on clients' posttraumatic stress symptoms as well as a moderate and statistically significant effect on symptoms of depression, anxiety and functional impairment.
- Most clients achieved clinically significant symptom reduction, with the percentage increasing as clients completed more treatment content: 61% of clients who engaged with the trauma-focused content experienced a reliable improvement in their symptoms, and 77% who engaged

with the relapse prevention content experienced reliable improvement, with an average reduction of 23 points on the PTSD Checklist for DSM-5.

- Treatment was effective for the full range of symptom scores. Clients with higher baseline trauma symptom scores were more likely to achieve reliable symptom improvement than those with lower scores.
- All client types were equally likely to achieve reliable symptom improvement: demographic characteristics and trauma type were not predictive of engagement with treatment, or of symptom change.

Abstract

Posttraumatic stress disorder (PTSD) is a debilitating condition often exacerbated by long wait times and lack of access to effective treatment. The first line psychological treatments for PTSD, and posttraumatic stress reactions more generally, are rooted in principles of cognitive behavioural therapy (CBT). Digital delivery of these treatments represents an opportunity to improve access to evidence-based treatment that can reduce symptoms of posttraumatic stress. In this study, we examined the impact of a therapist-assisted internet-delivered CBT (TAiCBT) program for posttraumatic stress symptoms in a large community sample with clients who had a wide range of trauma histories (e.g., sexual assault, witnessing work-related suffering). Our primary aim was to determine the effectiveness of this treatment and examine how pre-treatment client characteristics or trauma histories related to key treatment outcomes. Clients reported severe symptoms at baseline: 96% reported posttraumatic stress symptoms that exceeded the threshold for clinical caseness (i.e., probable PTSD), and 68% also reported symptoms of depression and anxiety as well as impaired functioning in day-to-day activities. Of all clients who participated in treatment, 52% achieved reliable symptom improvement. Of those who reached furthest treatment milestones (relapse prevention content), 77% achieved reliable symptom improvement. Clients with severe levels of symptoms at baseline were as likely to achieve significant symptom reduction as those with milder symptoms. There were no demographic variables, or type of trauma, that significantly predicted who was likely to benefit from treatment.

Introduction

Post-traumatic stress disorder (PTSD) is widely prevalent in the general population (Kessler, 2000), but as with other mental health concerns, accessing evidence-based treatment in a timely manner is challenging (Hitt et al, , 2004). In Canada, it takes 25 business days in on average to access community-based mental health services and wait times for specific conditions like PTSD can be much longer (Canadian Institute for Health Information, 2021). These barriers to treatment pose significant problems for people with PTSD, as well as for their families, and employers. While first-line treatments for depression and anxiety have become more accessible, there has not been a corresponding increase in access to evidence-based treatments for PTSD.

Digital delivery of therapy, especially digital delivery of cognitive behavioural therapy (iCBT), has a long history and its reach and availability has drastically increased over the past decade such as through the UK-based National Health Service 'Improving Access to Psychological Therapies' (IAPT) programme (National Collaborating Centre for Mental Health, 2021). However, while considerable evidence for the effectiveness of iCBT for depression and anxiety continues to accumulate (Cuijpers et al. 2010; Olthuis et

al., 2016), the evidence for the effectiveness of iCBT for PTSD remains thin, especially with respect to broader community samples (Simon et al 2021; Stephanopoulou et al 2020). Most studies of iCBT for PTSD focus on specific subsets of the population, such as groups that are assumed to have employment-related exposure to trauma, including members of the military (or veterans), first-line responders (emergency medical technicians, emergency room physicians), or law enforcement (Straud et al 2019; Stephanopoulou et al 2020). Given that interpersonal trauma – such as physical and sexual assault – accounts for a large proportion of PTSD cases (Bedoya et al., 2020), research on the effectiveness of iCBT for posttraumatic stress would benefit from expanding the field of study to include broader populations.

In contrast to randomized controlled trials (RCTs), which minimize confounding factors but typically examine treatment efficacy under narrowly defined and controlled conditions – such as specific demographic groups, or for a specific condition or severity of a condition in a group – a retrospective analysis of a community-based sample provides the opportunity to explore treatment effectiveness across various demographics, symptom severity or disease etiology. This is particularly useful when studying PTSD interventions, as people report symptoms of posttraumatic stress stemming from a wide variety of life events (Norris, 1992). The present study therefore employed a retrospective analysis to evaluate the efficacy of TAiCBT for symptoms of posttraumatic stress in a sample of people with diverse trauma histories, from across Canada.

In addition to evaluating the efficacy of CloudMD's posttraumatic stress treatment protocol to determine whether accessible, low-intensity treatment options can be effective for posttraumatic stress across the full spectrum of symptom severity, we also explored the effect of sample-specific factors on treatment outcomes. Specifically, we examined whether pre-treatment client characteristics such as gender, age, and trauma type predict differential response to treatment.

Methods

CloudMD Treatment Structure

The CloudMD TAiCBT for posttraumatic stress program is stored on and accessed via a secure, private digital platform. The program consists of readings and worksheets that are unlocked by a dedicated therapist as the client progresses through treatment. The therapist and client communicate through asynchronous messaging, and the therapist supports the client by encouraging them to engage with the material, reviewing and providing feedback on completed worksheets, and reviewing outcome measures. A standard course of treatment lasts 12 weeks, and clients have access to their completed materials and message history for 40 weeks after treatment ends.

PTSD Program Content

The CloudMD PTSD program is based on a social cognitive theory of PTSD, which prioritizes how the client has made sense of the traumatic event they have experienced, and the present-focused implications of that meaning. The program begins with psychoeducation about PSTD; for example, on the symptoms of PTSD and the role of avoidance in maintaining PTSD symptoms. Clients then move into more personal trauma-focused content, in which they learn about how traumatic events can impact the beliefs a person holds about themself, other people, and the world. They are instructed to reflect on their own beliefs about why their trauma occurred and how it continues to affect them, and they are taught to identify and challenge unhelpful beliefs related to their interpretation of the traumatic event.

Following this trauma-focused portion of the treatment, clients work through a series of modules on the themes of safety, trust, power/control, esteem, and intimacy, and are encouraged to challenge their unhelpful beliefs along those themes. The program concludes with present focused beliefs and relapse prevention content that encourages clients to make specific plans for maintaining gains and continuing to challenge unhelpful beliefs.

Program Customization

Therapists are encouraged to remain adherent to the prescribed treatment delivery guidelines but may use clinical judgment to tailor content to address specific client needs. For example, therapists sometimes incorporate the use of materials outside of the standard posttraumatic stress protocol for safety reasons (e.g., risk management where suicidal ideation is reported), or to address comorbid conditions (e.g., severe depression, insomnia).

Therapist Role

Throughout treatment, therapists are encouraged to be warm, validating, and supportive. In cases where the client has experienced multiple traumatic events during their lifetime, therapists help the client select their *index trauma* - the most distressing event they have experienced - and guide them to remain as focused as possible on that event during treatment. The therapist's role is largely to facilitate engagement with the program, and to troubleshoot barriers to that engagement when they arise. Therapists are instructed to respond to any form of client activity on the platform (i.e., client messages, completed worksheets, or completed outcome measures) within two business days. Therapists have access to a library of sample messages that they can adapt to formulate responses to their clients.

Clients

To participate in treatment, clients had to reside in Canada, and program access varied by geographical region within Canada. As a result, clients accessed the program via a variety of sources: self-referral (i.e., via a government-funded program in Ontario that provided free access to TAiCBT), or referral by primary healthcare providers or employee assistance programs. Depending on province of residence, insurance access and coverage, and public funding agreements, clients may have had the program fully or partially paid for or paid the full cost of the program ($525 CAD) out of pocket.

Informed Consent

Clients provided their consent at the following points in treatment: 1) when they created their user account on the CloudMD platform; 2) when they completed their assessment (to have the assessment reviewed by mental health professionals and be contacted if follow-up was needed); and 3) prior to starting treatment (to engage in treatment). They provided their consent to have their data stored, shared with relevant third parties (e.g., local health authorities in the case of high risk), de-identified and aggregated for research purposes, and reviewed for quality assurance purposes.

Assessment

To determine suitability for the CloudMD TAiCBT program, clients completed a digitally administered non-diagnostic assessment. The assessment consisted of a combination of structured and open-ended questions (e.g., "What brings you here?", "What do you hope to achieve during your time on CloudMD?") and screening instruments (e.g., the Patient Health Questionnaire, PHQ-9; Kroenke et al.,

2001) used to determine the likely presence or absence of various mental health concerns and their associated symptom severity. The assessment also asked about stressors, social support, physical health, and overall functioning. Completed assessments were reviewed by registered social workers who conducted clarifying calls as necessary and otherwise assigned appropriate clients to a therapist (registered social worker, psychotherapist, or psychologist). Clients were considered appropriate for treatment on the CloudMD platform if they:

- Resided in Canada
- Were 16 years or older
- Were able to read and write in English or French
- Had access to a computer and Internet
- Did not endorse active suicidality, homicidality, self-harm, uncontrolled psychosis, mania, or severe eating disorder, or were not dependent on one or more substances
- Were willing to provide an emergency contact

Posttraumatic Stress Program Eligibility

Clients were assigned to the CloudMD posttraumatic stress program if they endorsed at least one traumatic event on the Life Events Checklist for DSM-5 (LEC-5; Weathers, Blake et al., 2013), and if their score on the Posttraumatic Checklist-5 (PCL-5; Weathers, Litz, et al., 2013) was at or above the treatment cut-off score of 32. Clients who scored below the cut-off score on the PCL-5 were eligible if there were other indications of posttraumatic stress in their assessment (e.g., if they reported elevations on the Intrusions and Avoidance categories of the PCL-5). As part of the assessment, clients indicated that they were willing to participate in trauma-focused treatment if this was recommended.

Risk Management

As part of their training, therapists were taught how to manage risk on a digital platform. They were provided with written guidelines on risk management policies and were encouraged to seek consultation with peers and dedicated clinical consultants as needed. Therapists consistently assessed for suicide risk by monitoring clients' scores on the PHQ-9 (Kroenke et al., 2001), as well as by monitoring for client disclosures of risk in their messaging. When therapists determined that risk was low or moderate, they managed risk on the platform by using safety-planning materials designed for that purpose. When therapists determined that risk was high, they telephoned the client and/or involved other support (e.g., emergency services, emergency contact person) as necessary.

Outcome Measures

The Posttraumatic Checklist for DSM-5 (PCL-5; Weathers, Litz et al., 2013) is a reliable and valid 20-item self-report measure that assesses symptoms of PTSD (Blevins et al., 2015). In addition to its use in the baseline assessment, the PCL-5 was administered on the first day of treatment and then weekly (relative to the client's previous PCL-5 completion) throughout treatment.

Similarly, the PHQ-9 and the Generalized Anxiety Disorder-7 scale (GAD-7; Spitzer et al., 2006) – which assess symptoms of depression and anxiety, respectively – were administered as part of the assessment, on the first day of treatment, and then weekly (relative to the previous completion) throughout treatment. The Work and Social Adjustment Scale (WSAS; Mundt et al., 2002) assesses the impact of

mental health concerns on various areas of functioning, and was also administered as part of the assessment, on the first day of treatment, and then every 28 days relative to previous completion.

Data Analysis

Data analyses were completed using Python, version 3.7.12 (Python Software Foundation), and R, version 4.2.0 (R Core Team , 2022).

The first part of the analysis focused on developing a client profile. Exploratory analyses of demographics, baseline symptoms (collected during the assessment), trauma history, and treatment timelines were done to identify the characteristics of our sample. Non-parametric Kruskal-Wallis tests were used to determine if there were differences between the unequally sized groups at baseline. The significance level was set at $p < 0.004$ after a Bonferroni correction across the 12 comparisons ($p < 0.05/12$).

The second part of the analysis explored the effectiveness of the treatment on client symptoms and the interaction between engagement and client outcomes. In clinical interventions, there is typically a drop in client engagement over time. Chi-square (χ^2) and Mann-Whitney U tests were used to compare baseline symptom severity and demographics of those who continued through treatment versus those who did not engage to determine if there were identifiable differences between these groups. The significance threshold for these comparisons was set at $p< 0.007$ using a Bonferroni correction ($p < 0.05/7$). To determine the effectiveness of treatment, repeated measures t-tests were used to compare baseline to final treatment score for each of the different outcome measures. Cohen's d was also computed to quantify the magnitude of the change – i.e., how large and meaningful the effect was. Those tests were also used to explore symptom change and the effect size of the change for clients who reached the following milestones in the program: 1)Milestone 1 (M1) is starting treatment with material focused on PTSD psychoeducation, 2) Milestone 2 (M2) focused on identifying and challenging beliefs about the trauma, and 3) Milestone 3 (M3) focused present-focused beliefs and relapse prevention (i.e., maintenance of gains and planning for the future).

The third part of the analysis assessed the extent to which pre-treatment client factors predicted symptom change. We developed a multiple linear regression model to predict symptom improvement. Three groups of factors were hypothesized to relate to our dependent variable of score change (between final and baseline) on the PCL-5. The three groups of factors were 1) demographics, such as age and gender, 2) baseline symptom and functioning scores, and 3) perceived concerns (e.g., structured assessment question about "what brings you here?" and LEC-5). We included variables that were significant predictors of symptom improvement ($p<0.05$) through previous modelling. We did pairwise Pearson correlations to check for collinearity between variables. None of the relationships exceeded $\rho = 0.57$.

Results

During the study period (January 2020 and June 2022), 4,236 people consented to participate in CloudMD TAiCBT for posttraumatic stress program. On average, it took clients 7 days to go from submitting their assessment to having it reviewed, being assigned a therapist, and consenting to treatment. We found that 57% of clients completed their baseline assessment outside of standard work hours (i.e., 9am to 5pm Monday to Friday), and 55% of the program content was also completed outside

of standard work hours. Most clients (95%) accessed services directly on their own and a small number (5%) were referred through disability support programs or other mental health organizations.

Demographics

As shown in Table 1, clients were primarily White females between 16 and 35 years old. Given the large sample size, there were also many clients with other gender, ethnicity, and age characteristics, including 15% of clients identifying as male and 27% of clients identifying as Black, Indigenous or Person of Color (BIPOC). In terms of demographic representation, the proportion of clients who reported an ethnicity of white (69%) is slightly lower than in the population distribution for Canada (77%; Statistics Canada, 2017).

On average, clients presented with high-severity symptoms and significantly impaired functioning. Based on baseline assessment, 96% of clients were above the caseness[1] threshold of 32 on the PCL-5. The average score of 53.05 (SD=12.55), was well above the threshold for recommended treatment. Over two-thirds (68%) of clients also experienced severe symptoms of other comorbid disorders and impairments in day-to-day functioning (i.e., clients scored above caseness thresholds of PHQ-9 >= 10; GAD-7 >=8; WSAS >=21). Across the sample, the average score on the PHQ-9 was in the moderately severe range for depression (M=17.87, SD = 5.26), the average score on the GAD-7 was in the moderate range for anxiety (M=14.88, SD=4.76), and the average score on the WSAS was in the severe impairment range for functioning (M=25.76, SD=7.70).

On average, symptom scores for men and women were not statistically different. The average scores on the PHQ-9, GAD-7, PCL-5 and WSAS were all within 1 point across genders, suggesting similar levels of symptom severity. Clients identifying as BIPOC or Other had statistically higher posttraumatic stress symptom scores than those identifying as White, although the mean score difference was less than 3 points, which is not a clinically meaningful difference on the PCL-5. Other symptom and functioning scores did not differ across ethnic groups. There was no difference in depression symptom scores across age groups, but there were statistical differences for other symptom scores. The 16-25- and 26–35-year-old age groups had higher PTSD and anxiety symptoms and better functioning scores compared to the other, older age groups.

[1] Caseness is an indicator of symptom severity under the IAPT framework. When a person's symptom score exceeds the accepted clinical threshold for the relevant measure of symptoms, they have symptoms that warrant clinical intervention.

Table 1. Count and percent of clients by demographic groups

Demographic Group	Count (N=4,236)	Percent	Baseline PCL-5 mean (SD)	Baseline PHQ-9 mean (SD)	Baseline GAD-7 mean (SD)	Baseline WSAS mean (SD)
Gender						
Female	3476	82.06%	53.05 (12.51)	17.76 (5.28)	14.87 (4.75)	25.58 (7.77)
Male	629	14.85%	53.00 (13.01)	18.38 (5.17)	15.16 (4.69)	26.63 (7.34)
Other	131	3.09%	53.21 (11.67)	18.22 (5.04)	13.85 (5.21)	26.35 (6.98)
Ethnicity						
White	2903	68.53%	52.64 (12.38)*	17.86 (5.24)	14.87 (4.77)	25.81 (7.56)
BIPOC	1154	27.24%	53.72 (12.98)*	17.71 (5.32)	14.78 (4.77)	25.38 (8.04)
Other	179	4.23%	55.41 (12.13)*	18.96 (4.99)	15.66 (4.47)	27.30 (7.51)
Age						
16-25 years old	1114	26.30%	54.04 (12.46)*	18.28 (5.07)	15.41 (4.61)*	25.12 (7.58)*
26-35 years old	1392	32.86%	53.38 (12.90)*	17.80 (5.18)	15.08 (4.71)*	25.48 (7.68)*
36-45 years old	598	14.12%	52.72 (12.83)*	17.73 (5.38)	14.45 (4.83)*	26.47 (7.74)*
46-55 years old	359	8.47%	52.99 (11.56)*	17.96 (5.56)	14.45 (4.85)*	27.45 (7.61)*
56+ years old	187	4.41%	51.19 (11.47)*	17.66 (5.65)	13.45 (5.08)*	27.61 (7.91)*
Unavailable	586	13.83%	51.35 (12.35)*	17.39 (5.30)	14.57 (4.76)*	25.25 (7.63)*

* $p < 0.004$

Table 2 shows the breakdown of baseline symptom and functioning scores, as well as demographics, for clients who started treatment (i.e., completed at least one outcome measure) compared to those who consented but did not start treatment. The only difference in symptom scores that reached statistical significance was the score on the GAD-7, but the difference in average scores was within 1 point, which is not clinically meaningful. The percentage of clients in the demographic groups differed slightly between those who did and did not start treatment, but these differences did not reach statistical significance.

Table 2. Comparison baseline scores and demographics for clients who did or did not start treatment

Variable	Start Tx (n=3689)	No Start Tx (n=547)	Test stat	*P* value
Baseline PTSD score (PCL-5) Mean (SD)	52.89 (12.53)	54.09 (12.66)	954667.0†	0.042
Baseline depression score (PHQ-9) Mean (SD)	17.83 (5.09)	18.05 (5.28)	984808.5†	0.365
Baseline anxiety score (GAD-7) Mean (SD)	14.79 (4.77)	15.47 (4.63)	924246.5†	0.001*
Baseline functioning score (WSAS) Mean (SD)	25.64 (7.66)	26.52 (7.88)	939342.5†	0.009
Gender (female) n (%)	3046 (83%)	430 (79%)	4.806±	0.028
Ethnicity (white) n (%)	2556 (69%)	347 (63%)	7.291±	0.007
Age (16-35) n (%)	2207 (60%)	299 (55%)	5.048±	0.025

† Mann-Whitney U; ± Chi-square test for independence; * p <0.007

Trauma History

The sample consisted of clients seeking treatment for posttraumatic stress The majority of clients (95%) reported events that had happened to them directly, 57% of clients reported witnessing events, and 10% of clients reported experiencing events related to their employment (e.g., military, first responders). The interquartile range was between two and five directly experienced events and between zero and two witnessed events. Of clients who reported experiencing events related to their employment, all those in the interquartile range reported one event.

The percentage of clients who experienced each event differed across experience type. The five most reported directly experienced events were: other unwanted or uncomfortable sexual experience (68%); physical assault (59%); sexual assault (56%); other very stressful event or experience (54%); and transportation accident (36%). The most common 'witnessed' events were: life-threatening illness or injury (24%); severe human suffering (16%); sudden accidental death (12%); sudden violent death (11%); and physical assault (9%). The most common traumas that clients identified as 'part of my job' were: severe human suffering (3%); sudden accidental death (3%); exposure to toxic substance (3%) ; other very stressful event or experience (3%); and serious accident at work, home, or during recreational activity (3%).

Women reported unwanted sexual experiences (73%) and assaults (both physical (58%) and sexual (61%)) as the most common traumatic events. Men reported physical assaults (62%), other stressful experiences (52%) or a transportation accident (41%) as the most common traumatic events.

Treatment effectiveness

Among clients who consented to treatment, 13% of clients did not start treatment and 52% of clients started treatment but did not progress beyond the first milestone (i.e., the psychoeducation section; M1). 26% of clients did not progress beyond the second milestone (i.e., addressing trauma-related beliefs; M2), and 9% of clients progressed through all three milestones (i.e., reaching the present-

focused and relapse prevention section; M3). For this and further analyses, the sample was restricted to the subset of clients who completed at least one outcome measure during treatment (n= 3,689).

A week of active engagement was defined as a week when clients completed a reading or worksheet, messaged their therapist, or completed an outcome measure. The median number of weeks that clients in the M1 group were actively engaged was 3 weeks. Clients in the M2 and M3 groups actively engaged for 9 and 12 weeks, respectively. The amount of time clients engaged on the platform increased with the number of milestones they completed.

As shown in Table 3, clients' scores on the PCL-5 decreased on average by 12.69 points, which was statistically significant and represents a large effect size (d=0.82). Reliable improvement, which is defined as a minimum decrease of 10 points on the PCL-5[2], was achieved by 52% of clients. Changes in other outcome measures were also significant with medium to large effect sizes. Approximately one third of clients experienced reliable improvement on the PHQ-9, GAD-7 and WSAS, which reflects decreases of more than 6,4 and 8 points, respectively. Given that the majority of clients receiving treatment for posttraumatic stress symptoms had comorbid conditions, it is encouraging to see that this treatment protocol also reduced negative symptoms in these areas.

Table 3. Outcome measure scores, symptom score changes and test statistics

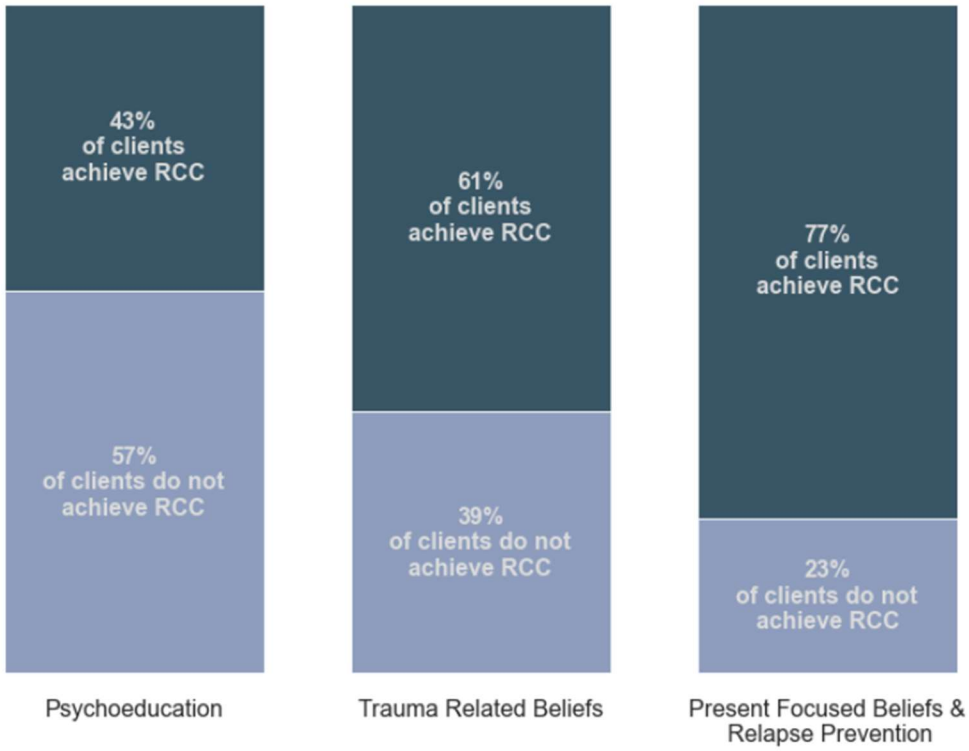
Group	**N**	**Baseline Score**		**Final Score**		**Score Change**		***t* value**	***P* value**	**Cohen's d**	**% Clients RCC**
		Mean	SD	Mean	SD	Mean	SD				
All – PCL-5	3689	52.89	12.53	40.20	17.89	12.69	16.43	46.92	<0.001	0.82	52.40%
All – PHQ-9	3662	17.84	5.28	13.40	6.65	4.43	6.03	44.43	<0.001	0.74	38.75%
All – GAD-7	3651	14.78	4.78	12.12	5.93	2.66	5.52	29.06	<0.001	0.49	38.32%
All - WSAS	3631	25.63	7.68	21.06	10.03	4.57	8.51	32.34	<0.001	0.51	32.31%
M1	2179	53.64	12.55	44.61	15.62	9.03	14.09	29.93	<0.001	0.64	43.36%
M2	1115	52.34	12.30	36.37	18.36	15.96	17.57	30.34	<0.001	1.02	61.25%
M3	395	50.32	12.68	26.66	19.02	23.66	18.21	25.82	<0.001	1.46	77.22%

Table 3 also shows the group sizes and results for clients grouped by the final treatment milestone they reached. The average score change from baseline to final for clients who reached each of these milestones was statistically significant. The magnitude of score change increased as clients completed more of the program, with effect sizes increasing from moderate (d=0.64) for clients who reached the first treatment milestone, to large (d=1.46) for clients who reached the third and final treatment milestone. The percentage of clients who achieved reliable improvement in symptoms also grew from 43.36% to 77.22% from milestone 1 to milestone 3. Figure 1 shows the breakdown of client outcomes

[2] Achieving reliable improvement (RCC) is determined by the reliable clinical change index found in the IAPT (Adult Improving Access to Psychological Therapies) manual. Each outcome measure has a point value associated with achieving RCC. IAPT is the UK national framework for psychotherapy. The reliable change threshold for the WSAS was defined as greater than 8 points or more than the variance reported in Mundt et al., 2002.

across these milestones in terms of the percentages of people who did or did not achieve reliable improvement.

Figure 1. Percentage of clients experiencing symptom change grouped by final treatment milestone



Predictors of outcome

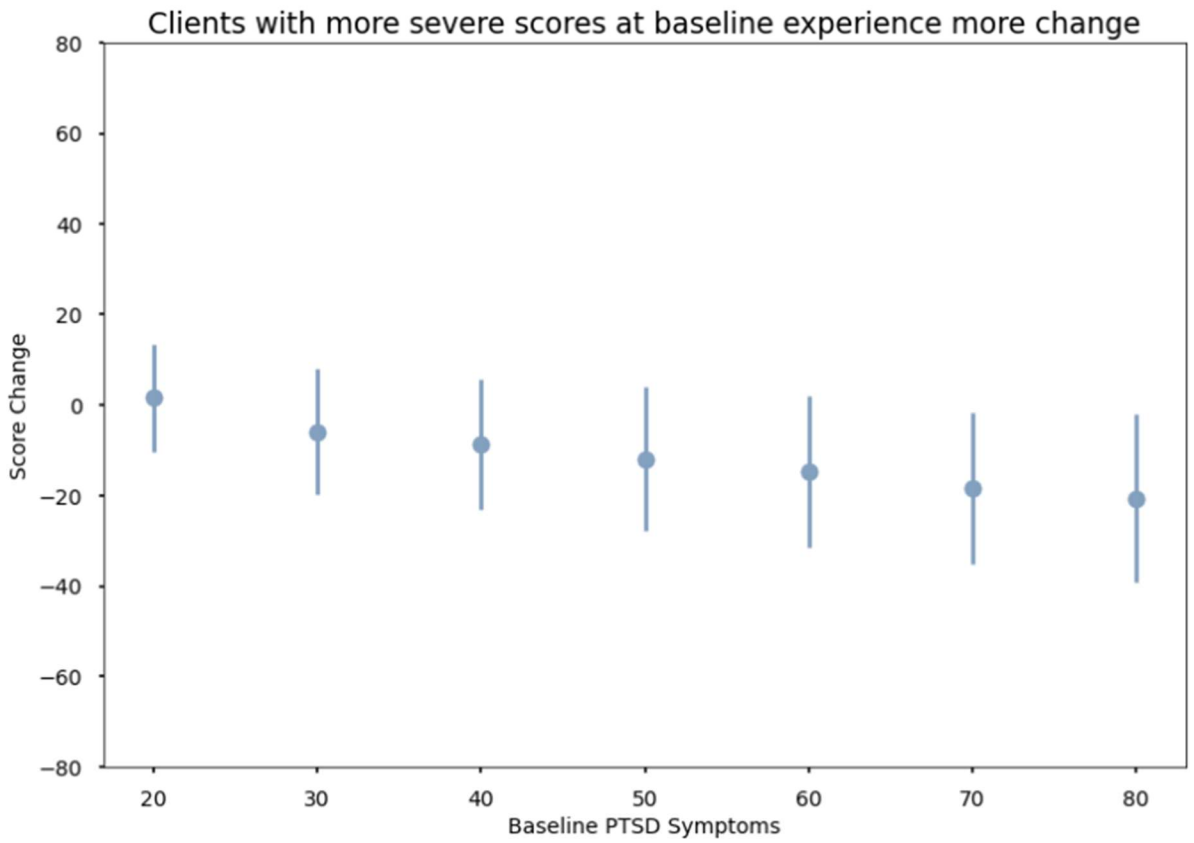
A multiple linear regression was used to examine the relationship between pre-treatment client factors and the magnitude of symptom change. Table 4 summarizes the results from the model. Demographics were not a predictor of score change. Baseline symptoms and functioning scores were significant predictors, with the baseline PCL-5 score contributing most to score change. The total number of traumatic events that were directly experienced was also predictive of score change. The model accounted for 45% of the variance in the prediction of score change ($R^2 = 0.45$).

Table 4. Linear Regression results for predicting symptom change

Variable	Estimate	Standard Error	*P* value
Gender	0.1649	0.535	0.758
Ethnicity	0.5796	0.459	0.207
Age	0.1900	0.161	0.237
Baseline PHQ-9 score	0.3542	0.068	**0.000**
Baseline GAD-7 score	0.2023	0.068	**0.003**
Baseline WSAS score	0.2697	0.042	**0.000**
Baseline PCL-5 score	-0.5841	0.024	**0.000**
Trauma concern	0.5474	0.552	0.321
Total LEC-5 happened	0.3994	0.122	**0.001**
Total LEC-5 witnessed	-0.0107	0.174	0.951
Total LEC-5 learned	-0.2008	0.119	0.092
Total LEC-5 job	-0.0826	0.212	0.698

Because the baseline PCL-5 score had the largest coefficient, we computed the average change in PCL-5 score grouped by baseline PCL-5 score. Figure 2 shows these results and displays the linear and downward trending relationship. Clients across the range of pre-treatment symptom severity experienced a reduction in PTSD symptoms, and the higher the PCL-5 score at baseline (i.e., the more severe the PTSD symptoms), the greater the average reduction in symptom score .

Figure 2. Average PTSD symptom reduction grouped by baseline symptoms



Discussion

The need for accessible, feasible, high-quality mental health services continues to outstrip available resources. The availability of a low-barrier and scalable digital treatment presents an opportunity to directly address and ameliorate this problem. This study shows that this TAiCBT for posttraumatic stress is effective for individuals suffering from severe, clinical-level symptoms of posttraumatic stress, challenging the notion that traditional in-person therapy is the only route to symptom change for most people.

TAiCBT provides further advantages relative to typical in-person treatment. For example, the 'time-to-treatment' for CloudMD services was less than 30% of the typical time in Canada for community-based mental health care, supporting the claim that digital delivery of therapy, including TAiCBT, can reduce wait times for people seeking help. Reducing barriers to treatment access is an important outcome in itself, as the ongoing experience of negative symptoms impacts quality of life. And while rapid-access programs, especially those permitting self-referral, are often plagued by high rates of early disengagement/drop-off, clients may still benefit from the experience of reaching out for help, being assessed, and offered treatment quickly. The traditional alternative to self-referral is referral through existing health care infrastructure, such as via a family physician, community clinic, or emergency care. These pathways are slower and more complex to navigate than self-referral pathways and are generally constrained by significant demands on limited human resources required to make connections between people needing help and care providers. A mixed model that allows rapid time to treatment through self-referral integrated with existing health care infrastructure would help meet the needs of clients for quick access and alleviate demand on traditional pathways.

In addition to delays in receiving treatment, many people report that it is difficult to access available treatments due to the time constraints of typical employment or other daytime responsibilities. The CloudMD posttraumatic stress treatment program addresses this concern with features such as asynchronous messaging and providing treatment materials that are accessible at any time. More than half of clients initially reached out for service outside of business hours and nearly three quarters of the content was completed outside of business hours. This suggests that, when available, people do take advantage of the flexibility of iCBT as a digital service.

PTSD can be caused by a wide variety of traumas (Stephanopoulou et al 2020, Norris 1992), and with a community-based sample, produced largely by a self-referral process, we wanted to identify types of trauma histories and their breakdown in the sample. In contrast with studies that focus on specific trauma types, we did not know in advance the breakdown of our sample by trauma type, or whether the trauma was related to a directly experienced event or a witnessed one. We found that the vast majority of people who sought treatment for symptoms of posttraumatic stress had directly experienced a traumatic event (95%); many reported also witnessing a traumatic event (57%), and a few experienced a traumatic event related to their employment (10%). These results suggest that increasing access to iCBT services for posttraumatic stress for the general population – in addition to and beyond individuals who experience trauma in their lines of work (e.g., military, first responders) – would likely be very beneficial and meet a substantial need. This could be important for future outreach and advertising of publicly funded treatments for posttraumatic stress, and for further study on the effectiveness of TAiCBT for posttraumatic stress in the general population.

Our study supports the effectiveness of the CloudMD TAiCBT program for posttraumatic stress in a real-world heterogenous sample of help-seeking individuals. More than half of clients experienced significant reduction in symptoms of posttraumatic stress; 38% of clients experienced reductions in depression and anxiety, and 28% of clients saw improvements in day-to-day functioning. The program led to reductions in symptoms for clients across the range of symptom severity. While the longer a client spent engaged in treatment, the greater their likelihood of achieving symptom improvement, many clients who did not complete all phases of therapy experienced reliable symptom improvement. These results suggest low-intensity treatment (i.e., one that requires a lower deployment of specialized therapist time than traditional in-person or "high intensity" treatment) may be sufficient care for many clients with posttraumatic stress.

Finally, it is important to note that we did not identify specific client factors that are predictive of symptom change. This means that our clients were, on average, equally likely to achieve clinically significant symptom improvement. It would be beneficial for clinicians, clients, and healthcare systems as a whole to be able to predict the likelihood of treatment engagement and outcome, but our results suggest that client demographics, and other information typically collected at treatment onset, do not differentiate those who will see symptom improvement from those who will not. We found that trauma history and symptom severity are predictive, to a small degree, of symptom change, but not to the point of being clinically useful. More research is needed to identify the factors, that predict who is most likely to benefit from treatment.

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