Original Paper

Online Acceptance and Commitment Therapy With Contingency Management for Women With Methamphetamine Use Disorder: Mixed Methods Feasibility Study

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Abstract

Background: Methamphetamine use disorder (MUD) is an escalating public health concern that disproportionately affects women and gender-diverse individuals and is frequently accompanied by trauma exposure and psychiatric comorbidity. Evidence-based psychosocial treatments remain limited, particularly interventions that are feasible, scalable, and responsive to these intersecting vulnerabilities.

Objective: This pilot study evaluated the feasibility, acceptability, and preliminary outcomes of an online acceptance and commitment therapy (ACT) group intervention combined with contingency management (CM) for individuals with MUD, with a primary focus on women and gender-diverse participants.

Methods: A single-arm, open-label feasibility trial was conducted with 61 (n=57, 93% women; n=4, 7% gender-diverse; mean age 39.8, SD 9.4 years) participants. The intervention comprised 15 online ACT group sessions delivered over 8 weeks, preceded by an individual motivational interviewing session, and supported by CM to reinforce session attendance. Primary outcomes were methamphetamine use (grams and days) assessed using the timeline follow-back method. Secondary outcomes included anxiety, depression, and trauma symptoms, psychological flexibility, craving, functional impairment, and quality of life. Changes over time were analyzed using linear mixed-effects models under an intention-to-treat framework. Effect sizes were calculated using standardized mean change relative to baseline. Postintervention, individual semistructured interviews were conducted via videoconferencing with all completers to evaluate satisfaction and perceived active ingredients of the intervention. Transcripts were analyzed using software-supported thematic analysis, and the themes were refined through discussions with the research team.

Results: Retention was moderate, with 50 participants attending at least 1 session and 30 completing the intervention (≥10 sessions). Significant reductions in methamphetamine use occurred across all timeline follow-back measures and were maintained at the 1-month follow-up. Significant improvements were observed in anxiety, depression, trauma symptoms, and psychological flexibility. Craving and quality-of-life domains did not show significant changes after correction. Qualitative thematic analysis revealed high acceptability across 4 primary themes. Participants emphasized emotional connection, normalization of experiences, and mutual accountability as key drivers of engagement, active monitoring of use, values-based reflection, and mindfulness tools useful for coping with cravings. They also highlighted platform convenience, a safe women-focused composition, and the role of financial incentives as external motivators supporting clinical adherence. Constructive requests were made for additional trauma-focused content and emotional literacy.

Conclusions: This online ACT protocol combined with CM appears feasible and acceptable for women and gender-diverse individuals with MUD and was associated with meaningful reductions in methamphetamine use and improvements in psychological functioning. While these preliminary results are limited by a single-arm design, a relatively short follow-up period, and reliance on self-report measures, they provide a strong foundation for future research. These findings support further evaluation of the integrated ACT+CM protocol in larger randomized controlled trials to assess long-term efficacy and help to close critical digital health treatment gaps for this population.

Trial Registration: Clinicaltrials.gov NCT05334914; https://clinicaltrials.gov/study/NCT05334914

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Introduction

Methamphetamine use and its associated harms, including methamphetamine use disorder (MUD), overdose, hospitalization, and illegal activity, are rising in Canada. Recent evidence shows that stimulant toxicity deaths in Ontario more than doubled between 2018 and 2021 [1], and national surveillance data indicate high levels of methamphetamine use among people accessing harm reduction services across the country [2]. Individuals with MUD represent a high-risk and high-needs population, as methamphetamine use is linked to depression, anxiety, psychosis, violent and aggressive behavior, increased risk of blood-borne infections such as HIV, overdose, and posttraumatic stress disorder (PTSD) [3-5].

Despite this urgent need, recent reviews underscore a persistent treatment gap. Currently, no pharmacological treatment is approved or supported by robust evidence for either methamphetamine withdrawal or long-term use reduction. Acheson et al [6], in a comprehensive meta-analysis of pharmacotherapies for methamphetamine withdrawal, found no convincing evidence that any available medication was effective in alleviating withdrawal symptoms, reducing craving, or improving global state. Similarly, Yates [7] concluded that although several compounds show promise in preclinical models, translation to human efficacy has been disappointing. This gap highlights the importance of advancing psychosocial interventions and exploring combined behavioral and pharmacological strategies. Furthermore, accounting for both sex-based biological differences and gender-related vulnerabilities (such as discrimination, trauma histories, and differential access to care) will be key to optimizing treatment outcomes.

Women with MUD are a particularly vulnerable population who require complex interventions that address a wide range of clinical issues [8]. Rather than experiencing a uniform increase in addiction severity, women face a distinct burden characterized by more severe functional impairment across medical, psychiatric, social/family, and employment domains, lower overall quality of life, and an accelerated progression from initial use to disorder [8-10]. Psychiatric comorbidity in women is marked by significantly higher rates of co-occurring internalizing disorders (such as major depression, anxiety disorders, and PTSD) stemming from trauma and abuse histories, whereas men demonstrate higher rates of externalizing disorders [8,10]. Furthermore, women frequently initiate substance use and relapse due to distinct psychosocial drivers linked to negative affect, stress, trauma, and lack of partner or interpersonal support [8,10-15]. Both preclinical and human neurobiological evidence reinforces these sex and gender disparities: women demonstrate distinct neurobiological profiles and

heightened reactivity to stress-induced cravings [9,16,17], whereas men more frequently show greater reactivity to drug-related reward stimuli [17].

Acceptance and commitment therapy (ACT) is a promising treatment approach for co-occurring disorders and trauma, especially in women. ACT is based on 6 core processes: observing the self, values, cognitive defusion, acceptance, contact with the present moment, and committed action [18]. Evidence supports ACT's effectiveness for a range of conditions, including depression [19], body image dissatisfaction [20], psychosis [21], opioid use, and smoking cessation [22-25]. Recent systematic reviews confirm that ACT produces positive outcomes for substance use disorders, often comparable to other empirically supported therapies [26,27].

Online ACT programs have demonstrated feasibility and effectiveness in reducing depression and anxiety symptoms, particularly among adolescents and college populations [28,29]. These findings, although mixed regarding changes in psychological flexibility, suggest that digital ACT delivery is acceptable and potentially scalable for individuals with high rates of comorbidity. Importantly, many of these studies included complex clinical samples, which may explain variability in psychological flexibility outcomes. ACT also aligns closely with trauma-informed treatment principles [30] and may be especially relevant for women with histories of abuse, PTSD, or other psychiatric comorbidities. In 2 studies including incarcerated women, ACT outperformed cognitive behavioral therapy in reducing both substance use and mental health symptoms [31,32].

Notably, in regional contexts such as Northern Ontario, Canada, many individuals who use methamphetamine reside in remote or rural areas facing severe transportation deficits and limited access to specialized addiction treatment [33,34]. Worldwide, fewer than 20% of individuals with drug use disorders receive treatment, with a pronounced gender disparity among users of amphetamine-type stimulants, in which women account for nearly half of consumers but only 27% of treatment recipients [35]. In these diverse regional contexts, including rural communities across the Americas, structural barriers such as geographic distance, transportation limitations, and health care infrastructure deficits severely restrict care delivery, reinforcing the potential of digitally delivered interventions to expand service reach and equity [35,36].

Despite this promise, few studies have tested online ACT for women with MUD. Many trials exclude people with co-occurring psychiatric conditions, psychotic disorders, and intersectional vulnerabilities such as a lack of stable housing, which limits generalizability. To address these challenges, the present study integrates one-on-one motivational interviewing (MI) sessions [37] to enhance readiness for change and contingency management (CM) strategies [38-41] to reinforce attendance. Combining MI and CM with ACT may maximize treatment engagement and retention, 2 core barriers to the successful delivery of interventions in populations with MUD.

CM is among the most robustly supported psychosocial interventions for stimulant use disorders, including MUD. A comprehensive systematic review by Brown and DeFulio [42] demonstrated consistent effects of CM on abstinence and treatment retention across diverse study designs. Evidence for CM extends beyond North American contexts; Okafor et al [43] reported its feasibility and effectiveness in a community-based program in South Africa, supporting its cross-cultural applicability. Importantly, CM has shown flexibility for remote implementation, with successful adaptations for virtual delivery reported during the COVID-19 pandemic [44], reinforcing its compatibility with online psychosocial interventions. In parallel, recent policy and implementation frameworks have emphasized CM as a key evidence-based strategy for addressing stimulant use disorders within public health systems, particularly for populations facing structural and clinical vulnerabilities [45]. Advances in digital platforms and reinforcement personalization further position CM as a scalable and contemporary component of integrated psychosocial care for substance use disorders [46].

Within integrative treatment models, CM may play a complementary role to ACT by enhancing treatment engagement and attendance, thereby increasing opportunities for exposure to ACT's core behavioral change processes. By reinforcing consistent participation, CM may support sustained contact with values-based action, psychological flexibility, and skills practice, particularly among populations with high levels of instability and comorbidity.

The current study aims to evaluate the feasibility and acceptability of an online ACT+CM program for women and gender-diverse individuals with MUD, and to explore preliminary clinical outcomes. We hypothesized that participants would show reductions in methamphetamine use and improvements in mental health symptoms, trauma symptoms, and psychological flexibility over the course of the intervention.

Methods

Study Design

This study was a single-arm, open-label feasibility trial designed to evaluate the preliminary effectiveness, feasibility, and acceptability of a combined ACT and CM intervention for women and gender-diverse individuals with MUD. The intervention was delivered online and consisted of 15 group-based ACT sessions conducted over an 8-week period. Participants who did not have access to a suitable electronic device were provided with one for the duration of the study. Outcomes were assessed at baseline, postintervention, and at a one-month follow-up to evaluate the maintenance of effects. This study was reported in accordance with the iCHECK-DH (Guidelines and Checklist for the Reporting on Digital Health Implementations) guidelines (Checklist 1).

Ethical Considerations

The study protocol was submitted to clinicaltrials.gov (NCT05334914) and approved by the Centre for Addiction

and Mental Health Research Ethics Board (REB number 017-2022). Informed consent was obtained from all individual participants prior to enrollment. All participant data were kept confidential and stored securely in accordance with institutional guidelines. Participant compensation for study attendance was provided via electronic gift cards according to the CM protocol.

Participants

This study was conducted in Ontario, Canada, through the Centre for Addiction and Mental Health (CAMH). Eligible participants were women, individuals identifying as women, or nonbinary individuals aged 18 years or older residing in Canada who met *DSM-5* (*Diagnostic and Statistical Manual of Mental Disorders* [Fifth Edition]) diagnostic criteria for MUD, as determined by the Structured Clinical Interview for *DSM-5* (SCID-5). Exclusion criteria included acute and unmedicated psychosis; severe suicidal ideation requiring immediate institutionalization; or severe cognitive impairment that would preclude meaningful participation in the intervention. A total of 61 participants were enrolled. Participants were recruited from both metropolitan centers and regional/rural communities via outpatient addiction and mental health clinics, community organizations, and online public advertisements between March 20 and December 5, 2024.

Intervention

ACT

Participants first completed a one-on-one MI session to enhance readiness for change, followed by a structured, group-based ACT intervention based on the ACT on Your Recovery manual. The program comprised 15 sessions organized into three 5-session modules: Open (focusing on acceptance and cognitive defusion of substance-related internal experiences), Active (emphasizing values clarification and committed action toward meaningful life goals), and Aware (developing present-moment awareness and self-as-context to reduce automaticity and shame). Sessions integrated experiential exercises, metaphors, and group discussions to promote psychological flexibility, reduce experiential avoidance, and support values-consistent behavior change.

All 15 group-based sessions were delivered remotely via the Cisco Webex videoconferencing platform, with each session lasting exactly 60 minutes. Groups were structured to maintain a mean of 8 to 10 participants per session to ensure sufficient opportunity for individual clinical engagement and the therapeutic group process.

Therapist Training and Fidelity

The online groups were cofacilitated by a multidisciplinary team of clinicians, including psychotherapists, counselors, and physicians, all of whom possessed prior clinical experience in addiction treatment and underwent specific training in the ACT protocol. To ensure safety and adherence, all sessions were systematically supervised by an experienced senior psychologist affiliated with the CAMH, who specializes in substance use disorders and ACT implementation.

Therapist adherence to the ACT model was assessed using the Acceptance and Commitment Therapy Fidelity Measure (ACT-FM [47]). The ACT-FM evaluates ACT-consistent and ACT-inconsistent therapist behaviors across 4 domains: therapist stance, open response style, aware response style, and engaged response style. Sessions were video-recorded, and a randomly selected subset of sessions was independently rated for fidelity by an experienced ACT-trained psychologist. Each item was rated on a scale from 0 (never) to 3 (consistently), yielding a total ACT-consistent score with a maximum of 36 points per session.

CM

The ACT intervention was supplemented with CM to reinforce treatment engagement and attendance. Participants received tangible reinforcers contingent on session attendance, consistent with established CM procedures for stimulant use disorders [48,49]. Reinforcement was delivered via electronic gift cards with an escalating schedule based on consecutive sessions attended. Participants received weekly incentives ranging from CAD $40 to CAD $100 (CAD $1=US $0.72 as of October 30, 2026), with the monetary value of reinforcers increasing incrementally across sessions and contingent on sustained attendance, consistent with CM best practices. This approach was intended to maximize retention while maintaining feasibility in an outpatient, digitally delivered intervention.

Procedures

After providing informed consent and completing eligibility screening, participants completed baseline assessments of substance use, mental health, and functioning. Substance use was assessed using the timeline follow-back (TLFB) method for methamphetamine use [50], the Severity of Dependence Scale (SDS [51]), and the Brief Substance Craving Scale (BSCS [52]). Psychiatric symptoms were assessed using the Patient Health Questionnaire-9 (PHQ-9) for depressive symptoms [53], the Generalized Anxiety Disorder-7 (GAD-7) scale for anxiety symptoms [54], and the Trauma Screening Questionnaire (TSQ) for trauma-related symptoms [55]. Psychological flexibility was measured using the Acceptance and Action Questionnaire-2 (AAQ-2 [56]). Quality of life was assessed using the World Health Organization Quality of Life–BREF (WHOQOL-BREF), including all 4 domains (physical, psychological, social relationships, and environment [57]).

These assessments were repeated after the study's final visit (postintervention) and at the 1-month follow-up. Urinalysis was conducted at each assessment point to corroborate self-reported methamphetamine use. All participants completed a single MI session prior to initiating the ACT program [58].

Qualitative data were collected postintervention with all 30 participants who completed the protocol, through individual, synchronous, semistructured interviews conducted by trained research assistants via online videoconferencing software

(Webex). Logistical barriers and a lack of response to multiple contact attempts precluded the administration of these interviews to participants who discontinued treatment prior to protocol completion. This process used a 13-item semistructured interview protocol designed to evaluate participant satisfaction, perceived active ingredients of the intervention, coping mechanisms, and the impact of the gender-responsive group format. All interview sessions were video-recorded with participant consent, and verbatim transcripts were automatically generated by the videoconferencing platform's built-in software and then manually verified for accuracy by the research team.

Data Analysis

Quantitative Analysis

Changes in outcomes over time were examined using linear mixed-effects models to account for repeated measures and missing data under a missing at random (MAR) assumption. Time (baseline, postintervention, and follow-up) was included as a fixed effect, and participant ID was modeled as a random effect to capture within-participant variability. Estimated marginal means (EMMs) were calculated for each time point, and pairwise comparisons between baseline and subsequent assessments were adjusted using the Bonferroni correction for multiple testing. All analyses followed an intention-to-treat (ITT) framework, allowing inclusion of all participants with available data.

Effect sizes (ES) were calculated to quantify the magnitude of change over time using standardized mean change scores. Specifically, ES were computed as the difference between the EMM at each postbaseline time point and the baseline EMM, divided by the observed standard deviation at baseline for each outcome. For outcomes in which reductions indicated improvement (eg, substance use and symptom severity), ES are reported in absolute magnitude to facilitate interpretation.

To evaluate potential selective attrition bias, baseline demographic, clinical, substance use, and quality of life characteristics were compared between treatment completers (≥10 sessions) and noncompleters (<10 sessions) using independent-samples Mann-Whitney *U* tests (Supplementary Table S1 in Multimedia Appendix 1). The WHOQOL-BREF environment domain (P=.02), which exhibited a statistically significant baseline difference, was subsequently specified as a covariate in the primary linear mixed-effects models to adjust for potential confounding; its inclusion did not alter model estimates. This analytical approach ensured that longitudinal intervention estimates were robust to baseline imbalances between completers and noncompleters. Importantly, the primary linear mixed-effects modeling framework inherently accommodates baseline variability across participants through random intercepts and accounts for missing data under a MAR assumption, providing a more robust analytic approach for repeated measures than traditional group-comparison tests.

Primary mixed-effects models were estimated using SPSS Statistics (version 27; IBM Corp). ES calculations and post hoc extraction of EMMs were performed using R (version 4.5.2; R Foundation for Statistical Computing) with the *lme4*, *lmerTest*, and *emmeans* packages.

Qualitative Analysis

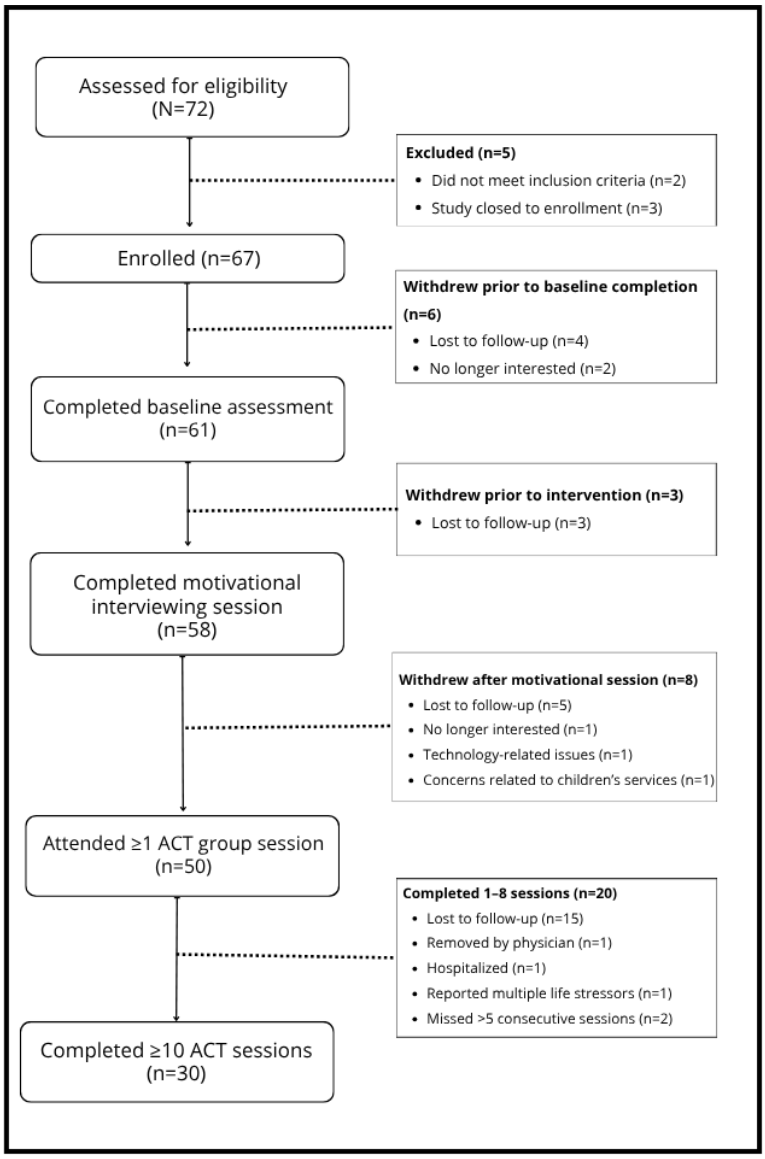
A qualitative descriptive approach was used, and responses were analyzed using thematic analysis, following the framework established by Braun and Clarke [59]. Data were imported into NVivo (version 15; Lumivero) by 1 researcher who performed the primary coding and developed the preliminary thematic framework. Codes were iteratively compared, refined, and organized into subthemes and higher-order themes through discussions with the wider research team, with particular emphasis on insights from the researchers involved in intervention delivery. To enhance transparency and complement the manual coding process, automated word frequency queries and word trees were used within NVivo to cross-examine core patterns. This analytic approach allowed for the identification of both common and nuanced themes reflecting the diversity of participant experiences.

Results

Participant Flow and Retention

As shown in Figure 1, a total of 72 individuals were screened for the study. Five were excluded due to ineligibility (n=2) or study closure to enrollment (n=3), resulting in 67 eligible participants. Of these, 6 were withdrawn prior to baseline assessments due to loss to follow-up (n=4) or declining further participation (n=2). Sixty-one participants completed baseline assessments and were included in the ITT analyses. Following baseline, 3 participants were lost to follow-up, and 8 others were withdrawn before initiating the intervention. Reasons included loss to follow-up (n=5), self-withdrawal (n=1), technology access issues (n=1), and concerns regarding external services (n=1). In total, 50 participants attended at least one ACT session. Among these, 30 participants completed the full intervention (defined as attendance of at least 10 out of 15 sessions).

Figure 1. Participant flowchart from recruitment to completion of the acceptance and commitment therapy (ACT) intervention.



Sample Characteristics

The final ITT sample (N=61) had a mean age of 39.8 (SD 9.4) years, and participant characteristics are presented in Table 1. Most participants identified as women (n=57, 93%) and were female at birth (n=58, 95%). The sample was diverse in terms of sexual orientation, with 56% (n=34) identifying as heterosexual and 20% (n=12) as bisexual; a smaller proportion identified as homosexual, pansexual, or other orientations (each approximately n=3, 5%), and 10% (n=6) of participants preferred not to disclose their sexual orientation.

Participants represented diverse racial and ethnic backgrounds. Among the 61 participants, the majority identified as White or European (n=37, 61%), while a substantial proportion identified as Indigenous (n=7, 11%) or Black (n=6, 10%). Overall, 39% (n=24) of participants identified with at least one racialized or Indigenous background, reflecting the heterogeneity of the population enrolled in the study.

Educational attainment varied widely across the sample. One-quarter of participants reported completing a college or university degree (n=15, 25%), while an additional 26% (n=16) reported some postsecondary education without completing a degree. However, more than one-quarter of participants (n=16, 26%) reported not completing high school, reflecting substantial educational disadvantage within the sample.

Income levels indicated marked socioeconomic vulnerability. The majority of participants (n=43, 70%) reported an annual income below CAD $20,000, with an additional 23% (n=14) reporting incomes between CAD $20,000 and CAD $39,999. Only a small minority reported incomes above CAD $40,000, highlighting the low-income status of most participants at study entry.

Table 1. Demographic characteristics of participants included in the intention-to-treat sample (N=61).

Variable and category	Frequency
Age, mean (SD)	39.8 (9.4)
Sex, n (%)	
Female	58 (95)
Male	3 (5)
Gender, n (%)	
Woman	57 (93)
Nonbinary	3 (5)
Two-spirit	1 (2)
Sexual orientation, n (%)	
Straight	34 (56)
Bisexual	12 (20)
Homosexual	3 (5)
Pansexual	3 (5)
Other	3 (5)
Prefer not to answer	6 (10)
Ethnicity, n (%)	
White/European	37 (61)
Black	6 (10)
Indigenous	7 (11)
East Asian, South East Asian, and Pacific Islander	3 (5)
Middle Eastern, North African, and Central Asian	1 (2)
White/European; Indigenous	5 (8)
Hispanic or Latino; White/European	1 (2)
Other	1 (2)
Education, n (%)	
College or university degree	15 (25)
Some college or university	16 (26)
One or 2-year diploma	3 (5)
One or 2 years post high school (not college)	2 (3)
High school diploma	9 (15)
Less than high school	16 (26)
Income (CAD $)[a], n (%)	
Less than 20,000	43 (70)
20,000-39,999	14 (23)
40,000-59,999	1 (2)
60,000-79,999	1 (2)
150,000-199,999	2 (3)

[a]CAD $1=US $0.72 as of October 30, 2026.

Clinical characteristics are presented in Table 2. Among the 61 participants, nearly all (n=59, 97%) met the criteria for severe MUD. Comorbid substance use disorders were common, particularly opioid use disorder (n=20, 33%) and cannabis use disorder (n=16, 16%). A high proportion of participants reported at least one additional psychiatric diagnosis (n=53, 87%). The most commonly reported mental health conditions were depression (n=33, 54.1%), anxiety disorders (n=31, 50.8%), and attention-deficit/hyperactivity disorder (n=21, 34.4%), followed by PTSD (n=19, 31.1%) and borderline personality disorder (n=18, 29.5%). Less frequently reported diagnoses included personality disorders not otherwise specified (n=12, 19.7%) and bipolar disorder (n=11, 18.0%). Notably, most participants reported more than one psychiatric diagnosis, and several mentioned other diagnoses not listed in the predefined categories. Most participants reported current use of psychiatric medication (n=44, 72%), but only 26% (n=16) were engaged in other psychological or psychiatric treatment at baseline.

Table 2. Clinical characteristics of the sample: substance use severity and mental health indicators (N=61).

Variable and category	Frequency, n (%)
Methamphetamine use disorder severity	
Severe	59 (97)
Moderate	2 (3)
Other substance use disorders	
Opioid use disorder	20 (33)
Cannabis use disorder	10 (16)
Alcohol use disorder	2 (3)
Stimulant use disorder	2 (3)
Alcohol use disorder and hallucinogen use disorder	1 (2)
Alcohol use disorder and opioid use disorder	1 (2)
Other/unknown substance use disorder	3 (5)
None	22 (36)
Reported psychiatric diagnosis	
Yes	53 (87)
No	8 (13)
Reported use of psychiatric medication	
Yes	44 (72)
No	17 (28)
Participation in other therapies	
Yes	16 (26)
No	45 (74)

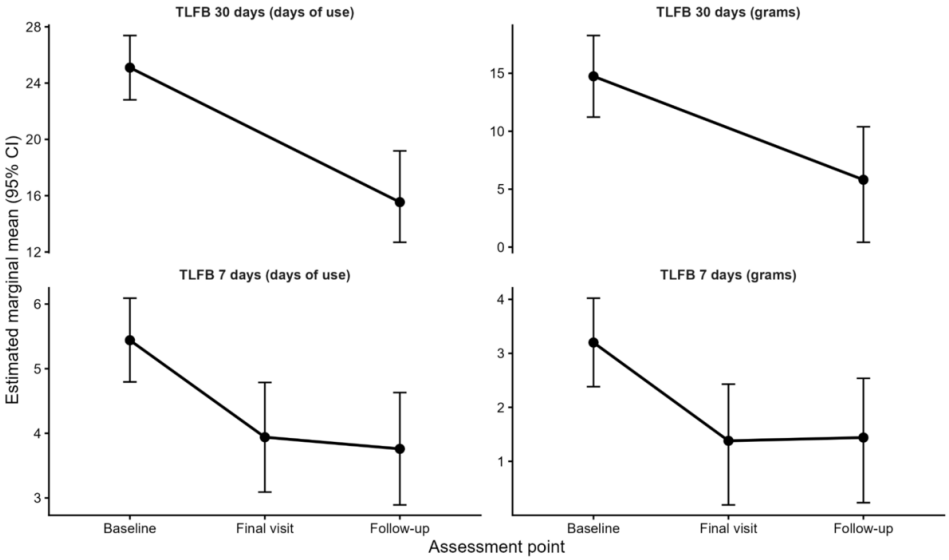
Primary Outcomes

Significant reductions in methamphetamine use were observed across all TLFB measures (Figure 2). For 7-day use (grams), mean use decreased from 3.20 (95% CI 2.38-4.02) grams at baseline to 1.31 (95% CI 0.19-2.43) grams at the final visit (P=.004; ES=0.50), with reductions maintained at 1-month follow-up (1.39 grams; 95% CI 0.23-2.54; P=.008; ES=0.48). A similar pattern was observed for days of use in the past 7 days, with mean use decreasing from 5.44 (95% CI 4.80-6.09) days at baseline to 3.94 (95% CI 3.09-4.79) days at the final visit (P=.001; ES=0.63) and 3.76 (95% CI 2.89-4.63) days at follow-up (P<.001; ES=0.70).

Thirty-day methamphetamine use outcomes also demonstrated significant improvements from baseline to follow-up, both in total grams (mean 14.74, 95% CI 11.22-18.26 vs mean 5.40, 95% CI 0.41-10.39; P=.001; ES=0.60) and number of days used (mean 25.10, 95% CI 22.81-27.38 vs mean 15.93, 95% CI 12.69-19.18; P<.001; ES=1.18). Together, these findings indicate clinically meaningful reductions in methamphetamine use across multiple time frames, with moderate to large ESs, particularly for frequency of use.

To evaluate potential selective attrition, baseline characteristics were compared between treatment noncompleters (<10 sessions attended; n=31) and completers (≥10 sessions attended; n=30, with valid baseline data available for n=29). Minor sample size variations across measures reflect sporadic missing questionnaire responses (Supplementary Table S1 in Multimedia Appendix 1). Independent Mann-Whitney U tests indicated no statistically significant differences between the 2 groups regarding baseline methamphetamine use severity. Specifically, noncompleters and completers reported statistically equivalent frequencies of monthly methamphetamine use days (mean 25.81, SD 6.26 vs mean 24.17, SD 9.18 d, respectively; P=.68). Similarly, no significant difference was observed for the total volume of methamphetamine consumed within the past 30 days (mean 13.69, SD 11.19 grams for noncompleters vs mean 15.93, SD 19.81 grams for completers; P=.78). These findings confirm that initial substance use severity did not predict premature discontinuation or engagement barriers within the online intervention framework.

Figure 2. Changes in methamphetamine use over time based on timeline follow-back (TLFB) assessments. Estimated marginal means (95% CIs) for methamphetamine use (grams and days of use) are shown at baseline, final visit (postintervention), and the 1-month follow-up. Values were derived from linear mixed-effects models under an intention-to-treat framework. Pairwise comparisons were Bonferroni-adjusted.



Secondary Outcomes

Psychological outcomes improved significantly over time (Table 3). Generalized anxiety symptoms, as measured by the GAD-7, declined from a mean of 11.44 (SE 0.69) at baseline to 8.77 (SE 0.94) at follow-up (P=.005; ES=0.51). Depressive symptoms (PHQ-9) showed a significant reduction from baseline to the final visit (mean 14.03, SE 0.84 to mean 10.60, SE 1.12; P=.003; ES=0.45), although a partial rebound was observed at follow-up. Trauma symptoms (TSQ) improved significantly from baseline (mean 6.48, SE 0.34) to follow-up (mean 4.60, SE 0.48; P=.001; ES=0.73). Psychological flexibility, assessed using the AAQ-2, showed a gradual and significant improvement from baseline to follow-up (mean 31.59, SE 1.38 to mean 27.00, SE 1.49; P=.005; ES=0.44).

Other domains showed more modest or nonsignificant changes. Craving scores, as measured by the BSCS, did not decrease significantly after correction (P=.06; ES=0.38). Quality of life, assessed using the WHOQOL-BREF, did not improve significantly over time across any of the 4 domains, with small ESs observed (ES range=0.10-0.32).

Fidelity ratings indicated moderate to high adherence to the ACT model. ACT-consistent behavior scores across the 3 rated sessions were 24, 22, and 23, yielding a mean score of 23.0 (SD 1.0) out of a possible 36 points. ACT-inconsistent behavior scores were 9, 5, and 5, with a mean of 6.33 (SD 2.31), suggesting a relatively low frequency of ACT-inconsistent therapist behaviors.

Table 3. Changes in psychological and functional outcomes across the study timeline.[a]

Measure and timeline	Estimated marginal mean (SE)	Mean difference vs baseline (95% CI)	Overall P value	Bonferroni-adjusted pairwise P value	Effect size
AAQ-2[b]			.008		
Baseline (n=61)	31.59 (1.38)	—[c]		—	—
Final visit (n=30)	30.36 (1.46)	–1.23 (–4.49 to 2.02)		.78	0.12
Follow-up (n=28)	27.00 (1.49)	–4.59 (–7.94 to –1.25)		.005	0.44
GAD-7[d]			.01		
Baseline (n=61)	11.44 (0.69)	—		—	—
Final visit (n=30)	9.63 (0.91)	–1.81 (–3.88 to 0.26)		.049	0.34
Follow-up (n=28)	8.77 (0.94)	–2.67 (–4.80 to –0.55)		.005	0.51
PHQ-9[e]			.01		
Baseline (n=61)	14.03 (0.84)	—		—	—
Final visit (n=30)	10.60 (1.12)	–3.43 (–5.97 to –0.90)		.003	0.45
Follow-up (n=28)	12.11 (1.15)	–1.92 (–4.53 to 0.69)		.10	0.25

Measure and timeline	Estimated marginal mean (SE)	Mean difference vs baseline (95% CI)	Overall *P* value	Bonferroni-adjusted pairwise *P* value	Effect size
TSQ[f]			.001		
Baseline (n=61)	6.48 (0.34)	—		—	—
Final visit (n=30)	5.32 (0.46)	−1.16 (−2.29 to −0.03)		.04	0.45
Follow-up (n=28)	4.60 (0.48)	−1.88 (−3.04 to −0.71)		.001	0.73
SDS[g]			.07		
Baseline (n=59)	12.26 (0.47)	—		—	—
Final visit (n=28)	11.93 (0.63)	−0.33 (−1.79 to 1.12)		>.99	0.10
Follow-up (n=27)	10.76 (0.64)	−1.49 (−2.97 to −0.01)		.048	0.42
BSCS[h]			.09		
Baseline (n=59)	10.71 (0.98)	—		—	—
Final visit (n=29)	8.89 (1.39)	−1.83 (−5.45 to 1.80)		.51	0.26
Follow-up	7.09 (1.44)	−3.62 (−7.34 to 0.11)		.06	0.38
WHOQOL-BREF[i] (environmental)			.53		
Baseline (n=59)	39.83 (2.38)	—		—	—
Final visit (n=29)	42.34 (2.85)	+2.51 (−2.74 to 7.75)		.55	0.17
Follow-up (n=28)	41.62 (2.91)	+1.79 (−3.61 to 7.18)		.90	0.10
WHOQOL-BREF (physical health)			.22		
Baseline (n=59)	41.95 (1.41)	—		—	—
Final Visit (n=30)	44.55 (1.74)	+2.60 (−0.92 to 6.13)		.19	0.18
Follow-up (n=28)	42.58 (1.78)	+0.64 (−2.98 to 4.26)		>.99	0.06
WHOQOL-BREF (social relationships)			.29		
Baseline (n=59)	34.62 (3.24)	—		—	—
Final visit (n=30)	39.74 (4.11)	+5.12 (−3.68 to 13.93)		.37	0.24
Follow-up (n=28)	40.05 (4.21)	+5.43 (−3.61 to 14.47)		.35	0.21
WHOQOL-BREF (psychological)			.09		
Baseline (n=59)	44.70 (2.15)	—		—	—
Final visit (n=29)	48.77 (2.71)	+4.07 (−1.55 to 9.68)		.20	0.24
Follow-up (n=27)	49.94 (2.78)	+5.24 (−0.54 to 11.01)		.08	0.21

[a]Values are estimated marginal means (SE) derived from linear mixed-effects models. Mean differences are reported relative to baseline with 95% CIs. Pairwise *P* values are Bonferroni-adjusted. Effect sizes represent the standardized mean change relative to baseline and are reported as absolute values.
[b]AAQ-2: Acceptance and Action Questionnaire-2.
[c]Not applicable.
[d]GAD-7: Generalized Anxiety Disorder-7.
[e]PHQ-9: Patient Health Questionnaire-9.
[f]TSQ: Trauma Screening Questionnaire.
[g]SDS: Severity of Dependence Scale.
[h]BSCS: Brief Substance Craving Scale.
[i]WHOQOL-BREF: World Health Organization Quality of Life–Brief Version.

Participant Satisfaction and Perceived Benefits

Qualitative analysis of participant feedback identified four overarching themes related to satisfaction and perceived benefits of the intervention: (1) group-based support and shared experiences, (2) increased awareness and self-regulation of methamphetamine use, (3) acceptability of structure and delivery format, and (4) perceived gaps and suggestions for enhancement.

Theme 1: Group-Based Support and Shared Experience

Participants consistently reported high satisfaction with the intervention, with the group format emerging as the most salient and frequently endorsed benefit. The subthemes of emotional connection, normalization of experiences, and accountability were prominent across responses. Many participants described the group as reducing feelings of isolation and fostering a sense of belonging. As 1 participant noted, “Not feeling like I was alone…the group aspect and the check-ins…helped with accountability.” Participants emphasized that interacting with peers facing

similar challenges enhanced motivation and engagement, thereby positioning the group setting as a central mechanism supporting participation and retention.

Theme 2: Increased Awareness and Self-Regulation of Substance Use

A second major theme reflected an increased awareness of methamphetamine use patterns and the development of new strategies for self-regulation. Participants described becoming more mindful of quantity and frequency of use, as well as being more intentional in their decision-making. This theme included subthemes of monitoring use, values-based reflection, and coping with cravings. One participant explained, "I'm much more aware of how much I use per day…I try not to go over what I was using." Mindfulness and grounding exercises were frequently identified as helpful tools for managing emotional distress and reducing impulsive use.

Theme 3: Acceptability of Structure and Delivery Format

The overall structure and duration of the intervention were perceived as acceptable and appropriate. Most participants described the session length and number of sessions as "just right" and compatible with their schedules. The online delivery format was generally viewed as convenient and accessible, particularly for individuals facing logistical barriers. The inclusion of women and nonbinary participants within the same group was frequently described as contributing to a safe, respectful, and relatable environment.

When reflecting on the CM component, several participants explicitly highlighted the positive role of the financial incentives and session-contingent compensation. Participants noted that the structure of the program (requiring attendance each week to receive the reinforcement) acted as a strong external motivator that facilitated adherence. As noted by 1 participant: "I like how you guys did that, like how you have to attend each week to get that money." For many, the financial reward provided concrete support and a sense of accountability—"didn't realize how much the money helped…it gives accountability," said another participant—while also being perceived as an empowering "bonus" for engaging in an intervention that was already inherently beneficial."

Theme 4: Perceived Gaps and Suggestions for Enhancement

Although few negative aspects were reported, participants identified areas for potential improvement. Subthemes included a desire for additional trauma-focused content, greater emphasis on emotional literacy, and discussions of other substances. A small number of participants expressed that they would have liked to engage more actively, but they reported interpersonal dynamics or technological barriers as limiting factors. These suggestions were framed constructively and reflected a desire for deeper engagement rather than dissatisfaction with the intervention.

Overall, most participants reported that their needs were met through participation in the program and did not identify additional unmet needs. Taken together, the qualitative findings support the acceptability of the intervention and highlight group-based processes, increased self-awareness, and structured delivery as key perceived benefits.

Discussion

Principal Findings

This pilot study aimed to evaluate the feasibility, acceptability, and preliminary clinical outcomes of a novel online, group-based ACT intervention integrated with CM, tailored specifically for women and gender-diverse individuals with MUD. Regarding our primary feasibility and acceptability objectives, the protocol demonstrated moderate completion rates, with 50 participants initiating the intervention and 30 completing the full protocol (≥10 sessions). Qualitative feedback strongly supported the acceptability of the treatment, highlighting the remote delivery format, structured session design, and the safety of the gender-responsive environment as crucial facilitators of engagement.

Consistent with our secondary hypotheses regarding preliminary clinical efficacy, participants demonstrated significant and sustained reductions in methamphetamine use across all TLFB measures at both the postintervention final visit and the 1-month follow-up. Furthermore, meaningful improvements were observed in several secondary psychological outcomes, including significant reductions in generalized anxiety, depression, and trauma-related symptoms, alongside a gradual enhancement in transdiagnostic psychological flexibility. However, when interpreting these positive clinical signals, it is critical to acknowledge a key methodological caveat highlighted during peer review. Individuals with lower baseline environmental quality-of-life scores were significantly more likely to discontinue participation. Therefore, the postintervention and follow-up findings must be interpreted with caution, as the completer sample may be inherently biased toward individuals with greater environmental stability and positive treatment alignment.

Engagement and retention patterns reflect both the challenges inherent in treating MUD and the potential of digitally delivered group-based psychosocial interventions. Retention rates observed in the present study are comparable to or slightly higher than those reported in other psychosocial treatments for stimulant use disorders, particularly in samples characterized by high psychiatric comorbidity and socioeconomic vulnerability [60,61]. Importantly, qualitative findings indicated high participant satisfaction; the group format, peer support, and accountability were consistently highlighted as key facilitators of engagement. These findings align with prior evidence that group-based interventions may enhance perceived support among individuals with substance use disorders, possibly contributing to retaining patients in treatment, as supported by studies [11,13].

Primary outcomes demonstrated significant and sustained reductions in methamphetamine use across multiple time frames, consistent with previous studies showing that psychosocial interventions emphasizing acceptance, mindfulness, and values-based action can reduce stimulant use [26,27,62,63]. Additionally, our results seem comparable to emerging pharmacotherapies, such as high-dose lisdexamfetamine [64]. Notably, recent literature emphasizes that nonabstinent reductions in stimulant use represent patient-important benefits and are associated with meaningful clinical improvements [65].

In our study, significant reductions in methamphetamine use occurred despite a nonsignificant decrease in craving severity (BSCS; P=.06). In traditional cognitive-behavioral models, ongoing craving is frequently positioned as a direct precursor to relapse. However, from an ACT perspective, this divergence is theoretically coherent and represents a fundamental marker of success: the primary aim is not the eradication of urges, but the reduction of experiential avoidance and the cultivation of psychological flexibility (AAQ-2), allowing participants to experience cravings without engaging in automatic, substance-seeking behaviors. This pattern echoes findings by Smout et al [62] and Glasner et al [63], who documented that mindfulness and acceptance-based approaches decouple the immediate relationship between internal distress or cravings and actual stimulant consumption. From an ACT perspective, this pattern is theoretically coherent because ACT does not primarily aim to eliminate craving but rather to alter individuals' relationships with internal experiences and promote values-consistent behavior in the presence of craving and distress [23]. In this sense, continued craving alongside reduced use may represent a clinically meaningful outcome and a marker of increased psychological flexibility rather than treatment failure.

Furthermore, the significant improvements in anxiety (GAD-7), depression (PHQ-9), and posttraumatic stress symptoms (TSQ) reinforce the role of ACT as an effective transdiagnostic intervention for individuals with complex trauma histories. Women with MUD frequently report histories of interpersonal violence, abuse, and psychiatric distress, which heavily drive substance use and relapse cycles. By organizing the protocol into structured modules (Open, Active, and Aware), this intervention aligns with trauma-informed care principles highlighted by Tompkins and Neale [30], providing a stable psychological framework to process emotional distress without resorting to chemical coping mechanisms. These findings are consistent with prior literature indicating that ACT may be particularly well-suited for individuals with co-occurring substance use and mental health conditions, including trauma exposure [25,28,30]. Improvements in psychological flexibility—a core ACT process—support the proposed mechanism of change and reinforce the transdiagnostic relevance of ACT for MUD, in which emotional avoidance and rigid behavioral patterns are common relapse risk factors [23,56].

Qualitative findings provide important contextual support for the quantitative outcomes and offer insight into potential mechanisms underlying engagement and change. Participants consistently emphasized the group-based format as central to their experience, highlighting normalization, shared understanding, and accountability. These processes closely map onto ACT mechanisms, including values clarification, present-moment awareness, and committed action within a relational context [23]. In this context, CM may have functioned as an engagement scaffold, reinforcing attendance and increasing repeated exposure to ACT processes within a supportive peer environment, which is consistent with prior evidence that CM enhances treatment engagement without undermining intrinsic motivation [49,66]. Increased awareness of substance use patterns and self-regulation strategies described by participants further suggest meaningful integration of mindfulness-based skills into daily behavior.

The predominance of women and inclusion of gender-diverse individuals underscore the importance of gender-responsive and gender-affirming approaches to MUD. Participants frequently described the women-focused group composition as fostering safety, relevance, and openness, particularly given high rates of trauma exposure and psychiatric comorbidity. These findings align with prior research indicating that interventions tailored to women's psychosocial contexts may enhance engagement and outcomes in substance use treatment [11,13]. Emerging evidence from other mental health conditions further suggests that gender-responsive interventions may yield enhanced acceptability and effectiveness, particularly when addressing trauma, relational factors, and caregiving responsibilities [8].

Therapist fidelity ratings indicated moderate adherence to core ACT processes, with relatively low levels of ACT-inconsistent behavior. Only 3 sessions were rated, reflecting a pragmatic sampling strategy commonly used in feasibility and early implementation studies to balance methodological rigor with resource constraints [47]. Fidelity scores were lower than those reported in some large-scale trials, which may reflect the early stage of implementation and potential challenges inherent to online group delivery. These findings underscore the importance of enhanced initial training, ongoing supervision, and systematic fidelity monitoring in future trials.

As part of the original study protocol, the integration of an adjunctive digital tool (the Chill Time app; Centre Axel, CIUSSS de l'Est-de-l'Île-de-Montréal) was planned but not implemented due to feasibility and logistical constraints. Documenting the nonimplementation of this planned component is important to inform future replication and scale-up efforts and aligns with open science principles [49,66].

Additional limitations include the single-arm design, as the absence of an active comparison condition prevents a definitive evaluation of the relative or synergistic contributions of ACT, CM, and their integrated combination. Further limitations involve the reliance on self-report measures for several outcomes, which may be subject to recall and social desirability biases despite corroboration with urinalysis, and a relatively short follow-up period that limits conclusions about longer-term maintenance of treatment effects. Furthermore,

the modest sample size and attrition over time restrict overall statistical power and generalizability. While substantial attrition in digital substance use trials often raises valid concerns regarding selection bias, several factors suggest this risk is minimized in the present study. Direct empirical comparisons confirmed that baseline substance use severity and clinical characteristics did not significantly differ between completers and noncompleters, suggesting a minimal risk of clinical selection bias. This statistical equivalence is further reinforced by our analytical approach; the use of linear mixed-effects models under an ITT framework mathematically mitigates the impact of missing data under a MAR assumption, thereby preserving the validity and stability of our longitudinal estimates. Nonetheless, the sample remains vulnerable to environmental attrition bias, as individuals with lower baseline environmental quality-of-life scores were significantly more likely to discontinue the study.

Conclusions

In conclusion, this pilot trial demonstrates that an online, integrated ACT+CM group protocol is both feasible and highly acceptable for women and gender-diverse individuals who are navigating severe MUD and complex psychiatric comorbidities. These findings offer a special contribution to digital public health. By demonstrating that comprehensive, trauma-informed psychosocial care can be safely and effectively scaled via digital videoconferencing platforms, this model bypasses traditional geographic, financial, and stigma-related barriers to treatment entry. Notably, online interventions are generally less costly to implement and highly desirable for reaching populations residing far from major urban centers, where specialized addiction services are often scarce. Furthermore, this digital delivery format facilitates the inclusion of individuals facing severe mobility constraints, transportation deficits, or demanding caregiving and work schedules; these limitations would otherwise severely restrict or entirely preclude their participation in traditional face-to-face, in-person interventions.

Moving forward, this protocol or its variants should be evaluated in multisite randomized controlled trials. Testing the intervention in larger trials allows for assessing its efficacy against standard care, measuring how well its effects hold up over the long term, and finding the right balance between individual and group delivery in digital spaces. Future trials should also directly compare the online translation of this protocol with its traditional in-person counterpart to evaluate potential differences in therapeutic alliance, session attendance, and the objective monitoring of withdrawal symptoms. Additionally, research is needed to determine how this digital framework operates across different demographic and clinical profiles. This includes examining whether younger cohorts require more immediate, tailored contingency reinforcement due to higher impulsivity, and how older populations navigate the demands of digital literacy to benefit from the reflective core of ACT. Finally, given that nearly the entire sample presented with severe substance dependence, exploring how varying levels of severity affect treatment outcomes will be very beneficial.

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Generative AI Use

The authors disclose that Gemini (Gemini 1.5 Pro model; Google) was used during the preparation of this manuscript solely for textual revision and grammatical correction. The AI tool was not used to generate, analyze, or interpret scientific data or to write any substantial content or the conclusions of the paper. The final manuscript was thoroughly reviewed, edited, and approved by the authors, who take full responsibility for the accuracy, integrity, and originality of its content.

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Data Availability

The datasets generated and analyzed during the current study are not publicly available due to ethical restrictions and confidentiality agreements designed to protect the privacy and sensitive information of the participants. However, the data can be made available to peer reviewers upon reasonable request, subject to compliance with ethical guidelines and institutional protocols. Requests for access should be directed to the corresponding author.

Authors' Contributions

ACR contributed to data collection, conducted the data analysis, and drafted the manuscript. PS cosupervised the research team during protocol implementation and contributed to study coordination and to the interpretation of the findings. TSH contributed to data collection, provided clinical support during the intervention, and contributed to data interpretation. YH supported protocol implementation and provided input on the clinical and methodological aspects of the intervention, as well as on data interpretation. CM, MM, and JR contributed to participant recruitment, clinical assessments, and data collection. SJ contributed to study setup and implementation. DC and BLF conceived the study, designed the protocol, and provided senior scientific oversight throughout the project.

All authors contributed to the critical revision of the manuscript and approved the final version for submission.

Conflicts of Interest

BLF has obtained funding from Indivior for a clinical trial sponsored by Indivior. BLF has in-kind donations of placebo edibles from Indiva. BLF has obtained industry funding from Canopy Growth Corporation (through research grants handled by the Centre for Addiction and Mental Health [CAMH] and the University of Toronto). He has participated in a session of a national advisory board meeting (Emerging Trends in buprenorphine extended-release) for Indivior Canada and is part of the steering board for a clinical trial for Indivior. He has been a consultant for Shionogi, Third Bridge, and Changemark. He is part of a scientific advisory board for NFL Biosciences. He received travel support to attend an event by Bioprojet. He is supported by CAMH, Waypoint Centre for Mental Health Care, a clinician-scientist award from the Department of Family and Community Medicine of the University of Toronto, and a Chair in Addiction Psychiatry from the Department of Psychiatry of the University of Toronto.

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Multimedia Appendix 1

Baseline comparisons of substance use, clinical, and quality of life characteristics between noncompleters and completers (Mann-Whitney *U* test).

[DOCX File (Microsoft Word File), 10 KB-Multimedia Appendix 1]

Checklist 1

iCHECK-DH reporting checklist.

[DOCX File (Microsoft Word File), 14 KB-Checklist 1]

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Abbreviations

AAQ-2: Acceptance and Action Questionnaire-2
ACT: acceptance and commitment therapy
ACT-FM: Acceptance and Commitment Therapy Fidelity Measure
BSCS: Brief Substance Craving Scale
CAMH: Centre for Addiction and Mental Health
CM: contingency management
***DSM-5*:** *Diagnostic and Statistical Manual of Mental Disorders* (Fifth Edition)
EMM: estimated marginal mean
ES: effect size
GAD-7: Generalized Anxiety Disorder-7
iCHECK-DH: Guidelines and Checklist for the Reporting on Digital Health Implementations
ITT: intention-to-treat
MAR: missing at random
MI: motivational interviewing
MUD: methamphetamine use disorder
PHQ-9: Patient Health Questionnaire-9
PTSD: posttraumatic stress disorder
SCID-5: Structured Clinical Interview for *DSM-5*
SDS: Severity of Dependence Scale
TLFB: timeline follow-back
TSQ: Trauma Screening Questionnaire
WHOQOL-BREF: World Health Organization Quality of Life–Brief Version

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