

Research Article

Online Self-Directed Cognitive Behavioural Therapy for Anxiety in Pregnancy and Postpartum: Quantitative Findings of a Randomized Controlled Trial

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Abstract

In Canada, approximately 368, 928 babies were born during 2024-25. The perinatal period, spanning pregnancy to 12 months following childbirth, encompasses some of life's most substantial changes and transitions (e.g., physiological, emotional, social, familial) and involves prominent medical, psychological, sociocultural, and economic resources and impacts. Challenges experienced during the perinatal period can lead to a worsening of mental health or development of a new onset of a mental health problem.

INTRODUCTION

In Canada, approximately 368, 928 babies were born during 2024-25 [1]. The perinatal period, spanning pregnancy to 12 months following childbirth, encompasses some of life's most substantial changes and transitions (e.g., physiological, emotional, social, familial) and involves prominent medical, psychological, sociocultural, and economic resources and impacts [2-4]. Challenges experienced during the perinatal period can lead to a worsening of mental health or development of a new onset of a mental health problem [5-7]. Though there may be many new joys to experience while pregnant and postpartum, there are also many new stressors and worries to consider. Some degree of worry concerning fetal development, one's health and safety as the pregnant or postpartum person, and the incredible task demands of raising an infant is common. When worry is excessive,

challenging to curb, impacting sleep, and interfering with day-to-day functioning, perinatal anxiety treatment may be needed [8]. Lack of timely intervention can lead to adverse outcomes on maternal, fetal or infant health [9], such as preeclampsia, preterm delivery, low birth weight of infant, as well as socio-emotional, cognitive, language and motor problems in infant, with negative impacts lasting years into childhood [10-12]. Further, untreated mental health problems in pregnancy are the strongest predictor of postpartum mental health challenges [13-15].

Emerging literature indicates that anxiety has become increasingly prevalent among the perinatal population worldwide. For example, in a meta-analysis by Dennis et al. [16], the prevalence of self-reported symptoms of anxiety during pregnancy was estimated to be 22.9% and 17.8% in the first month postpartum, decreasing to 15% afterward. Additionally, a Canadian study reported that the increasing

prevalence rate of perinatal anxiety is greater than that of perinatal depression, with rates being approximately 17.4% for anxiety and 6.5% for depression [17].

The prevalence of perinatal anxiety spiked from 29% pre-pandemic to 72% during the COVID-19 pandemic [18], which may be partly attributed to the heightened uncertainty and isolation which accompanied the pandemic [19].

Additional factors which exacerbated perinatal anxiety during the pandemic included fear of attending in-person health appointments, increased isolation, worries about risking one's own health or that of their infant, long wait times, lack of social support, and increased family stressors [20-22]. In addition to increased anxiety, many perinatal people also reported experiencing low mood and feelings of hopelessness associated with the uncertainty during the pandemic [18]. In line with other populations, anxiety and depression are highly comorbid in the perinatal period, where both anxiety and depression co-occur in approximately 9% of the global perinatal population [23]. High comorbidity of anxiety and depression increases the severity of presentation, enhancing the need for readily accessible and effective treatments [24].

There have been recent global, national, and provincial calls for accessible and effective mental health services to treat and reduce the whole-family-health impacts of mental health problems [25,26]. The Canadian Network for Mood and Anxiety Treatments (CANMAT), which involves a group of academics and clinicians, has outlined effective clinical practice guidelines for mood and anxiety disorders during the perinatal period, which suggest the use of psychological interventions for the treatment of mild to moderate symptoms of anxiety and depression [26]. One effective psychological treatment involves the use of cognitive-behavioural therapy (CBT), which has been evidenced as the gold-standard approach to treat mild to moderate levels of anxiety and depression within the perinatal population [27]. Despite this, mental health service access and use remain limited [28-30]. Further, for many who do seek perinatal mental health services, they may experience tremendous barriers, including long wait times, financial strain, lack of transportation and childcare, geographical barriers, and stigma [22,31,32]. One solution to mitigate barriers is the utilization of e-health programs, which offer a great potential to improve access to services and meet the service needs of this underserved population group [33].

The rapid shift from traditional face-to-face service delivery to e-health programs during the COVID-19 pandemic transformed access, as digital services opened

alternative to seek support safely during lockdowns [34]. Indeed, the rise of digital services is posited as one of the silver linings of the pandemic, continues to be offered present-day, and is often a preferred form of service delivery for many perinatal people [35,36]. Findings investigating the efficacy of e-health programs for perinatal mental health have shown promising results, including reduced anxiety and depression, and improved coping mechanisms [37-40]. Particularly, the flexibility offered by e-health programs, such as online CBT, increases accessibility for parents of newborns, as these interventions are accessible from home at any time of day [41-43]. Given the increasing acceptability of e-health programs for perinatal mental health problems across the globe, this study sought to provide rigorous randomized controlled trial findings of a self-directed six-session CBT e-health intervention for anxiety in pregnancy and postpartum during the COVID-19 pandemic [44,45].

MATERIALS & METHODS

Participants

People were eligible for the present study if they were: 1) over 18 years of age, 2) currently pregnant or had given birth within the past 12 months, 3) experiencing subclinical or clinical levels of anxious and/or depressive symptoms, 4) current residents of [blinded for review], 5) could communicate in English, and 6) had Internet access. Participants with existing psychological treatment plans and/or stable medication regimes at the time of recruitment were eligible to participate. Participants were ineligible if they 1) met clinical criteria for current substance use disorder, schizophrenia, or bipolar disorder, and/or 2) endorsed current and active suicidal ideations during screening.

Participants were recruited through community organizations, hospital clinics, university psychology services, social media, and mainstream media. Participants were screened for eligibility through a virtual screening interview and a clinical symptom interview (Mini International Neuropsychiatric Interview [MINI]; Adult Standard MINI 7.0.2; [46]. Eligible participants were considered enrolled in the study once they completed their baseline questionnaire ($N = 95$). The number of women within the intervention ($n = 48$) and waitlist ($n = 47$) conditions was approximately equal. The minimum sample size was 50 participants per condition ($N = 100$) after accounting for attrition ($\alpha = .05$, power = .80). Our attrition rate was approximately 39% and was similar across the program and waitlist conditions (35.4% and 42.6%, respectively).

Table 1 indicates the demographic and psychosocial characteristics of the total sample and by condition. On average, participants were 32.40 years old ($SD = 4.21$) and were predominately in the postpartum period ($n = 67, 70.5\%$). All participants identified as female. Of the participants who reported their ethnicity ($n = 85$),

most identified as being of European descent ($n = 69, 81.2\%$). Most participants were married at the time of study participation ($n = 77, 81.1\%$) or in a common law relationship ($n = 17, 17.9\%$). The majority of participants had graduated from a college, trade school, or university program (undergraduate or graduate; $n = 82, 86.3\%$).

Table 1: Demographic and Psychosocial Characteristics across Conditions at Baseline (T1)

Characteristics	Total sample (N = 95)	Program condition (n = 48)	Waitlist condition (n = 47)	χ^2/t	df	p	Effect size
Age, $M(SD)$	32.40 (4.21)	32.52 (4.59)	32.28 (3.83)	0.27	92	0.786	0.06
Perinatal status, $n(\%)$				0.15	1	0.701	0.04
Pregnant	28 (29.5)	15 (31.3)	13 (27.7)				
Postpartum	67 (70.5)	33 (68.8)	34 (72.3)				
First child, $n(\%)$	61 (64.2)	30 (62.5)	31 (66.0)				
Ethnicity $n(\%)^a$				0	1	0.958	0.01
European origins	69 (81.2)	35 (81.4)	34 (81.0)				
Another ethnicity	16 (18.8)	8 (18.6)	8 (19.0)				
Relationship status, $n(\%)^a$				0.65	1	0.421	0.08
Married	77 (81.9)	37 (77.1)	40 (85.1)				
Common law	17 (17.9)	10 (20.8)	7 (14.9)				
Highest level of education, $n(\%)^a$				0.73	1	0.393	0.09
High school or attended university, college, or trade school	13 (13.7)	8 (16.7)	5 (10.6)				
Graduated university, college, or trade school	82 (86.3)	40 (83.3)	42 (89.4)				
Occupation status, $n(\%)^a$				0.16	1	0.691	0.04
Maternity leave	67 (72.0%)	33 (68.8%)	34 (72.3%)				
Employed (full-time or part-time)	26 (28.0%)	14 (29.2%)	12 (25.5%)				
Lifespan mental health, $M(SD)$	2.60 (0.87)	2.67 (0.88)	2.53 (0.86)				
Lifespan physical health, $M(SD)$	3.68 (0.76)	3.75 (0.73)	3.62 (0.80)				
Previous anxiety or depression, $n(\%)$	83 (87.4)	44 (91.7)	39 (83.0)				
Previous psychotropic medication use, $n(\%)$	43 (45.3)	18 (37.5)	25 (53.2)				
Previous psychological treatment, $n(\%)$	76 (80.0)	40 (83.3)	36 (76.6)				
Current medication or psychological treatment use, $n(\%)$				0.01	1	0.924	0.01
Yes	44 (46.3)	22 (45.8)					
No	51 (53.7)	26 (54.2)					
Mental health diagnoses							
Any anxiety disorder	65 (68.4)	33 (68.8)	32 (69.6)				
Generalized anxiety disorder	26 (27.4)	13 (27.1)	13 (27.7)				
Illness anxiety disorder	10 (10.5)	7 (14.6)	3 (6.4)				
Current or lifetime panic disorder	27 (28.4)	15 (31.3)	12 (25.5)				
Social anxiety disorder	6 (6.3)	4 (8.3)	2 (4.3)				
Agoraphobia	18 (18.9)	9 (18.8)	9 (19.1)				
Specific phobia	8 (8.4)	4 (8.3)	4 (8.5)				
Subclinical anxiety symptoms	28 (29.5)	14 (29.2)	14 (29.8)				
Depression							
Past major depressive episode	62 (65.3)	33 (68.8)	29 (61.7)				
Current major depressive episode	16 (16.8)	8 (16.7)	29 (61.7)				
Obsessive compulsive disorder	8 (8.4)	6 (12.5)	2 (4.3)				
Posttraumatic stress disorder	8 (8.4)	6 (12.5)	2 (4.3)				
Weeks to complete program, $M(SD)$	6.54 (2.77)	6.40 (3.22)	6.71 (2.19)				
Outcome measures at baseline (T1), $M(SD)$							
Anxiety (PASS)	38.03 (14.81)	39.96 (13.56)	36.06 (15.89)				
Depression (EPDS)	12.03 (4.56)	12.48 (4.42)	11.57 (4.70)				
Psychological stress (K6)	9.41 (4.73)	9.58 (4.32)	9.23 (5.16)				
Perceived life stress (PSS)	20.53 (2.24)	20.58 (2.07)	20.47 (2.43)				
COVID-19 stress	64.23 (19.04)	68.54 (20.94)	59.83 (15.94)				
Antenatal attachment (MAAS) ^b	71.68 (9.75)	70.80 (11.63)	72.69 (7.36)				
Postnatal attachment (MPAS) ^c	73.65 (9.89)	72.87 (11.31)	74.38 (8.45)				
Maternal efficacy (MEQ) ^c	31.57 (4.83)	32.12 (3.90)	31.03 (5.60)				

Note. Data have been reported for responses options when $n > 5$. Valid percentages have been reported when data are missing. df = degrees of freedom.

^aResponse categories were collapsed to increase the power of our analysis.

^bOnly pregnant participants were asked to complete this item ($n = 28$).

^cOnly postpartum participants were asked to complete this item ($n = 67$).

Experimental Intervention

Overcoming Perinatal Anxiety [44,45], is a six-session cognitive behavioural therapy-based intervention targeting anxiety during the perinatal period. The existing OPA workbook (*Overcoming Anxiety in Pregnancy and Postpartum*) was adapted for an online program by clinical psychologists [blinded for review] and clinical psychology graduate students [blinded for review] on our team. The revised workbook included content around COVID-19 specific worries, as the e-health program was launched during the midst of the pandemic.

The online OPA program is completed on a self-guided basis, with unique content and practice sessions in each module (Table 2). Participants could access the online program on their smartphone, tablet, or laptop. A voice-over option and video content were created by team members to provide various learning modalities. Participants were asked to complete one OPA module per week. Participants who completed all six modules were classified as program completers ($n = 58$).

Procedure

The CONSORT diagram shown in Figure 1 illustrates the screening process, randomization, and participant retention throughout the study. Women who were interested in the study completed a virtual screening

interview with a designated research assistant to determine initial eligibility. Eligible participants who provided informed consent were scheduled to complete a clinical symptom interview with a trained member of the research team. The MINI assesses 17 of the most common mental health disorders, including a range of anxiety disorders [46]. Participants who endorsed anxious or

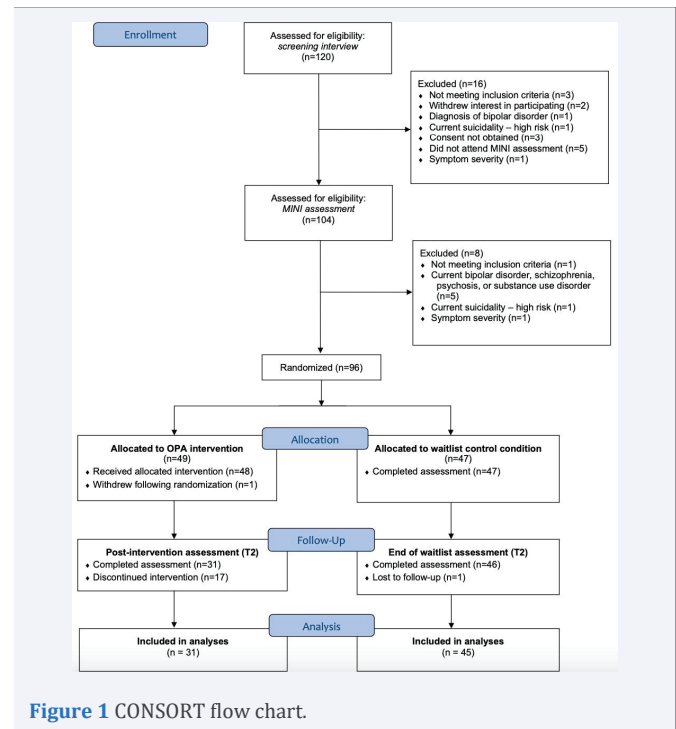


Figure 1 CONSORT flow chart.

Table 2: Overcoming Anxiety in Pregnancy and Postpartum Program Content

Module title	Brief description	Practice sessions
1. Psychoeducation	• Psychoeducation: anxiety, mood, and trauma- and stressor-related disorders that present in pregnancy and postpartum • Orientation to the anxiety cycle and CBT model	• Anxiety Cycle
2. Self-care	• Mom's Bill of Rights • Identifying needs • Managing expectations • Relaxation exercises	• What are Your Needs? • Managing Expectations
3. Setting goals and facing fears	• Avoidance • Checking and reassurance-seeking • Setting goals • Facing fears	• What are You Avoiding? • Goal Sheet • Steps to Reach my Goal
4. Nurturing development with baby/infant	• Relationship with baby during pregnancy and postpartum • Bonding with baby • Dealing with perfectionism • Encouraging bond between partner and baby	• How are You Connecting with Your Pregnancy? • How are You Connecting with Your Baby?
5. Coping with negative thoughts and worries	• Productive and unproductive worry • Problematic thinking patterns • Coping thoughts • Myth of the supermom	• Thought Diary • Recognizing Problematic Thinking Patterns • Myth of the Supermom • Designing Your Own Coping Thoughts
6. Looking forward	• Summary/review of material • Managing setbacks • Relapse prevention planning	• Coping Statements • Relapse Prevention Plan

depressive symptoms on the MINI were considered eligible for the present study, regardless of whether full diagnostic criteria were met. If participants endorsed active suicidal ideations or recent suicidal attempts during either of their screening interviews, the interviewer immediately consulted with a clinical psychologist on the team to ensure participant safety and to determine eligibility. All participants were provided with a list of alternative mental health resources and a \$15 Amazon e-gift card following their clinical symptom interview, regardless of eligibility.

Eligible participants ($n = 96$) were randomized into the intervention or six-week waitlist control condition. One participant withdrew from the study following randomization, leaving a total of 95 participants with baseline data. The research team were blinded to the randomization process and only viewed the participant's assigned condition after the clinical symptom interview. Participants were contacted via email by the research team to inform them of their condition, to administer the baseline questionnaire, and to provide them with a list of mental health resources. Participants randomized to the intervention condition were given access to OPA program once they completed their baseline questionnaire, while those in the waitlist condition waited six weeks to access the program. Waitlisted participants received a check-in email with a mental health resource list at week three. Throughout the study, participants in both conditions were sent a check-in email after 7 days of program inactivity.

Data were collected via online surveys in Qualtrics between April 30, 2021 to June 29, 2022. Participants completed these surveys at various time points in the study (Table 3), and received a \$10 Amazon e-gift card for each questionnaire battery completed. Ethics approval was obtained from the University of Manitoba Research Ethics Board (P2020:104, HS24437) and the Shared Health Research Impact Committee (SH2021-070). This study was pre-registered as a randomized controlled trial (ClinicalTrials.gov, identifier: NCT04844138).

Measures

Within the present study, participants were asked a series of questions about their sociodemographics. Our primary outcome measure was anxiety symptoms, which were measured using the Perinatal Anxiety Screening

Scale [47,48]. In regard to secondary outcomes, we evaluated participants' symptoms of depression using the Edinburgh Postnatal Depression Scale [49]. We also assessed participants' levels of psychological stress (Kessler Distress Scale 6-Item Version [K6]; [50], life stress (Perceived Stress Scale [PSS]; [51], and COVID-19-related stress (COVID-19 Stress Scales, [52]. To assess prenatal attachment among pregnant participants, we administered the Maternal Antenatal Attachment Scale [53-54], while postnatal attachment was evaluated among postpartum participants using the Maternal Postnatal Attachment Scale (MPAS; [55]. We also assessed maternal self-efficacy among postpartum participants using the Maternal Efficacy Questionnaire [56]. These measures were completed at T1 through T5. When assessing participants' symptoms of anxiety, our team developed a shortened version of the PASS from Somerville et al. [47], that was administered at the end of each program module to monitor symptoms of anxiety across each module. For a detailed description of each measure, please see Appendix A of the supplementary materials.

Data Analysis

Data were cleaned and analyzed using the Statistical Package for Social Sciences (SPSS) Version 29. Participants were categorized by condition and program completion status (program completer or non-completers). Outliers were not removed or transformed as they varied based on these groupings. Among program completers, missing data ranged from 0% to 3.7% across all outcome measures completed at baseline, post-module surveys, post-program, and follow-up.

Data were analyzed using a complete case analysis approach, such that only individuals who completed the program were considered within inferential analyses. This is common practice when less than 5% of cases are missing [43].

Descriptive statistics were calculated to characterize our sample's demographic and psychosocial functioning at baseline. Although participants were randomized to conditions, we explored potential differences between intervention and waitlist groups at T1 and T2 using chi squares analyses and independent and paired samples *t*-tests (Table 1). Demographic variables were collapsed as

Table 3: Data Collection Time Points

Condition	T1 (Week 1)		T2 (Week 6)	T3 (Week 10)	T4 (Week 12)	T5 (Week 16)
Intervention	Baseline	<i>Intervention</i>	Post-program	1-month follow-up	–	–
Waitlist	Baseline	<i>Waitlist period</i>	End of waitlist	<i>Intervention</i>	Post-program	1-month follow-up

Note. A subset of questionnaires was also administered at the end of each program module. Participants did not receive an honorarium for surveys completed at the end of each module. – indicates that no research activities or data collection took place.

needed to improve the power of the chi squares analyses. Following, paired-sample *t*-tests were conducted to compare pre-post program scores for program completers on all primary and secondary outcome measures. It was not possible to compare differences in antenatal attachment due to the limited number of pregnant participants who completed the program ($n = 11$). To more precisely estimate the effect of our treatment program on the intervention group relative to the waitlist condition, we conducted a series of ANCOVA analyses. Covariates were selected based on theory and our primary outcome variable, and included age, use of medication or therapy services during program participation, and baseline anxiety scores (T1). To assess outcome variables at follow-up, we computed within participant change scores and evaluated these scores descriptively. Residuals from some *t*-test analyses demonstrated evidence of non-normality; however, analyses based on nonparametric *t*-test alternatives (i.e., Mann-Whitney U, Wilcoxon Signed-rank) resulted in no substantive changes in conclusions, and parametric test results have been reported.

RESULTS

Demographic and Psychosocial Characteristics

Most participants were pregnant with or had given birth to their first child ($n = 61$, 64.2%) at the time of study involvement. Just under half of participants were currently using medication for their mental health or accessing psychological services ($n = 44$, 46.3%). Most participants met diagnostic criteria for at least one anxiety disorder ($n = 65$, 69.1%), while nearly one third of the sample endorsed sub-clinical symptoms of an anxiety disorder ($n = 28$, 29.5%).

Outcome measures at baseline are shown in Table 1. Participants' anxiety scores fell within the mild to moderate range ($M = 38.03$, $SD = 14.81$). Participants within the program and waitlist conditions possessed similar demographic and psychosocial characteristics. The difference in COVID-19 stress scores at baseline (T1) between women in the intervention ($M = 68.54$, $SD = 20.94$) and waitlist conditions ($M = 59.83$, $SD = 15.94$) was statistically significant, $t(87.71) = 2.29$, $p = .025$, $d = 0.47$, 95% CI [1.13, 16.29]; however, this difference may be due to chance given that participants were randomized to conditions. Additionally, we explored differences in outcome measures between intervention participants at baseline (T1) and waitlist participants at the end of the waitlist period (T2). Participants in the waitlist condition had significantly lower anxiety scores prior to beginning the program ($M = 33.07$, $SD = 17.38$) compared

to intervention participants ($M = 39.96$, $SD = 13.56$), $t(92) = 2.15$, $p = .034$, $d = 0.44$, 95% CI [0.52, 13.26]. We also assessed potential differences in outcome measures within the waitlist condition at baseline (T1) and the end of the waitlist period (T2). Participants in the waitlist condition reported experiencing significantly lower levels of anxiety at the end of the waitlist period ($M = 33.07$, $SD = 17.38$) than at baseline ($M = 36.43$, $SD = 15.85$), $t(45) = 2.13$, $p = .039$, $d = 0.31$, 95% CI [0.18, 6.56]. To account for these differences in baseline anxiety scores within and across conditions, we included this value as a covariate in our ANCOVA models.

Overall, 58 (61.1%) of participants completed the OPA program ($n = 31$ intervention participants, $n = 27$ waitlist participants). On average, participants completed the online program within 6.54 weeks ($SD = 2.77$), although this varied across participants from 2.43 to 18.43 weeks. See Uchechukwu et al. [32], (in preparation) for an exploration of the demographic and psychosocial differences between program completers and non-completers and factors associated with program completion.

Changes in Anxiety and Depression Scores by Module

Participants reported their anxiety (s-PASS) and depression (EPDS) symptoms across modules 1-5 (Figure 2 and Figure 3, respectively). Module 6 is not included as participants completed their post-program battery of questionnaires at the end of this module. Participants' mean anxiety scores ranged from 6.55 to 9.01 across modules. Participants' total depression scores averaged from 8.56 to 12.24 across modules. Participants reported the greatest reduction in both anxiety and depression symptoms after completion of module 2.

Pre-Post Intervention Comparisons

Paired-sample *t*-tests were conducted to investigate changes in outcome measures before and after program completion (Table 4), pooling these change scores from both conditions.

Following completion of the OPA online program, participants reported significantly lower symptoms of anxiety than pre-program ($M_{\text{change}} = -9.81$, $SE = 1.44$), $t(56) = -6.79$, $p < .001$, $d = -0.90$, 95% CI [-12.70, -6.91]. With regards to our secondary outcome variables, participants reported significantly lower symptoms of depression after completing the OPA intervention ($M_{\text{change}} = -2.72$, $SE = 0.61$), $t(57) = -4.44$, $p < .001$, $d = -0.58$, 95% CI [-3.95, -1.50]. Program completers also experienced significant reductions in psychological stress ($M_{\text{change}} = -1.60$, $SE = 0.44$), $t(57) = -3.68$, $p < .001$, $d = -0.48$, 95% CI [-2.48, -0.73]. Significant reductions in COVID-19 related stress

Table 4: Differences in Outcomes Pre- and Post-Intervention for Combined Program and Waitlist Participants

Outcome variable	Mean post-score (SD)	Mean pre-score (SD)	Mean difference (SE)	t	df	p	d	95% CI
Anxiety (PASS)	25.07 (13.52)	34.88 (15.05)	-9.81 (1.44)	6.79	56	< .001	0.90	[-12.70, -6.91]
Depression (EPDS)	8.10 (4.60)	10.83 (4.86)	-2.72 (0.61)	4.44	57	< .001	0.58	[-3.95, -1.50]
Psychological stress (K6)	6.67 (3.83)	8.28 (4.27)	-1.60 (0.44)	3.68	57	< .001	0.48	[-2.48, -0.73]
Perceived life stress (PSS)	19.84 (2.32)	20.38 (2.19)	-0.53 (0.35)	1.52	57	.135	0.20	[-1.24, 0.17]
COVID-19 stress	59.47 (19.07)	66.28 (20.62)	-6.81 (1.72)	3.95	57	< .001	0.52	[-10.26, -3.36]
Postnatal attachment (MPAS)	77.22 (7.16)	74.30 (9.79)	2.92 (0.86)	-3.38	43	.002	-0.51	[1.18, 4.65]
Maternal efficacy (MEQ)	33.64 (2.81)	31.20 (3.72)	2.44 (0.47)	-5.25	44	<.001	-0.78	[1.51, 3.38]

Note: Pre-intervention scores include responses on T1 measures from the program condition and T2 measures for the waitlist condition. Post-intervention scores include responses from T2 for the program condition and T4 for the waitlist condition. df = degrees of freedom. d = Cohen's d. CI = confidence interval.

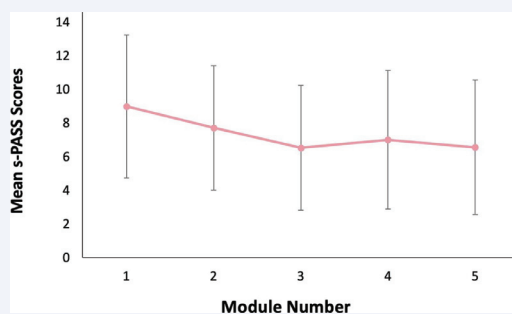


Figure 2 Changes in Anxiety Symptoms across Modules Pooling All Participants.

Note. s-PASS = shortened Perinatal Anxiety Screening Scale. Each data point contains between 57-80 participants as varying numbers of participants completed each module.

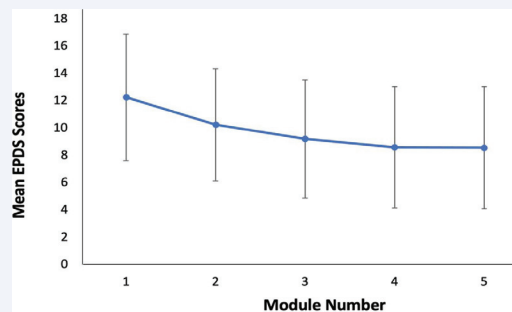


Figure 3 Changes in Depression Symptoms across Modules Pooling All Participants

Note. EPDS = Edinburgh Postnatal Depression Scale. Each data point contains between 57-80 participants as varying numbers of participants completed each module.

were also reported ($M_{\text{change}} = -6.81$, $SE = 1.72$), $t(57) = -3.95$, $p < .001$, $d = -0.52$, 95% CI [-10.26, -3.36]. In regard to postnatal attachment, postpartum participants endorsed significantly higher levels of attachment toward their infant following program completion ($M_{\text{change}} = 2.92$, $SE = 0.86$), $t(43) = 3.38$, $p = .002$, $d = 0.51$, 95% CI [1.18, 4.65].

Postpartum participants also reported significantly higher levels of maternal self-efficacy after completing the OPA program ($M_{\text{change}} = 2.44$, $SE = 0.47$), $t(44) = 5.25$, $p < .001$, $d = 0.78$, 95% CI [1.51, 3.38].

Intervention Effects on Outcome Variables: ANCOVA Analyses

A series of ANCOVA models were constructed to determine whether there were significant treatment effects on the primary and secondary outcome variables at T2 after adjusting for covariates (age, medication or psychological treatment, and baseline anxiety scores [T1]). Program participation had a significant effect on participants' anxiety symptoms after controlling for covariates, $F(1, 70) = 9.12$, $p = .004$, $\eta^2 p = .12$. Participants in the intervention condition had significantly lower PASS scores ($M_{\text{adjusted}} = 26.08$, $SE = 1.97$) relative to women in the waitlist condition ($M_{\text{adjusted}} = 33.74$, $SE = 1.59$; $M_{\text{difference adjusted}} = -7.66$, $SE = 2.54$).

Participation in the OPA program led to significant improvements in several secondary outcome variables. Program completion had a significant effect on depression symptoms after controlling for covariates, $F(1, 71) = 13.24$, $p < .001$, $\eta^2 p = .16$, leading to a reduction in EPDS scores among program participants ($M_{\text{difference adjusted}} = -3.65$, $SE = 1.00$). Additionally, a significant treatment effect was found on psychological stress (K6) when controlling for covariates, $F(1, 71) = 7.68$, $p = .007$, $\eta^2 p = .10$. Participants in the intervention condition had significantly lower adjusted mean scores on the K6 than women in the waitlist condition ($M_{\text{difference adjusted}} = -2.42$, $SE = 0.87$). For postpartum participants, program participation had a significant effect on maternal self-efficacy (MEQ) when controlling for covariates, $F(1, 55) = 9.29$, $p = .004$, $\eta^2 p = .15$, and led to improved MEQ scores for program participants ($M_{\text{difference adjusted}} = 2.92$, $SE = 0.96$). See Table 5 for an overview of all ANCOVA analyses.

One-Month Follow-up

Comparisons between outcome variables measured at one month follow-up and post-program completion are shown in Table 6. Reductions in anxiety scores ($M_{\text{difference}} = -3.82$, $SE = 1.29$), depression scores ($M_{\text{difference}} = -0.91$, $SE = 0.49$), psychological distress scores ($M_{\text{difference}} = -1.33$, $SE = 2.87$), perceived life stress ($M_{\text{difference}} =$

Table 5: Treatment Effects on Primary and Secondary Outcome Variables: ANCOVA Findings

Outcome variables	Program (n = 45)		Waitlist (n = 30)		Mean difference (standard error)	ANCOVA	
	Adjusted mean	SE	Adjusted mean	SE		F (df, df)	p
Anxiety (PASS)	26.08	1.97	33.74	1.59	-7.66 (2.54)	9.12 (1, 70)	0.004
Depression (EPDS)	7.76	0.78	11.41	0.64	-3.65 (1.00)	13.24 (1, 71)	<.001
Psychological stress (K6)	6.35	0.68	8.77	0.55	-2.42 (0.87)	7.68 (1, 71)	0.007
Perceived life stress (PSS)	20.16	0.4	20.75	0.33	-0.59 (0.52)	1.26 (1, 71)	0.266
COVID-19 stress	63.31	3.56	62.51	2.91	-0.80 (4.60)	0.30 (1, 71)	0.863
Postnatal attachment (MPAS)	78.49	1.77	75.1	1.42	3.39 (2.23)	2.31 (1, 54)	0.135
Maternal efficacy (MEQ)	33.87	0.76	30.96	0.6	2.92 (0.96)	9.29 (1, 55)	0.004

Note: Analysis of treatment effects for each outcome measure based on ANCOVA models including each outcome variable at T2 and controlling for participant age, use of psychotropic medication or therapy during study participation, and baseline (T1) anxiety scores as measured by the PASS.

Table 6: Changes in Outcome Variables between Program Completion and One Month Follow-Up

Outcome variable	Mean follow-up score (SD)	Mean post-program score (SD)	Mean difference (SE)	t	df	p	d	95% CI
Anxiety (PASS)	21.67 (13.16)	25.49 (13.52)	-3.82 (1.29)	-2.96	54	.005	-0.40	[-6.41, -1.23]
Depression (EPDS)	7.32 (4.56)	8.23 (4.54)	-0.91 (0.49)	-1.87	56	.067	-0.25	[-1.88, 0.06]
Psychological stress (K6)	5.44 (3.91)	6.77 (3.79)	-1.33 (2.87)	-3.51	56	<.001	-0.47	[-2.09, -0.57]
Perceived life stress (PSS)	19.51 (2.50)	19.91 (2.28)	-0.40 (0.38)	-1.07	56	.288	-0.14	[-1.16, 0.35]
COVID-19 stress	55.39 (17.50)	59.79 (19.07)	-4.40 (1.90)	-2.32	56	.024	-0.31	[-8.21, -0.60]
Postnatal attachment (MPAS)	78.14 (7.50)	77.35 (7.15)	0.80 (0.59)	1.36	45	.182	0.20	[-0.39, 1.98]
Maternal efficacy (MEQ)	33.62 (3.00)	33.49 (2.87)	0.13 (0.32)	0.42	44	.678	0.06	[-0.51, 0.78]

Note: Post-program scores include responses from T2 for the intervention condition and T4 for the waitlist condition. One-month follow-up scores include responses from T3 for the intervention condition and T5 for the waitlist condition. CI = confidence interval.

-0.40, $SE = 0.38$), and COVID-19 stress ($M_{\text{difference}} = -4.40$, $SE = 1.90$) were maintained and, interestingly, continued to decrease at follow-up. Gains in postnatal attachment ($M_{\text{difference}} = 0.80$, $SE = 0.59$) and maternal self-efficacy ($M_{\text{difference}} = 0.13$, $SE = 0.32$) were maintained at follow-up.

DISCUSSION

The primary aim of this study was to evaluate the efficacy of a six-session self-directed CBT e-health program, Overcoming Perinatal Anxiety [44,45], on participants' level of anxiety before and after completing the program. We also aimed to examine the effects of program completion on perinatal participants' symptoms of depression, psychological distress, life stress, COVID-19-related stress, self-efficacy, and levels of attachment to infant. Since participants were randomized to intervention or waitlist conditions, the study also aimed to compare group differences across the listed variables. Our findings highlighted a significant reduction in anxiety, depression, psychological distress, life stress, and COVID-19-related distress in participants across both conditions following program completion. Symptom reduction was maintained and continued to decline at one-month follow-up.

Participants also indicated increased levels of attachment toward their infant and improved maternal self-efficacy immediately after completing the program, and this was maintained at one-month follow-up.

Additionally, our study found a significant positive effect on maternal self-efficacy after controlling for factors such as maternal age, anxiety at baseline, and participants' use of medication or psychological services. As such, our study provides evidence supporting the efficacy of the six-session self-directed CBT e-health program, OPA. Our results are consistent with the growing body of literature investigating the effectiveness of e-health interventions, including *Mamma-Mi* [57], *WazzUp Mama?! [58]*, and *MUMentum Pregnancy [59]*, programs, which have significantly reduced symptoms of depression, anxiety, and distress among perinatal women.

In our sample, participants in the intervention group reported significantly lower anxiety, depression, and psychological stress, relative to women in the waitlist condition, who waited six weeks before receiving the intervention, and these results were noted after controlling for age, medication or psychological treatment, and baseline anxiety scores. This is not surprising, as long waitlists typically result in increased worries for individuals awaiting mental health care [60]. However, not all individuals respond similarly to being waitlisted. For example, in a separate qualitative study, perinatal women who were waitlisted in this study varied in their reactions, with some indicating feelings of disappointment, some reporting excitement about being accepted to receive the program, and a few noting a sense of relief, as the wait allowed them some time to prepare for the program and to focus on other competing demands in the interim [22].

This sense of relief among some participants may offer one explanation for the significantly lower levels of anxiety symptoms noted by those in the waitlist condition at the end of the waitlist period compared to baseline.

STRENGTHS, LIMITATIONS, AND FUTURE DIRECTIONS

The OPA program is one of the first few self-directed e-health interventions designed exclusively to target perinatal anxiety during the COVID-19 pandemic. In a meta-analysis exploring the availability of 16 remotely delivered treatments for anxiety in pregnancy, Evans et al. [61], reported that none of the interventions specifically targeted anxiety. Given that treatment for anxiety is often subsumed under broader interventions, particularly those that target depression and overall psychological well-being, the findings from this study uniquely contribute to the limited literature on treatment availability for perinatal anxiety. Additionally, this study was a randomized controlled trial and was sufficiently powered, factors which further added to the study's strengths. However, the study also had limitations, with the first being the lack of heterogeneity in the study sample. Research indicates that BIPOC communities are commonly underrepresented in research and are likely to report worsened mental health problems during the perinatal period compared to their White counterparts [62]. Future studies are also recommended to recruit a diverse sample that reflects the shifting demographic landscape of Canada. Second, given that one of the study's inclusion criteria was access to a stable Internet, this may have hindered participation from perinatal people residing in rural or remote communities who are more likely to lack access to a stable Internet connection.

Findings from this study extend beyond pandemic-related contexts and contribute to a broader understanding of the efficacy of self-directed e-health interventions. In addition to enabling the rapid delivery of mental health care and being comparable in their effectiveness to traditional face-to-face interventions [63-65], e-health interventions help mitigate logistical barriers and offer increased flexibility and anonymity, which help buffer against stigma and further enhance accessibility among the perinatal people [38,41]. However, one element that the self-guided online OPA program lacked was social connection [32]. Future studies may supplement informal supports, such as peer support, to mitigate this barrier. Peer support has been found to help facilitate knowledge sharing and foster a sense of community among women with similar lived experiences who may benefit from emotional and informational support [66-76].

CONCLUSION

Overall, our findings indicated that the self-directed online OPA program was efficacious in reducing perinatal anxiety, depression, perceived stress, as well as COVID-19-related stress. The program also helped to improve maternal self-efficacy and maternal attachment. The results of this study contribute to the limited literature on the treatments for perinatal anxiety, and demonstrated the efficacy of the online self-direct OPA program. Although this study was conducted and evaluated during the COVID-19 pandemic, its findings contribute meaningfully to the literature on the effectiveness of e-health interventions, lending support to them as a promising solution to the growing demand for mental health care.

ETHICAL APPROVAL

Ethics approval was obtained from the University of Manitoba Research Ethics Board, Fort Garry Campus (P2020:104, HS24437) and the Shared Health Research Impact Committee (SH2021-070).

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Data, Materials, and/or Code Availability

A de-identified copy of the datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Clinical Trial Identifier

This study has been registered as a randomized controlled trial NCT04844138.

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