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Are There Mental Health Benefits for Those Who Deliver Peer Support? A Mobile App Intervention for Adults with Type 1 Diabetes

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Abstract

Background/Objectives: Peer support offers a promising approach for improving psychosocial outcomes among adults with type 1 diabetes (T1D). However, research has focused largely on the recipients of peer support rather than the individuals who provide support. This pilot study investigates the impact of delivering support on diabetes distress and other secondary mental health outcomes (e.g., depressive symptoms, resilience, and perceived social support). **Methods:** This pre-post single-cohort study recruited 44 adults with T1D who underwent a six-hour Zoom-based peer supporter training program designed to equip them with support-related skills (asking open-ended questions, making reflections, expressing empathy). Of this group, 36 served as peer supporters for REACHOUT, a six-month mental health support intervention delivered via mobile app. Assessments were conducted at baseline and after six months and measured diabetes distress (Type 1 Diabetes Distress Scale), depressive symptomatology (Patient Health Questionnaire-8), resilience (Diabetes Strengths and Resilience Measure), and perceived social support. Unadjusted and adjusted linear mixed models were performed for each outcome measure of interest. **Results:** Peer supporters had a mean age of 41 ± 16 years, with a majority identifying as female (75%). At baseline, peer supporters had little to no diabetes distress (50%) and no to mild depressive symptomatology (72%). Mean scores at baseline for diabetes distress, depressive symptoms, resilience, and perceived social support were sustained at 6 months post-intervention. **Conclusions:** Among peer supporters whose diabetes distress scores start around the target range, ongoing maintenance of these levels may reflect a favorable outcome associated with delivering mental health support.

Keywords: digital interventions; peer support; diabetes distress; mental health; type 1 diabetes; adult



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1. Introduction

Approximately 42% of adults with type 1 diabetes (T1D) living in North America experience diabetes distress (DD), i.e., continuous worries, concerns, and fears in response

to the overwhelming demands of managing this chronic condition [1,2]. Not only is DD associated with worse clinical, behavioral, and healthcare utilization outcomes, but it is also linked to poor mental health outcomes such as a reduced quality of life [3–6].

Peer support interventions offer a low-cost solution to reduce distress by drawing on shared experiences, providing emotional encouragement, and reducing feelings of isolation [7,8]. Reviews of behavioral and psychosocial interventions for T1D emphasize the value of peer relationships in fostering emotional support to reduce diabetes-related distress [9–11]. For instance, a systematic review of 18 studies on young adults with T1D highlighted the instrumental role of peer support in addressing psychosocial needs, enhancing self-management behavior, and facilitating the transition to adult care [11]. Moreover, a recent randomized control trial involving 60 adults with T1D demonstrated that a peer-led storytelling intervention significantly reduced DD, burnout, and depressive symptoms, whereas no improvements were observed in the control group receiving routine care [12]. By fostering emotional support, peer support contributes to improved psychological well-being for individuals with T1D.

Communities that have limited access to care or are geographically restricted often face unique challenges when managing chronic diseases, like diabetes [13]. Rural and remote communities encounter obstacles (timing, location, resources) to obtaining traditional face-to-face support [9,14]. Thus, the shift towards digital platforms has increased access to the T1D population. Online diabetes peer support communities can foster a sense of normalcy, satisfy unmet psychosocial needs, and provide emotional validation and encouragement [15,16].

Digitally delivered peer support can be especially advantageous, as these models use online communication platforms and/or mobile apps to extend the reach of support and provide information “in real-time” [17,18]. A recent systematic review of nine digital peer support interventions for T1D reported improvements in DD and depressive symptoms in three and two studies, respectively [19]. However, only one study in this review recruited adults 26 years and older [19]. Clearly, more research investigating digital peer support models for adults with T1D is needed.

Peer support research has largely examined outcomes for individuals receiving support rather than those providing support (i.e., peer supporters). To our knowledge, only three studies have evaluated the health-related benefits of peer supporters among adults with diabetes [20–22]. In all studies, peer supporters had an average hemoglobin A1c (HbA1c) within the target range at baseline. Moreover, peer supporters were able to sustain their blood sugar levels in the short term (6–12 months) [20,22] and in the long term (2–4 years) [21,22]. Specifically, among 43 adults with type 2 diabetes (T2D), Afshar and colleagues found that peer supporters maintained distress scores and depressive symptoms post-intervention [20]. However, in a sample of 33 adults with T2D, improvements in depressive symptoms were observed [22]. Finally, among 87 adults with T2D, Garner and colleagues found that quality of life and general well-being scores remained stable while perceived diabetes self-efficacy increased [21]. While promising, existing studies have focused exclusively on adults with T2D. Thus, these questions warrant examination in the T1D population.

REACHOUT is a mobile app intervention that provides peer-led mental health support to adults with T1D living in rural and remote communities in British Columbia (BC), Canada. It offers multiple support delivery modalities, including one-on-one support delivered by a self-selected peer supporter and group support via text and/or virtual face-to-face support. Given that peer supporter outcomes are under-investigated in the literature, this present study will complete a secondary analysis of the larger intervention [18]. The aim of this study is to investigate whether delivering six months of mental health support

is associated with changes in diabetes distress and other secondary outcomes (depressive symptoms, resilience, perceived support).

2. Materials and Methods

2.1. Study Design

This pre–post single cohort pilot study was approved by the Behavioral Research Ethics Board at the University of British Columbia (H20-00267) and is part of a larger investigation (REACHOUT) that examines whether participation in a six-month peer-led digital mental health support intervention is associated with mental health improvements [18]. Based on the self-determination theory, REACHOUT supports the three basic needs for motivation to change: autonomy (control over their diabetes), relatedness (connection with others facing similar T1D-related challenges), and competence (mastery of diabetes-related tasks) [18,23]. The goal of the pilot study was to determine feasibility and acceptability among participants (i.e., individuals receiving peer support). Data from the present study examines pre–post changes for peer supporters (i.e., individuals who delivered the intervention).

Peer supporters were recruited between July 2020 and March 2022 from patient-run T1D support organizations, T1D-specific Facebook support groups and social media, and referrals by providers from Diabetes Education Centers in the Interior Health region of BC, Canada. Eligibility criteria were (1) having T1D, (2) being 18 years or older, (3) speaking English, (4) willingness to complete a 6 h training program, and (5) having access to the internet and/or a smartphone. Eligible individuals were invited to an online screening interview to assess baseline traits before attending the training program [18]. Those deemed eligible and screened successfully were enrolled in the training program and provided informed consent before participating.

2.2. REACHOUT Intervention Description and Training

Developed by Tang and colleagues and described in detail elsewhere, REACHOUT is a six-month peer-led mental health intervention delivered via a mobile app [13]. All peer supporters created their own profile consisting of a written and video segment. All profiles are housed in an e-library where participants can browse and select a peer supporter who fits their unique support needs. After a peer supporter was selected, the peer supporter was required to initiate weekly contact with the person(s) they are supporting and lead two mandatory exercises: (1) a values exercise to identify personal values and internal motivation for change and (2) an exercise to interpret and discuss the participant's DD profile to identify sources of distress. In addition to the one-on-one support delivered by the peer supporter, all study participants were also offered access to group support via a 24/7 chat room and video huddles. As part of their training, peer supporters were prohibited from answering medical or clinical questions. To monitor treatment fidelity, the research team followed up with peer supporters (and participants) after one month, three months, and five months. For those matched by a participant, treatment fidelity questions assessed the completion of the two mandatory exercises, frequency and method of contact with the participant, perceived usefulness of peer supporter training, the process of participant matching, and suggestions for improvement. Group support features were also assessed on the frequency of use of the 24/7 chat room and attendance at virtual huddles. If not matched by a participant, group support features were assessed at three months only. Peer supporters received a \$25 CAD and \$40 CAD Amazon e-gift card for completing the baseline and 6-month assessment, respectively.

The peer training program required eligible trainees to attend a 6 h training session conducted over Zoom [24]. The session was structured into three segments: (1) internal motivation, resilience, and empathy; (2) mindfulness, emotions, and diabetes distress;

and (3) active listening and deferring clinical questions to professionals. To evaluate performance, trainees were paired with a “standardized T1D participant” to complete a five-day practice trial. Following the five days, the standardized T1D participant rated trainees on eight competencies: (1) listen attentively without interrupting (eye contact, body language); (2) ask open-ended questions; (3) focus on feelings and emotions (provider validation, expressing empathy); (4) refrain from passing judgment or being judgmental; (5) sit with strong emotions (e.g., tears, sadness, anger); (6) avoid dispensing advice; (7) make an effort to relay back understanding of what the other person is communicating; and (8) defer medical or clinical questions to health professionals. To graduate successfully, peer supporter trainees needed to score at least 4 on a 5-point Likert scale across the eight competencies and were given three attempts to pass. Upon completion, trainees received a \$160 CAD Amazon e-gift card. A detailed evaluation of the peer supporter training program is reported elsewhere [24].

2.3. Outcomes and Measures

Data was collected from peer supporters at baseline and at six months post-intervention. The primary outcome was DD. Secondary outcomes included depressive symptoms, resilience, and perceived social support. Peer supporters who withdrew from this study after completing baseline assessments or did not complete the post-intervention assessments were considered dropouts. Sociodemographic variables were collected at baseline and included age (years), years living with T1D, sex, marital status, ethnicity, education, income, and employment.

Diabetes distress was measured by the T1D Diabetes Distress Scale (T1-DDS), a 28-item instrument that assesses total distress and seven distress subscales, including powerlessness, management distress, hypoglycemia distress, negative social perceptions distress, eating distress, physician distress, and friends/family distress [25]. Responses are scored on a 6-point Likert scale, from 1 = “not a problem” to 6 = “a very serious problem”. Scores are calculated by taking the mean of all items (total distress) or the specific items associated with each subscale, with scores < 2 reflecting little or no distress, between 2.0 and 2.9 reflecting moderate distress, and scores 3.0 and higher reflecting high distress.

Depressive symptoms were measured by the eight-item Patient Health Questionnaire (PHQ-8) [26]. The questionnaire contains eight questions where answers could be “not at all,” “several days,” “more than half the days,” or “nearly every day,” and scored from 0 to 3 respectively. The scores were summed to produce a total score between 0 and 24, with scores indicating no significant depression (0–4), mild depression (5–9), moderate depression (10–14), moderately severe depression (15–19), and severe depression (≥ 20) [26].

Resilience was measured by items adapted from the Diabetes Strengths and Resilience Measure (DSTAR) designed for young adults aged 18–22 (DSTAR-YA) [27]. Of the sixteen items from the original measure, we modified the wording of two items to better fit the adult population. Items were scored using a 5-point Likert scale, from 1 = “never” to 5 = “almost always”. For the total score, higher scores indicate having greater T1D-related strengths.

Perceived support was measured using items adapted from Tang and colleagues’ social support survey and assessed two support dimensions: the amount of support received and satisfaction with support across three sources of support: friends/family, the healthcare team, and T1D peers [28]. Responses to the amount of support received were scored on a 5-point Likert scale from “no support” to “a great deal of support,” and satisfaction was rated on a similar 5-point scale from “not at all satisfied” to “extremely satisfied.” Total scores for each support source were calculated by taking the mean of scores from each item.

2.4. Statistical Analysis

Descriptive analysis was performed on baseline sociodemographic variables using mean and standard deviation for continuous variables and frequencies and percentages for categorical variables. To examine potential differences in sociodemographic characteristics between study peer supporters and dropouts, Mann–Whitney U tests were applied for continuous variables and Fisher’s Exact Test for categorical variables.

Linear mixed-effects models (LMMs) were used to evaluate changes in the primary and secondary outcome variables from baseline to six months post-intervention. LMMs are used to account for correlated effects of the same peer supporter taking the survey over different time points. Each set had 13 independent LMMs for each outcome measure of interest. The unadjusted LMMs examined “pre/post” as the fixed effect and the peer supporter as the random effect. Random effects are the use of random intercepts to account for repeated data collection time points of the same peer supporter. Following unadjusted models, one set of independent LMMs adjusted for sex was conducted to control for potential confounding effects and to examine potential interactions. Previous research in the adult T1D community has found sex differences in mental health, with women experiencing higher severity and frequency of depressive symptoms and anxiety [29–31]. One psychological intervention for young adults resulted in reduced HbA1c and DD for women, but not men, with T1D, which prompted us to adjust for sex as a possible confounder [32]. The LMMs adjusted for sex examined “pre/post”, “sex”, and “pre/post and sex interaction” as fixed effects, with the peer supporter as the random effect. The pre/post effect analyzes the change in outcome as a result of the intervention, while the interaction effect assesses if sex had a differential effect on the pre/post change. The confidence level was set at 95%, whereby effects with $p < 0.05$ were considered statistically significant. Cohen’s d was reported to examine effect size. All analyses were conducted in R (version 4.4.2) and RStudio (version 2024.12.1.563) [33,34].

3. Results

3.1. Description of Peer Supporters’ Baseline Characteristics

Of the 51 peer supporters who graduated successfully from the 6 h training program, 44 completed baseline assessments (Figure 1). Of that group, eight dropouts (attrition rate = 18%) were due to shifting priorities and timing between peer supporter training and intervention start. Specifically, four peer supporters withdrew before onboarding to the REACHOUT app; two peer supporters withdrew during the intervention and were not matched; one peer supporter withdrew during the intervention and was matched; and one peer supporter was lost to follow-up and was unmatched. At post-intervention, 36 peer supporters completed final assessments.

Table 1 presents the sociodemographic characteristics of the 44 peer supporters who completed the baseline assessment. Peer supporters were largely female (75%) and White (80%); the average age was 41 years (± 16 years); the majority were never married, employed full-time, and reported a pre-tax household income of more than \$70,000 CAD. There were no significant differences in sociodemographic characteristics between study completers and dropouts.

We categorized diabetes distress (T1-DDS) and depressive symptomatology (PHQ-8) by severity level. Most peer supporters had little to no distress (50%) and no to mild depressive symptomatology (72%) at baseline. There were no statistical differences between study peer supporters and dropouts in the distribution of DD ($p = 0.93$) and depression severity ($p = 0.11$). For this pre/post analysis, data from the study peer supporters ($n = 36$) who completed both the baseline and post-intervention assessments were evaluated.



Figure 1. Flowchart for recruitment, training, and study milestone completion of peer supporters.

Table 1. Sociodemographic characteristics of peer supporters at baseline.

	Total (N = 44)	Study Peer Supporters (n = 36)	Dropouts (n = 8)	<i>p</i> -Value
Age, Years, Mean (SD)	41 (16)	40.9 (16.3)	41.9 (15.5)	<i>p</i> = 0.82
Years Living With T1D, Years, Mean (SD)	20.8 (15.8)	19.6 (15.5)	26.3 (16.9)	<i>p</i> = 0.19
Gender				<i>p</i> = 0.66
Female	33 (75%)	27 (72%)	7 (88%)	
Male	11 (25%)	10 (28%)	1 (13%)	
Marital Status				<i>p</i> = 0.62
Never married	22 (50%)	19 (53%)	3 (38%)	
Married/living together	28 (41%)	14 (39%)	4 (50%)	
Divorced/widowed	4 (9%)	3 (8%)	1 (13%)	

Table 1. Cont.

	Total (N = 44)	Study Peer Supporters (n = 36)	Dropouts (n = 8)	p-Value
Ethnicity				$p = 0.33$
White	35 (80%)	30 (83%)	5 (63%)	
Not White	9 (20%)	6 (17%)	3 (38%)	
Education				$p > 0.99$
High school graduate	5 (11%)	4 (11%)	1 (12%)	
College graduate	38 (86%)	32 (89%)	7 (88%)	
Income				$p = 0.67$
<\$70,000 CAD	14 (32%)	11 (31%)	3 (38%)	
>\$70,000 CAD	22 (50%)	19 (53%)	3 (38%)	
Decline to answer	8 (18%)	6 (17%)	2 (25%)	
Employment				$p = 0.52$
Full-time	19 (43%)	17 (47%)	2 (25%)	
Retired	10 (23%)	6 (17%)	4 (50%)	
Other	15 (34%)	13 (36%)	2 (25%)	
Matching				
Matched	-	20 (56%)	-	-
Unmatched	-	16 (44%)	-	-
Diabetes Distress Score				$p = 0.93$
Little or no distress	22 (50%)	18 (50%)	4 (50%)	
Moderate distress	18 (41%)	15 (42%)	3 (38%)	
High distress	4 (9%)	3 (8%)	1 (13%)	
PHQ8 Depression Severity				$p = 0.11$
None	18 (40%)	17 (47%)	1 (13%)	
Mild	14 (32%)	9 (25%)	5 (62%)	
Moderate	7 (16%)	8 (22%)	1 (13%)	
Moderately severe	5 (11%)	2 (6%)	1 (13%)	
Severe	0 (0%)	0	0	

3.2. Unadjusted Linear Mixed Models

The unadjusted LMM analysis of overall DD and its seven subscales showed no significant change from pre- to post-intervention. Similarly, no significant changes were detected in depressive symptoms, resilience, or perceived social support from friends and family, the healthcare team, or T1D peers.

3.3. Linear Mixed Models Adjusted for Sex

In this exploratory analysis, there were 10 males (28%) and 27 females (82%). When adjusted for sex, no significant pre–post changes were observed for the primary outcome and secondary outcomes (Table 2).

Figure 2 illustrates the pre–post model adjusted for sex. The pre–post and sex interaction effect was significant for the friends and family diabetes distress subscale ($p = 0.01$), suggesting that the intervention impacted males and females. Males showed a decrease in friends and family distress (mean difference = -0.5 , SD = 0.81 , 95% CI [-1.1 , 0.08], $p = 0.08$), while females exhibited a slight increase from pre- to post-intervention (mean difference = 0.30 , SD: 0.79 , 95% CI: [-0.2 , 0.6], $p = 0.07$). However, the within-group changes were not significant for either males or females.

Table 2. Changes in psychosocial outcomes from baseline to six months post-intervention using linear mixed models adjusted for sex.

Outcome	Baseline Mean (SD)	Post-Intervention Mean (SD)	Adjusted Pre/Post, Estimate (95% CI)		Cohen's d (95% CI)	Sex Fixed Effect, Estimate (95% CI)		Pre/Post and Sex Interaction Effect, Estimate (95% CI)	
Diabetes Distress Total	2.1 (0.7)	2.2 (0.7)	0.18 (−0.05, 0.41)	<i>p</i> = 0.15	Female −0.42 (−0.95, 0.16)	−0.00 (−0.06, 0.41)	<i>p</i> = 1.00	−0.10 (−0.56, 0.35)	<i>p</i> = 0.65
					Male −0.17 (−1.12, 0.78)				
DDS: Powerlessness	2.9 (1.1)	3.1 (1.1)	0.22 (−0.18, 0.63)	<i>p</i> = 0.29	Female −0.30 (−0.86, 0.26)	−0.15 (−0.96, 0.67)	<i>p</i> = 0.73	−0.14 (0.91, 0.63)	<i>p</i> = 0.72
					Male −0.11 (−1.00, 0.79)				
DDS: Management	1.8 (0.8)	2.0 (0.9)	0.10 (−0.21, 0.40)	<i>p</i> = 0.54	Female −0.17 (−0.73, 0.39)	−0.07 (0.71, 0.58)	<i>p</i> = 0.85	0.28 (−0.30, 0.86)	<i>p</i> = 0.35
					Male −0.67 (−1.57, 0.24)				
DDS: Hypoglycemia	2.4 (1.2)	2.2 (0.9)	−0.23 (−0.65, 0.19)	<i>p</i> = 0.29	Female 0.30 (−0.26, 0.86)	−0.22 (−1.00, 0.56)	<i>p</i> = 0.59	0.41 (−0.39, 1.20)	<i>p</i> = 0.32
					Male −0.23 (−1.13, 0.67)				
DDS: Negative Social Perception	1.8 (0.3)	1.8 (0.9)	0.16 (−0.05, 0.38)	<i>p</i> = 0.15	Female −0.41 (−0.97, 0.16)	0.50 (−0.14, 1.14)	<i>p</i> = 0.13	−0.36 (−0.78, 0.50)	<i>p</i> = 0.10
					Male 0.50, (−0.41, 1.41)				

Table 2. Cont.

Outcome	Baseline Mean (SD)	Post-Intervention Mean (SD)	Adjusted Pre/Post, Estimate (95% CI)		Cohen's d (95% CI)	Sex Fixed Effect, Estimate (95% CI)		Pre/Post and Sex Interaction Effect, Estimate (95% CI)	
DDS: Eating	2.2 (0.9)	2.6 (1.1)	0.40 (−0.4, 0.83)	<i>p</i> = 0.08	Female −0.50 (−1.06, 0.06) Male −0.38 (−1.27, 0.52)	−0.36 (−1.1, 0.38)	<i>p</i> = 0.35	−0.10 (−0.92, 0.73)	<i>p</i> = 0.82
DDS: Physician	1.7 (0.9)	2.0 (1.3)	0.35 (−0.11, 0.81)	<i>p</i> = 0.14	Female −0.42 (−1.00, 0.15) Male −0.57 (−1.52, 0.38)	−0.29 (−1.12, 0.55)	<i>p</i> = 0.51	0.12 (−0.77, 1.01)	<i>p</i> = 0.79
DDS: Friends and Family	1.8 (0.9)	1.8 (0.9)	0.30 (−0.01, 0.60)	<i>p</i> = 0.06	Female −0.53 (−1.09, 0.04) Male 0.89 (−0.03, 1.80)	0.53 (−0.11, 1.16)	<i>p</i> = 0.12	−0.80 (−1.38, −0.22)	<i>p</i> = 0.01
PHQ-8	6.1 (4.9)	6.3 (5.5)	0.76 (−0.47, 1.99)	<i>p</i> = 0.24	Female −0.34 (−0.92, 0.23) Male 0.54 (−0.37, 1.45)	−1.18 (−4.95, 2.59)	<i>p</i> = 0.55	−1.96 (−4.27, 0.35)	<i>p</i> = 0.11
DSTAR	66.8 (7.3)	66.6 (7.5)	−1.35 (−3.74, 1.04)	<i>p</i> = 0.28	Female 0.31 (−0.25, 0.87) Male −0.62 (−1.53, 0.29)	−0.01 (−5.37, 5.34)	<i>p</i> = 1.00	4.07 (−0.45, 8.60)	<i>p</i> = 0.09

Table 2. Cont.

Outcome	Baseline Mean (SD)	Post-Intervention Mean (SD)	Adjusted Pre/Post, Estimate (95% CI)		Cohen's d (95% CI)	Sex Fixed Effect, Estimate (95% CI)		Pre/Post and Sex Interaction Effect, Estimate (95% CI)	
Friends and Family Support	3.2 (1.1)	3.2 (1.1)	0.15 (−0.28, 0.59)	<i>p</i> = 0.49	Female −0.19 (−0.75, 0.37)	−0.06 (−0.85, 0.73)	<i>p</i> = 0.88	−0.20 (−1.03, 0.62)	<i>p</i> = 0.63
					Male 0.06 (−0.83, 0.96)				
Healthcare Support	2.8 (1.1)	2.8 (1.1)	0.04 (−0.45, 0.53)	<i>p</i> = 0.88	Female −0.04 (−0.61, 0.52)	−0.56 (−1.35, 0.24)	<i>p</i> = 0.18	0.18 (−0.78, 1.14)	<i>p</i> = 0.71
					Male −0.25 (−1.19, 0.70)				
T1D Peers Support	3.4 (1.1)	3.7 (1.2)	0.19 (−0.28, 0.65)	<i>p</i> = 0.44	Female −0.22 (−0.81, 0.35)	−0.37 (−1.23, 0.50)	<i>p</i> = 0.41	0.37 (−0.52, 1.26)	<i>p</i> = 0.43
					Male −0.67 (−1.63, 0.28)				

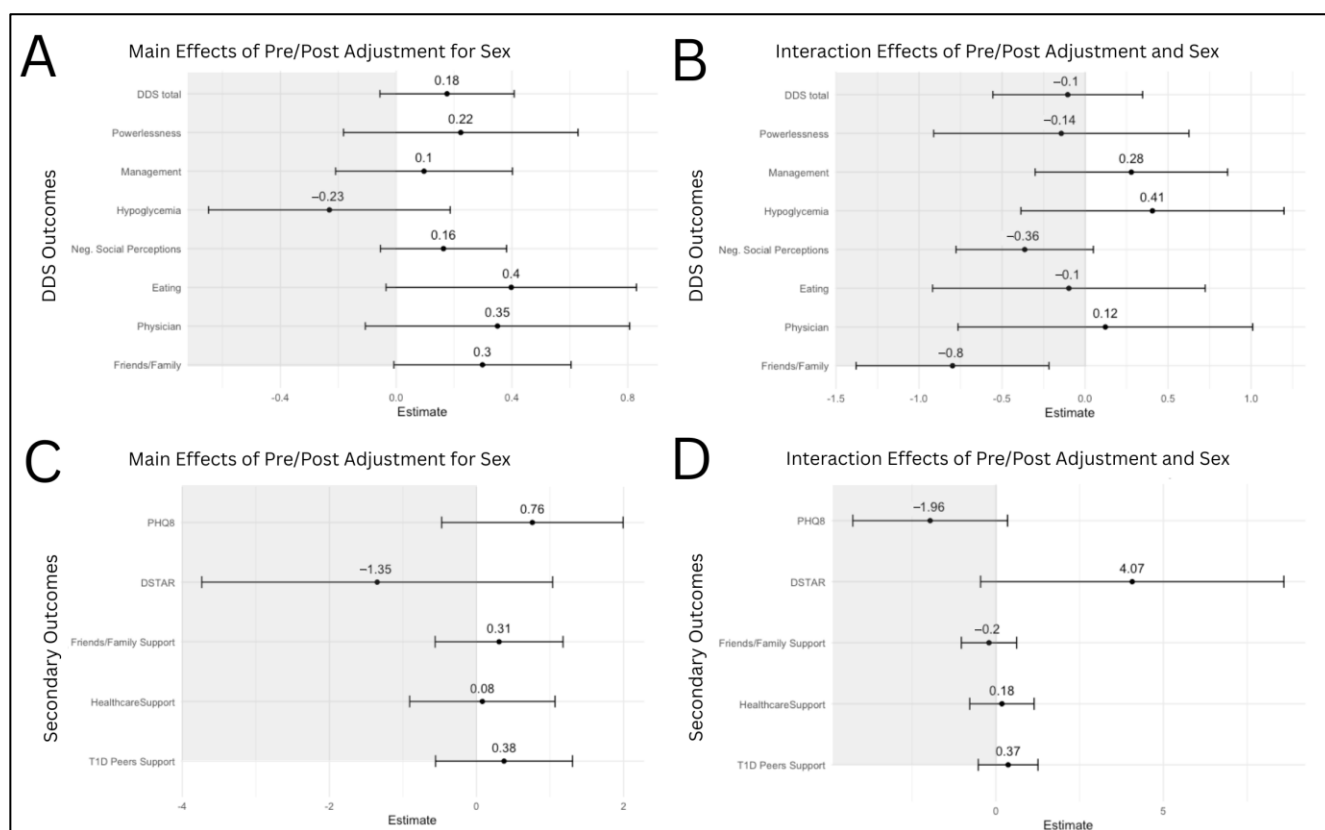


Figure 2. Visualization of effect sizes of intervention effects using linear mixed models adjusted for sex. Points represent estimated effects from linear mixed models, and horizontal bars indicate 85% confidence intervals. (A) effect sizes of the pre–post linear mixed models when adjusted for sex on diabetes distress total and the subscale outcomes; (B) interaction effect sizes of pre–post and sex on diabetes distress total and the subscale outcomes; (C) effect sizes of the pre–post linear mixed models when adjusted for sex on the secondary outcomes; (D) interaction effect sizes of pre–post and sex on the secondary outcomes.

4. Discussion

To our knowledge, this is the first study to examine whether delivering (versus receiving) mental health support is associated with improvements in DD and other psychosocial outcomes in adults with T1D. In this pre–post evaluation, baseline levels of overall DD and its subscales, which were at or close to target levels, were sustained at six months post-intervention. Furthermore, scores for depressive symptoms, resilience, and perceived social support also remained unchanged.

Our findings are consistent with a study investigating a telephone-based peer support intervention for adults with T2D [20]. Specifically, Afshar and colleagues found that peer supporters' diabetes distress levels and depressive symptoms were sustained from baseline to 12 months [20]. Alternatively, at 6 months post-intervention, peer supporters for a different T2D-specific telephone-based peer support intervention reported reductions in depressive symptoms [22]. Notably, in this intervention, peer supporters were trained to promote self-management efforts rather than provide mental health support [22]. Nevertheless, improvements in self-care behaviors combined with peer support likely produced positive mental health outcomes.

In REACHOUT, support was led by peer supporters as they underwent 6 h of training to develop the core skills needed to deliver one-way support to participants [24]. Alternatively, peer-to-peer reciprocal support invites a two-way flow of support. Heisler and colleagues conducted an RCT comparing reciprocal peer support to individual nurse-led

care [35]. Not only did participants in the reciprocal support arm report increased diabetes social support, but they also experienced greater reductions in HbA1c compared to those in the nurse-led condition [36]. In that study, peers were not assigned roles of “mentor and mentee” but rather gave and received support to one another. Furthermore, in group-based support interventions that promote more egalitarian conditions, adults with T1D reported lower diabetes distress scores post-intervention [36,37]. Possibly, REACHOUT’s structured support model did not afford peer supporters opportunities to seek support or address emotional concerns even if desired.

In the process of working with participants, peer supporters may have been reminded of their diabetes-related burdens. For example, a qualitative study of peer supporters in mental health recovery observed that those who experienced depressive symptoms in the past felt a re-emergence of feelings after engaging with support recipients who were severely depressed [38]. Future interventions should establish systems to assist peer supporters in managing any emotional byproduct resulting from their role as helpers.

While we detected a significant interaction between sex and pre- to post-intervention change, where males reported a slight decrease in friends and family distress while females reported a slight increase, interpretation of this finding is limited by the small number of males and large percentage of females in this sample. Consequently, this study is underpowered to draw firm conclusions regarding sex differences. Nonetheless, a similar sex-based pattern emerged for depressive symptoms and resilience. This trend with females experiencing a higher emotional burden in the peer supporter role compared to males is consistent with a qualitative study of nine key informants from global peer supporter studies for adults with T2D [39]. Specifically, Okoro and colleagues suggest that women’s high levels of empathy may lead them to provide social and emotional support more than any other form of support [39]. It has been found that female mentors in higher-power positions often perform more emotional labor than their male counterparts, due to both internal motivation and external expectation to provide emotional support and care [40]. In turn, female peer supporters in this study may have experienced the negative effects of emotional labor, either by internalizing the worries of the person they are supporting or by feeling pressured to offer consistent support [40]. Indeed, a fully powered trial is warranted to investigate whether sex and/or gender differences exist amongst those who deliver peer support.

At baseline, diabetes distress scores were at or close to the target range. Thus, there was limited space for peer supporters to lower distress levels even further [41]. In other words, low to no distress levels sustained over a six-month intervention should be considered a favorable outcome. In fact, according to Fisher and colleagues, if left untreated, individuals who start with low DD levels could experience worsening over time [42]. Therefore, the REACHOUT intervention may potentially have a protective effect. However, to better investigate the impact of REACHOUT on peer supporters, future studies should use a crossover design comparing active peer supporters to inactive peer supporters over a six-month period, with the latter assuming the peer supporter role after the delay. Finally, to gain a more in-depth understanding of how peer supporters may inadvertently receive support and mental health benefits while functioning in their role, qualitative approaches like focus groups and interviews should be conducted in parallel to the quantitative self-report measures [43].

This study has several limitations. First, our peer supporter cohort was small and largely female. Although this demographic profile is consistent with the sex breakdown in other diabetes peer support interventions [44,45], we were unable to perform meaningful subgroup analyses by sex. Secondly, multiple testing without applying a correction factor increased the risk for committing a Type 1 error. Third, the goal of the larger pilot trial was

to determine the feasibility and acceptability of REACHOUT from recipients of support, not peer supporters. Therefore, this study was not powered for detecting distress changes among peer supporters. Lastly, we utilized self-report measures, which are subject to social desirability bias [46].

5. Conclusions

While digitally delivered peer support interventions have been designed, generally, to improve outcomes for recipients of support, mounting evidence suggests that those who deliver peer support benefit as well. However, to optimize these models for peer supporters, future qualitative research should explore the unique experience and perspective of this group. Tailoring interventions to fit the distinct support needs of all parties involved is likely to enhance the impact they have on the T1D population at large.

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Abbreviations

The following abbreviations are used in this manuscript:

DD	Diabetes distress
DSTAR	Diabetes Strengths and Resilience Measure
DSTAR-YA	Diabetes Strengths and Resilience Measure for Young Adults
HbA1c	Hemoglobin A1c
LMM	Linear mixed-effects models
PHQ-8	Patient Health Questionnaire
T1D-DDS	T1D Diabetes Distress Scale
T1D	Type 1 diabetes
T2D	Type 2 diabetes

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