Tools for Tackling Type 1 (3T1): Evaluating an Intervention to Improve Diabetes Management and Mental Health Through a Family Self-Efficacy Intervention

by

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DISSERTATION ABSTRACT

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Doctor of Philosophy in Department of Counseling Psychology and Human Services

Title: Tools for Tackling Type 1 (3T1): Evaluating an Intervention to Improve Diabetes Management and Mental Health Through a Family Self-Efficacy Intervention

Type 1 diabetes (T1D) is a chronic metabolic disorder characterized by blood glucose (BG) dysregulation and insulin dependence. T1D often emerges in childhood, and those with T1D often require assistance from caregivers to manage BG. Even in adulthood, diabetics benefit from regular social and medical support. T1D affects the entire family, particularly caregivers, as without their BG management strategies T1D can be unmanageable.

Diabetes education, when made available to families with members with T1D, has historically been offered at diagnosis or during periods of crisis (e.g., after a hospitalization). This education often focuses on how to implement best practices for T1D management, such as proper nutrition and exercise, dosing insulin, and adequate monitoring and controlling out-of-range BG. In the current study, I applied a social cognitive lens to develop and then evaluate a novel intervention to increase diabetes self-management self-efficacy (DSMSE) for people with T1D and caregivers of people with T1D. I evaluated the study using a mixed-methods approach combining quantitative analyses of biomarker and psychosocial measures with an essentialist and semantic approach to qualitative analysis to learn about the experiences of being in the study.

Seven female participants (four with T1D and three caregivers) and five interventionists were recruited to participate in this pilot and were assessed on self-report measures of DSMSE, outcome expectations, diabetes distress, and stress-related biomarkers. Psychosocial and

biological measures provided descriptive information about participants' beliefs and stress levels during and after the six-week intervention. Written and transcribed verbal reports provided qualitative impressions of the study. Results showed that participants found the intervention acceptable, appropriate, and feasible. Interventionists reported the experience of facilitating Tools for Tackling T1D felt meaningful and recommended that the intervention focus on establishing structures to increase session coherence. Participants identified numerous T1D-related challenges, including perfectionism related to BG regulation. Recommendations for research and interventions include extending intervention timelines and building community to foster feelings of hope and normalcy. Implications for group programs for families with T1D are discussed.

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DEDICATION

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CHAPTER I

INTRODUCTION

Type 1 diabetes mellitus (T1D or T1DM), formerly known as "juvenile diabetes", is characterized as a chronic metabolic disorder caused by an acquired or innate inability to naturally produce the hormone insulin which regulates blood glucose levels (BG). Diabetes mellitus is one of the most prevalent chronic illnesses in the United States, as approximately 55 of every 10000 and 860 of every 10000 people have Type 1 and Type 2 diabetes, respectively (Bullard et al., 2018). Healthcare costs for these 23 million people constitute approximately two thirds of all healthcare costs, or roughly 18% of US gross domestic product (Ahn et al., 2013). These costs are often borne by those least able to weather them which is made worse by the fact that chronic illnesses do not remit, and the incidence of diabetes is on the rise, particularly in marginalized communities (Billimek & August, 2014). Despite the prevalence of the disease and decades of research, adherence to diabetes treatment remains a pervasive and multi-faceted problem that requires close examination to better understand and identify possible solutions. Furthermore, while adherence is often framed as a universal good by medical providers and educators, non-adherence is common but often experienced as a source of shame by families with T1D (Archer, 2014).

The aims of this dissertation research were to: (1) develop a pilot intervention to support caregiver and diabetic behavior related to BG management and psychosocial wellbeing; (2) to pilot the intervention with caregivers and diabetics; (3) investigate the feasibility, appropriateness, acceptability, and experiences of participants of this novel intervention; and (4) to assess its potential utility for enhancing diabetes self-management self-efficacy (DSMSE) and psychosocial wellbeing. In order to contextualize the complex health-maintenance behaviors

involved in BG regulation, I present relevant psychological dimensions involved in regulating BG including an overview of T1D, its prevalence, history, treatment, and means of understanding adherence uptake. After this review, I introduce a theoretical lens to frame how diabetes treatment adherence is developed and maintained followed by my study purpose, research questions, and research methods.

A literature review was conducted on March 15, 2024, using the PsycNet and PubMed databases using terms “type 1 diabetes”, “neurological”, “cognitive effects”, “social effects”, “biological effects”, “family intervention”, “adherence”, “perfectionism”, “self-efficacy”, and “outcome expectations”. Articles were screened for abstracts relevant to factors related to diabetes self-management self-efficacy (DSMSE). Additional literature searches were conducted using the PsycNet database on “Social cognitive theory” and “self-efficacy” to identify relevant background information around this dissertation's underlying theoretical foundations. Articles were excluded if they did not pertain to type 1 diabetes, health-related self-efficacy, or family-based interventions. Approximately 180 articles met these criteria and were further reviewed as background for this study and are referenced below as appropriate. I continued to monitor literature around interventions, Type 1 diabetes treatment, self-efficacy, and other topics of interest, such that I reference studies that were published after 2024.

Diabetes terminology

Diabetes is very common, but what to call those with the condition? As of this writing, a debate remains about the correct term used to describe someone with T1D (i.e., “person” vs. “patient,” and “having/with diabetes” vs. “diabetic”). In this paper I use the terms “diabetic” and “person with diabetes” interchangeably when referring to those with T1D. While some practice guidelines emphasize person-first language intended to not define people by their illness (see

Dickinson, 2017), other research has found that diabetics do not report distress at being called "diabetics" compared with "people with diabetes" (Ogden & Parkes, 2013).

Even as this paper focuses on Type 1 diabetes mellitus, it is important to frame T1D in the context of the much more prevalent Type 2 diabetes mellitus (T2D, or non-insulin-dependent diabetes). Much existing public knowledge about diabetes concerns T2D, meaning researchers, clinicians, and even diabetics can erroneously conflate the two. T2D represents approximately 91% of all cases of adult diabetes in the United States, making it significantly more common than T1D, at 5.6% (Xu et al., 2018). Estimates also show that T1D is historically more common in youths because T2D typically presents as a disease caused by damaged beta cells and insulin-receptor sites, rather than a lack of insulin-secreting beta cells brought on by a childhood autoimmune disorder (Dabelea et al., 2014). Autoimmune diseases most commonly manifest in childhood, likely because immune systems are still developing and error prone. Since T1D mostly develops in minors, it is often considered a disease that affects an entire family rather than an isolated individual illness, as children usually require supervision and support from one or multiple caregivers in managing T1D.

There are cases of adult-onset T1D. Thomas and colleagues (2018) estimated that up to 42% of new T1D cases arise from the larger adult population. Research has identified differences between childhood and adulthood T1D onset, as evidenced by different biomarkers, genetic markers, cell formation, and immune responses (Ilonen et al., 2019; Poudel et al., 2015; Sabbah et al., 2000). Despite possible differences, the treatments and recommendations for BG control are comparable. For reasons still under debate, rates of T1D and T2D are both rising, though rates of T2D are rising faster across all ages groups compared with T1D (Dabelea et al., 2014; Mayer-Davis et al., 2017; Menke et al., 2013; Xu et al., 2018).

Etiology of T1D

T1D is a disorder of BG regulation due to a lack of sufficient endogenous insulin. Insulin is a hormone normally secreted into the blood by beta cells in the islets of Langerhans in the pancreas. Insulin enables cells to uptake glucose for use as energy in cellular metabolism or to store for later use, particularly as glycogen in the liver (Van Belle et al., 2011). Without endogenous insulin production, musculoskeletal and adipose cells lose the ability to readily uptake glucose through the process of Insulin-Mediated Glucose Uptake (IMGU). Should these essential cells cease functioning correctly, severe impairment or death soon follows. Other cells do not require insulin to function, including neuronal, blood, and endothelial cells, as they absorb glucose through Non-Insulin-Mediated Glucose Uptake (NIMGU; Baron et al., 1988). While NIMGU can occur in muscle and adipose tissue, it is generally only observed during and after strenuous exercise and is largely unsustainable as a means of regular BG control.

Insulin-secreting cells are most often destroyed due to an autoimmune reaction whereby cytotoxic T-lymphocytes (or T-cells) identify these cells as pathogenic, leading to their destruction and eventual extinction (Notkins & Lernmark, 2001). Due to the lack of insulin and IMGU processes, glucose levels in the blood rise, leading to *hyperglycemia*. Lipids and proteins are then used in cellular metabolism instead of glucose (ketosis), releasing fatty acids into the circulatory system that are then oxidized as toxic ketone bodies by the liver. These ketones acidify the blood and cause osmotic diuresis, which can result in potentially fatal *diabetic ketoacidosis* (DKA; Eledrisi et al., 2006). Exogenous insulin, which is most often administered by injection into subcutaneous adipose tissue, can replace endogenous insulin to induce IMGU, lower BG levels, and prevent or limit the production of ketones. However, even with life-sustaining exogenous insulin, intermittent hyperglycemia can cause long-term health

complications, including kidney disease, heart failure, stroke, neuropathy, and blindness (Van Belle et al., 2011).

While insulin-therapy is the primary treatment for T1D, adhering to proscribed treatment is notoriously difficult. BG is affected by a multitude of factors, including diet, stress, hormone levels, physical exertion, and any other behaviors that affect cellular metabolism. Therefore, while adherence to treatment can be thought of as a unitary construct, it is more accurately viewed as a cluster of interrelated behaviors that share a common function.

Diabetic health markers

Since the introduction of insulin synthesized using recombinant DNA in the 1980s, diabetic life expectancy began to improve; insulin derived from modified bacterial cell cultures is vastly more effective than that derived from the mashed pancreases of farm animals like pigs (Hirsch et al., 2020). While the disease progression of T1D appeared to slow with insulin therapy, it was not clear whether microvascular disease (i.e., disease caused by damage to capillaries, particularly in the retinas, kidneys, cerebrum, and extremities), was inevitable. As glucose travels through the blood stream, it binds to or *glycates* hemoglobin proteins on red blood cells, impairing the function of hemoglobin to transmit oxygen. Glycated hemoglobin can increase blood viscosity and impair blood flow, while also increasing inflammation, blood vessel permeability, and plaque build-up (Saleh, 2015). Hemoglobin type A can be readily isolated in chromatography assays, and the subfraction hemoglobin-A-1-c (known as "HbA1c" or just "A1c") has become the most common glycoprotein to be isolated in blood tests to measure glycation, which serves as a proxy for average BG over the life of a red blood cell (about 3 months). Excessive glucose leads to microvascular disease due to the formation of toxic advanced glycation end-products, damage to capillary walls, and proliferative vascular genesis

(Barot et al., 2013). Finally, ketoacidosis can cause microvascular tissue and larger organ damage, a cause for concern since most diabetics will experience ketoacidosis, even if only at the time of diagnosis.

The Diabetes Control and Complications Trial (DCCT) was a landmark study designed to evaluate the effects of strict glycemic control compared with managed symptoms of hyperglycemia for people with T1D. Lasting from 1982-1993 and involving 1441 subjects, the DCCT found that keeping BG in range (and thereby keeping HbA1c levels below 7%), greatly reduced the risk of complications, and that close glycemic control was possible with appropriate monitoring and adherence to treatment (Nathan, 2014). Subsequent research identified that comorbidity with organ damage caused by microvascular injury was strongly and positively correlated with levels of glycated hemoglobin (Nathan, 2014). These findings are the basis on which HbA1c is still considered the gold standard marker of diabetes control.

Diabetes treatment

As recommendations for diabetes care became more standardized and professionalized, there were also a greater number of opportunities for empowerment among diabetics. To control BG, a regimen of diet, exercise, and insulin therapy requires close adherence, and in exchange, the risk of future illness is greatly reduced (Nathan, 2014). While diabetes education emphasizes proper treatment adherence, it does not routinely address the psychological challenges that adherence presents. Focus is usually placed on treatment components like regimented BG monitoring (Patton, 2015), limiting the frequency of hypoglycemia, and controlling HbA1c levels (Kizler et al., 2007). Adherence behaviors have been associated with improved metabolic outcomes (see meta-analysis by Hood et al., 2009). Among parents and caregivers, there is great concern and awareness that anything less than ‘perfect control’ (i.e., blood sugar levels similar to

those of non-diabetics) will result in adverse health outcomes, while among children and even older diabetics, adherence can be experienced as restrictive through seemingly artificial rules with vague consequences since microvascular disease can take decades to develop.

Adolescence is a particularly challenging time for treatment adherence. Some estimates find that only 21% of adolescent diabetics meet HbA1c target levels (Datye et al., 2015). There are a multitude of reasons why adherence during adolescence may be especially challenging, including hormonal changes in adolescents (which affect insulin metabolism), changes in communication styles between caregivers and children, changes in peer support, psychosocial distress, onset of maladaptive behaviors like disordered eating, difficulty integrating diabetes into a sense of self, and changes in interactions with medical providers (Datye et al., 2015; Pereira et al., 2011). Other research also suggests that, particularly for diabetics diagnosed before adolescence, reduced treatment adherence behaviors are met with commonly occurring regressions-to-the-mean phenomena whereby BG monitoring, appropriate dosing of insulin, and appropriate dieting drop off from the peak adherence seen in the first year after a diabetes diagnosis (Pereira et al., 2011).

Self-efficacy theory: A framework to understand treatment adherence

Diabetes treatment adherence is complicated and its component behaviors all bear thoughtful consideration of how they are initiated, maintained, and changed. One useful framework to conceptualize the ways in which learning occurs and shapes behavior is Albert Bandura's theory of self-efficacy, which describes how individuals can develop confidence and competence in a domain of behavior. Bandura describes the concept of *self-efficacy* (SE) as a domain-specific construct related to one's belief that one can accomplish certain tasks (Bandura, 1977; Bandura et al., 1999). Diabetes self-management self-efficacy (DSMSE) includes beliefs

about abilities to manage diabetes by acting on specific knowledge related to diabetes care. For example, a child with T1D may learn that testing blood glucose before eating results in a more accurate dosing of insulin, which in turn keeps BG in tighter glycemic control, which results in feeling better. In experiencing the rewards of a proper testing regimen, SE theory predicts that the child would gain greater confidence in their ability to engage in adherence behaviors and persist even in the face of future setbacks. A related construct is that of *outcome expectations*, which refers to beliefs that engaging in specific behaviors will result in a desired outcome. In the example above, the child develops positive outcome expectations that performing the testing will lead to feeling better and is therefore more likely to repeat those behaviors.

According to Bandura (1989), SE can arise from four primary sources, including direct performance experience, vicarious experience (i.e., witnessing someone else perform a task), verbal persuasion (i.e., being encouraged to do a particular task with a particular outcome as a goal), and physiological changes (i.e., physiological effects of performing a behavior reinforce or decrease likelihood of doing that behavior). Experiences that contribute to DSMSE differ for diabetics and their caregivers, as caregivers experience the effects of their management behaviors differently than the diabetics themselves. There is evidence that DSMSE is a viable and productive intervention target that can be used to reduce HbA1c and increase treatment adherence behaviors (Bassi et al., 2021; Biglar Chopoghlo et al., 2021; Iannotti et al., 2006). The SE framework is presented throughout this paper as a tool to identify ways in which DSMSE can explain phenomena related to biopsychosocial aspects of adherence behaviors that are relevant to treatment adherence interventions.

In the following sections, I summarize factors relevant to the intervention evaluated in this research. This review of biopsychosocial factors begins with a review of BG management

and factors affecting psychosocial wellbeing, followed by reviewing how DSMSE can be targeted through interventions, and concludes with presenting the specific research questions of this study to assess the utility of this pilot intervention for diabetic families. My literature review primarily focuses on early-life experiences rather than older adulthood due to the higher prevalence of onset of T1D among children and the comparative lack of research focusing exclusively on T1D among older adults.

Key Considerations for T1D Treatment Adherence

Factors influencing blood glucose

Treatment adherence for T1D is multimodal and expansive but as noted above, it principally concerns BG regulation. Diabetics are encouraged to closely monitor BG and the amount and nature of the food that they consume (Patton, 2015). Of principal concern is the consumption of carbohydrates, as carbohydrates are metabolized into simple sugars in the digestive tract beginning in the mouth and ending in conversion into glucose absorbed into the bloodstream in the small intestine. Other macro-nutrients (i.e., proteins which provide amino acids and fats which provide lipids) influence glucose metabolism too. Fats and proteins slow the absorption of carbohydrates, which can help BG regulation by prolonging the release of glucose into the bloodstream, causing fewer spikes in BG. Therefore, diabetics are encouraged to manage their consumption of other macronutrients and to time the uptake of glucose with metabolic needs, such as exercise (which will lower BG through both IMGU and NIMGU) or rest (during which time elevated or rising BG is typically undesirable). Most diabetics do not have an extensive knowledge of nutrition, digestion, or metabolism, but increased knowledge about carbohydrate absorption is essential in the development of DSMSE. Addressing potential gaps in

nutrition knowledge may offer greater likelihood of adhering to treatment adherent diets, which could improve long term HbA1c.

Sex differences and challenges of treatment adherence

There are many significant factors associated with treatment adherence that are outside the scope of mutable behaviors. On the axis of sex, females with diabetes have significantly worse long-term health outcomes compared with males, as evidenced by increased rates of cardiovascular disease, renal disease, and stroke (Huxley et al., 2015). These sex differences were observed in the standardized mortality ratios for 15,273 diabetics and may be due in part to increased incidence of tissue damage from DKA and disordered eating (Shah et al., 2018). Disordered eating deserves mention due to the significant association between T1D and eating disorders, particularly among adolescent and young adult diabetic women.

Carbohydrate and fat consumption are often stigmatized due to concerns that they lead to excessive adipose tissue, resulting in negative beliefs about eating foods rich in those nutrients (see Kemp et al., 2007). A meta-analysis by Dean et al. (2024) found that people with T1D show a significantly higher prevalence of disordered eating behaviors compared to controls, including engaging in excessive exercise, laxative use, and anorexia. There was a significantly higher prevalence of bulimia compared to the general population (risk ratio or RR = 2.80, $p = .02$). This was particularly worrying among women, who also displayed higher levels of insulin misuse (i.e., inducing hyperglycemia to force the body to engage in muscle and adipose tissue catabolism, breaking down of fat and muscle) compared with men (RR = 6.51, $p = .04$). Insulin misuse and omission combined with purposefully disordered eating to lose weight is known as “diabulimia”. This condition can lead to dramatic weight loss, as hyperglycemia not only causes excessive protein and lipid catabolism, but both excessive BG and the ketone bodies created as

byproducts induce nausea, which further reduces caloric intake. This condition is prevalent with incidence of up to 15% among diabetic adolescent females (see Hall et al., 2021, for a review of diabulimia). As such, interventions supporting female diabetics may be particularly critical given the sociocultural and psychological challenges that women tend to experience.

Unfortunately for the long-term health of diabetics, tightly managing food intake due to disordered eating patterns shares much in common with some of the monitoring required for proper diabetes care. Therefore, certain disordered eating behaviors and experience managing food and exercise to control metabolism may enhance SE for treatment adherence. In such cases, SE for managing distress tolerance and for engaging in healthy food intake may also be indicated to support long term healthy eating behaviors.

Parents and diabetic children: T1D through a social and family illness lens

T1D can be considered a family disorder given that T1D most frequently manifests during childhood and caregivers often become intimately involved in BG regulation, an intervention target that is often very difficult to hit and tends to create numerous new stressful tasks for caregivers. Even as they manage their own stress, caregivers serve an essential role in the development of DSMSE. Vicarious learning and social encouragement are key factors that contribute to self-efficacy (Bandura, 1986) and caregivers can provide these experiences to diabetic children or even young adults. As such, providing psychosocial support and diabetes education to caregivers is an essential component to the development of DSMSE within diabetics.

The impact of T1D on parents is colossal. Fornasini and colleagues (2020) conducted a systematic review of 29 studies (142 articles in total) that identified that parents of children with T1D struggle principally with managing their and their children's emotions after diagnosis,

developing new routines (e.g., checking BG, administering insulin), and becoming educators for their children and their communities. Kimbell et al. (2021) drew similar conclusions with a review of 14 studies of parents of children with T1D and found that T1D tended to "monopolize" parents' lives as they felt their children could die or experience significant hardship without adequate supervision and intervention. Kimbell and colleagues also found that connecting with other caregivers of diabetics and sympathetic healthcare professionals could relieve some psychological stress. These findings make sense in the context of the vast amount of work that caregivers (especially caregivers of young children) take on.

Lohan et al. (2015) presents a systemic review of six studies that found that interventions for caregivers of children with T1D targeted a range of behaviors in caregivers with some beneficial psychological and metabolic effects, including improving diabetic-parent cooperation, reducing child problem behaviors, improving parental behaviors like managing conflict, and reducing diabetes distress and burnout. These are but a few of the different issues that caregivers contend with as they learn to manage a child's BG. Caregivers' roles can be thought of as sharing part of a child's cognitive load by providing reminders and instructions about treatment adherence behaviors, such as reminders to check BG, eat, administer insulin appropriately, and to monitor their glycemic sense (i.e., internal sense of BG level). A study in Serbia found that parental engagement with monitoring behaviors was associated with age (with more involvement and better glycemic outcomes for diabetics ages 8-12) and did not vary with other sociodemographic factors (like gender or geographic location; Smudja et al., 2024).

Prior research also supports that parental, particularly paternal, involvement is associated with improved diabetes adherence (Berg et al., 2008; Ellis et al., 2007) as well as DSMSE among adolescents (King et al., 2014). Caregiver engagement, especially during critical periods (i.e.,

before age 12), is essential to diabetic health until brain maturation advances. Ceding autonomy to adolescents and emerging adults with diabetes is associated with better mental health outcomes for these diabetic youth (Tilden et al., 2024). Unsurprisingly, higher levels of support for primary caregivers (i.e., spousal support) have been associated with higher adherence and family treatment adherence self-efficacy (King et al., 2014; Lewandowski & Drotar, 2007). These studies are cross-sectional and rely on self-report data from families, but their claims are bolstered by demonstrable differences in HbA1c, which are not subject to reporter-desirability or other biases. In combination, these studies strongly support the association between support for parents and improved ability to assist diabetic children with T1D management and to develop DSMSE.

Parental involvement is important but there is evidence that targeted psychoeducation and solutions-focused interventions for parents alone are insufficient to improve diabetes outcomes (Fung et al., 2024). Monitoring behaviors and sharing cognitive load is typically stressful for caregivers as they manage functions of life that other children do not need assistance with, accompanied by worries of what will happen if diabetes treatment adherence is insufficient. The most effective attempts at glycemic control must therefore involve treatment for an entire family that accounts for varied stages of development and critical periods during which DSMSE can be expected to grow. Adherence behaviors, including monitoring food intake, exercise, exogenous insulin, stress, and sickness all require skills that develop over the course of neurological maturation. Adolescence is a time during which diabetes adherence tends to decline (see Borus & Laffel, 2010, for a review of factors contributing to adherence difficulties and interventions). Diabetics see a decrease in glycemic control that distinguishes adolescence from proximal developmental periods (Urakami, 2010). While Urakami (2010) was a limited cross-sectional

study, it bolsters the notion that diabetes needs to be attended to during critical periods, although the study did not disambiguate whether lower family support increases the diabetic's allostatic load that interferes with glycemic control, or whether adolescents do or do not continue to rely on family members for essential glycemic regulation (i.e., reminders to administer insulin).

There is not a linear association between parental involvement and diabetes adherence. Yeo and colleagues (2022) provide evidence that among adolescents with T1D, high levels of negative affect and low effortful control were both associated with worse adherence when in conjunction with high parental engagement. That is, for minors disinterested in controlling BG themselves or who have a more hostile emotional reaction towards authority, the opportunity to build DSMSE can be hindered and adherence is impaired. SE is not a static construct but rather dynamically changes across the lifespan and develops differently in conjunction with factors such as the two that Yeo et al. (2022) highlighted. As an example, parental diabetes management SE can be affected by factors like their personal relationships. Strong relationships with romantic partners can bolster both parental diabetes management SE and the necessary belief that a parent can bear the additional cognitive load of diabetes management for a child with T1D. Harrison et al. (2020) found that partner relationship maintenance behaviors (e.g., spending pleasant time together) was associated with less stress, and better child-parent bonds as well as reduced allostatic load and fewer biomarkers of stress among mothers, who tend to be the primary caregivers of children, particularly ones with chronic illnesses.

While all caregivers must balance initial dependence of children that gradually gives way to greater autonomy over time, the extended period for caregivers of children with chronic illnesses like T1D reflects the complicated nature of treatment adherence that requires caregiver supervision. Caregivers recognize that forces beyond their control could harm their children, but

when the force in question is a capricious disease that can bring severe, and at worst fatal consequences, many caregivers become consumed with worry. As noted by Kimbell and colleagues (2021), it is little wonder that a great source of caregiver relief comes from other caregivers and attentive healthcare professionals who can acknowledge caregiver struggle and normalize both feelings that no level of care will ever protect children from all the effects of T1D and that caregivers are doing their best. Interventions that emphasize supportive structures for caregivers, learning to balance autonomy with vigilance for caregivers and diabetics alike, and supporting the development of DSMSE appear more likely to improve mental and diabetic health outcomes. It is around these tenets that the current intervention was designed.

Stigma and social support

Social connection has been shown to be one of the most effective means to reduce distress among diabetics. Saylor et al. (2018) found that among US college students affiliated with a collegiate diabetes network, connection with social and student organizations was associated with less diabetes distress, while Razeghi et al. (2024) found that among Iranian people with T1D, social connectedness appeared negatively correlated with diabetes distress. While both studies' results may have been due to third variables, such as existing collectivistic behaviors that tend to promote well-being when nurtured with social connections, isolation is strongly associated with negative health outcomes across the lifespan (Akhter et al., 2016; Joensen et al., 2016a; Joensen et al., 2016b; Mellerio et al., 2015; Özbey et al., 2024). There are short-term effects of spending time with other diabetics in controlled settings such as "diabetes camps" (comparable to traditional summer camps but with a focus on diabetic well-being, treatment adherence, and diabetes education), including reductions in HbA1c and increases in diabetes knowledge according to a meta-analysis by Hasan et al. (2021). Most interventions such

as diabetes summer camps are short-term in nature and lack follow-up assessments, so it is unclear whether or for whom there are long-term benefits of participating in such programs. Learning from other diabetics about how to manage common situations can increase skill usage and adherence to treatment, and the combination of verbal persuasion and vicarious experiences may be particularly valuable in such settings for increasing DSMSE, as diabetics become exposed to differential and presumably high levels of BG control. However, social support is most often found through family members and friends who appear to understand the psychological and physical burdens that diabetes imposes, rather than exclusively among collectives of diabetics (Berg et al., 2008; Ellis et al., 2007; King et al., 2014; Mattacola, 2020).

Some studies have shown the beneficial effects of diabetes-specific peer support on adherence and well-being, particularly in minors; however, this effect appears moderated by the kinds of support offered (Mattacola, 2020). Even well-meaning peers can contribute to poor diabetes treatment adherence and reduced self-esteem by over-emphasizing differences due to illness. Children ostracized by peers may believe they are not good enough to participate in activities that their peers regularly engage in, or that participation risks bullying and threats or acts of violence. Mattacola (2020) conducted semi-structured interviews with T1D adolescents in England and found participants did not like diabetes-specific support, preferring instead uncomplicated social support that enhanced feelings of safety and normality.

For young diabetics, peers, agemates, and siblings are highly important with regards to diabetes adherence behaviors. This is of particular concern because many diabetes maintenance behaviors (e.g., eating sweet foods to treat hypoglycemia, insulin injections, and blood-droplet glucose tests) necessitate engaging with behaviors that tend to be stigmatized (i.e., sugar consumption, syringe use, and drawing blood). If exposure to these treatment adherent behaviors

provokes disdain or fear from peers, a diabetic child or even a diabetic adult is less likely to engage in those behaviors openly. A key element of the intervention studied for this dissertation is its group setting which was developed to create a space of mutual understanding and support that may allow participants, especially adolescents, to feel comfortable experiencing fears and learning that difficult situations are tolerable.

Mental health and psychopathology

Diabetes increases allostatic load by forcing diabetics and their family members to engage in monitoring and glycemic management behaviors, and this additional burden is taxing. Monitoring and management behaviors are considered preferable to non-adherence, as failure to engage in these activities can cause protracted sickness and even greater levels of stress. As such, mental health concerns, particularly internalizing disorders like anxiety and depression, are prevalent amongst diabetics and their family members. It is common for diabetics to feel hopeless or highly worried by the specter of glycemic dysregulation. Hope for change is low when BG levels fluctuate and impair or fully impede conventional functioning in daily life. Colloquial advice to manage depression and anxiety, such as "What doesn't kill you makes you stronger" or "Just try to distract yourself", are less palatable for diabetics stressed by the ways that T1D inevitably damages their bodies and requires regular attention. Other techniques, such as mindfulness and not focusing on experiences that elevate anxiety and depression, however, may be helpful in reducing allostatic load and distress.

Anxiety is especially common among diabetics. A review by Grigsby et al. (2002) found that 14% of diabetics met criteria for generalized anxiety disorder (GAD), while 40% showed elevated levels of anxiety, compared with general population rates of 6.2% for GAD and 34% for any anxiety disorder (Szuhany & Simon, 2022). Given that rates of anxiety have increased over

time (Javaid et al., 2023), it is likely that anxiety among diabetics has only increased alongside non-diabetic peers. Other studies, particularly in countries with more robust universal healthcare, have more mixed results about the relationship between T1D and anxiety. For example, a Norwegian study of 40 adolescents with T1D found no significant markers of mental health concerns compared with non-diabetic peers (Sivertsen et al., 2014).

Depression is also very common, with estimates of clinical depression among diabetics ranging from 12-33%, although rates are higher among younger and female diabetics (Roy & Lloyd, 2012). Heightened allostatic load, poverty, and lack of DSMSE are associated with higher rates of depression and worse glycemic control (Hassan et al., 2006). Depression is associated with reduced drive, hopelessness, and despair, all of which can be induced by repeated difficulties with glycemic regulation, which in turn can increase symptoms of depression (Hassan et al., 2006; Moulton et al., 2015; Powers et al, 2017; Roy & Lloyd, 2012). While few studies specifically link T1D and depression pathogenesis, it is possible that the early onset of the disease increases rates of learned hopelessness and causes changes in the personalities of diabetics that increase the risk of depression later in life (e.g., by increasing sensitivity to threat and increased feelings of hopelessness due to having a chronic illness; Moulton et al., 2015). Additionally, some symptoms of depression, like lethargy and psychomotor retardation, resemble both hypo-and hyperglycemia, such that a diabetic may misattribute signs of BG to mood problems and vice versa or be socially reinforced to make such associations.

There is evidence that diabetic mental health is amenable to change. Zhao and colleagues (2019) conducted a meta-analysis of 17 randomized controlled trials examining the effects of psychological interventions on the caregivers of people with T1D and concluded that interventions significantly reduce levels of depression, distress, and reluctance to ask for social

support. Unlike other meta-analyses, there was no significant change in level of caregiver anxiety or caregiver confidence in diabetes management. Zhao and colleagues also noted that roughly one third of studies showed improvements for only 6 months post-intervention, suggesting that interventions that are short-term (as the interventions under review were between 5-12 sessions over 2-52 weeks) may suffer from short sleeper effects.

Developing self-efficacy to augment treatment adherence

Diabetes treatment adherence behaviors are strongly affected by an individual's cognitive and affective experience and can be usefully understood through the lens of Social Cognitive Theory (SCT; Bandura, 1977; Bandura, 1989; Bandura et al., 1999). Through SCT, Albert Bandura proposed that behaviors, cognitions, and the environment mutually influence each other in a triadic reciprocal manner. SE can be a productive focus for interventions to change behavior given that many deliberate behaviors, which include treatment adherence behaviors, first require a conscious desire to act and belief that one can act and achieve desired change. As mentioned above, Bandura proposed that SE, or the belief in one's ability to successfully perform a behavior or task in a particular domain, is affected by performance experience, vicarious experience, verbal persuasion, and physiological changes (Bandura, 1989). Applied to maintenance behaviors, SCT predicts that diabetics with higher DSMSE (i.e., stronger confidence in their ability to effectively engage in diabetes treatment adherence behaviors), will be more likely to enact behaviors for disease management, and more likely to persist in the face of challenges to enacting those behaviors. Indeed, there is strong support for the relationship between SE and adherence to treatment (e.g., Martos-Mendez, 2015; Roncoroni et al., 2019). The following is a review of different components of DSMSE.

In this context, performance experience refers to experiences carrying out adherence behaviors, like proper insulin administration, BG monitoring, dieting, exercising, or other behaviors. These behaviors can become easier with time, which would enhance DSMSE, while unsuccessful attempts at these behaviors would reduce DSMSE. That said, many important treatment behaviors like drawing insulin into a syringe or estimating the carbohydrates in a meal prior to eating become easier as learning occurs. Repeated success experiences lead to mastery and an increased likelihood of continuing the behavior. The diabetic who for the thousandth time taps air bubbles in a syringe to the tip of the needle and then plunges them out with minimal loss of insulin has mastered this behavior and does it with ease compared with the diabetic who is handed a syringe for the first time. The former diabetic is therefore much more likely to do this behavior more often, accurately, and quickly due to experience and learning than the latter, who may be disinclined to attempt to remove air bubbles without supervision or assistance, and who therefore does the behavior less.

Physiological and affective feedback presents an important component to the development of DSMSE, as it represents the most immediate way that diabetics receive feedback about the utility and effectiveness of their adherence behaviors. The averse physiological effects of dysregulated BG are highly effective at eliciting change, with many diabetics feeling noticeably sickened with even slight changes in BG. Hypoglycemia tends to induce hunger, disorientation, mental confusion, shakiness and tingling in extremities, pallor in the face and extremities, and eventually blurry vision, muscle weakness, and slurred speech. Affective experiences include feelings of dread, anxiety, or even panic accompanying the physiological response as the body tries to conserve glucose by sending reserves to vital organs and reducing functioning in extremities (Cryer et al., 1994). A diabetic who administers too much insulin or

exercises too much is therefore likely to rapidly experience the consequences of these excesses and try to regulate BG soon with the consumption of carbohydrates, which itself is a treatment-adherent behavior. The negative reinforcement achieved by avoiding these consequences through management behaviors may contribute to DSMSE.

Considerable care is often paid in diabetes education curricula to warn against administering too much insulin in attempts to lower blood sugar more quickly. Instead, emphasis is placed on encouraging diabetics to patiently wait while their BG levels drop, since peak IMGU action from rapid-acting insulin does not occur for 1-3 hours (Inzucchi et al., 2005). According to SCT, the belief that one can successfully tolerate physiological and affective distress accompanying hyperglycemia should increase the likelihood of waiting instead of taking additional doses of insulin (Bandura, 1989), and strong DSMSE should be protective even in the face of failure (i.e., glycemic dysregulation).

The final sources of DSMSE derive from vicarious experiences and verbal persuasion, which can be especially essential for encouraging behaviors that themselves are not altogether pleasant. Vicarious experiences refer to the social learning that occurs when an individual witnesses another doing a behavior. In the case of diabetes, a diabetic might learn how to do a finger stick blood glucose check by first watching someone else set up a lancet, place it on the side of a finger pad, and activate the device before then doing it themselves. Likewise, watching others behave in a calm and relaxed manner when hypoglycemia or hyperglycemia persist models an emotional and behavioral response that encourages the diabetic to not overcorrect with too much glucose or insulin to treat the BG dysregulation. Verbal persuasion can take the form of instruction, encouragement, and commands, and is often particularly important during early phases of treatment adherence behavior development, before routines are adopted by the

diabetic. Instruction is pivotal given the highly technical nature of diabetes management, which includes use of glucometers, ketone meters, insulin pumps, CGM receivers, and other technology, as well as insulin administration, counting carbohydrates, and monitoring exercise, fatigue, hydration, glycemic sense, and other factors. Many families with T1D report initially feeling intimidated by the range of behaviors needed to adhere to diabetes management and are often advised to learn from a certified diabetes educator about proper procedures (see Burke et al., 2014 for a review of modern diabetes management and education).

Given that T1D treatment adherence typically involves caregivers, at least among diabetic minors, caregiver treatment adherence SE is essential for predicting and managing diabetic health. Until caregivers are no longer involved, their belief and confidence in their ability to affect diabetes outcomes affects opportunities for diabetics to develop mastery (e.g., being allowed to engage in diabetes management themselves when not under caregiver supervision), to receive instruction (e.g., being told how to manage blood glucose dysregulation), to experience vicarious learning (e.g., modeling how to treat hyperglycemia), and even affective experiences (e.g., developing associations between shame and glucose dysregulation induced by caregiver comments about the appropriateness of dysregulation). Caregiver DSMSE provides a relatively novel target for diabetes interventions (Lohan et al., 2015; Zhao et al., 2019) and can be expected to affect diabetic DSMSE as well.

DSMSE is relevant not only from the perspective of research scientists but also from the experiences of individuals with diabetes. Taraban et al. (2022) conducted semi-structured interviews of youth with T1D, from childhood through young adulthood and found that the majority worried about diabetes' impact on several domains, including SE. Many minors in the study reported concerns that T1D would limit their ability to live fully and that their ability to

manage diabetes was insufficient for the task. While Taraban and colleagues also identified common patterns of effective avoidance and change behaviors to manage these worries, the additional allostatic load and real threat of harm suggests that DSMSE may play a significant role in mediating stress that culminates in worry. Finally, the authors noted that proposed DSMSE and other intervention targets would benefit from social components to strengthen social networks and normalize diabetic stress. Jiang et al. (2019) concluded that, "self-efficacy-focused education would probably reduce A1c, enhance self-efficacy, regulate self-management behaviors, increase knowledge, and improve the QOL for patients with diabetes" (p. 67).

Iannotti et al. (2006) likewise found the DSMSE was associated with measures like glycemic control. In smaller studies, however, there has been greater variability, with Survonen et al. (2019) finding no significant association between SE and metabolic control. Another recent study based in Iran found significant effects of a mobile phone-based intervention that administered a self-care educational program on DSMSE among adolescents with T1D (Biglar Chopoghlo et al., 2021). While there is evidence that DSMSE is an appropriate target for an intervention to improve glycemic control, there is a wide range of variation in the data collected and many studies are characterized by homogenous, small samples, and variance in measurement, intervention structures and modalities (Jiang et al., 2019). There also appear to be differences in outcomes within samples. For example, in a trial by Grey and colleagues (2000), a group of diabetic youth who received both diabetes education and non-diabetes-specific coping skills training (i.e., general psychosocial coping skills) showed significant improvements in HbA1c and better diabetes and medical self-efficacy when compared with a control group receiving only diabetes education, but only female participants experienced significantly reduced weight gain and hypoglycemia (Grey et al., 2000). As such, research focused on interventions to

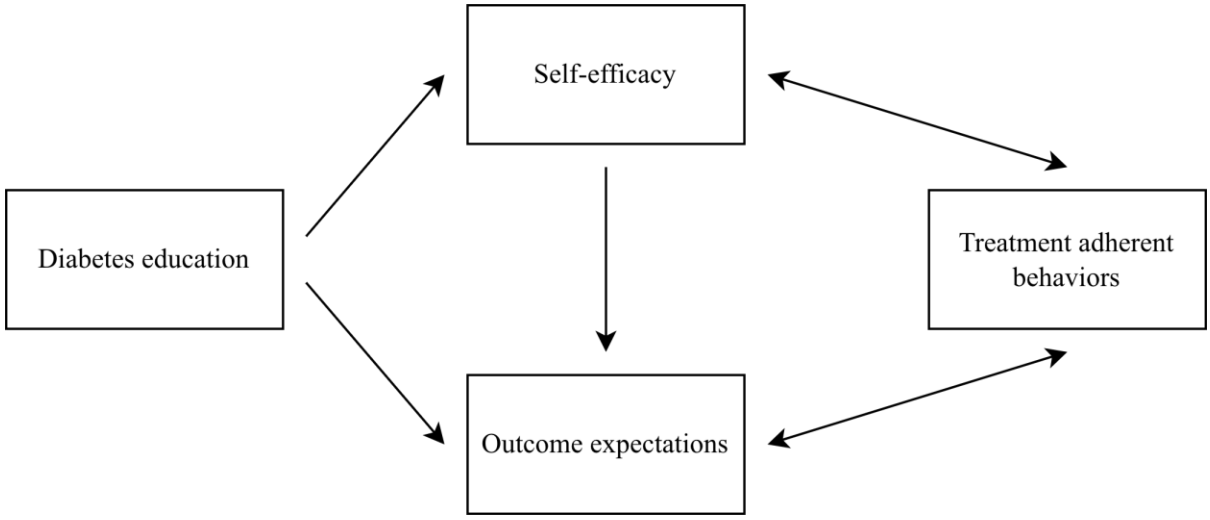
enhance DSMSE should provide sufficient detail regarding measurement, sample, and intervention components to contribute meaningfully to the literature.

Outcome expectations

Self-efficacy beliefs, or the expectation that one can successfully perform certain behaviors, are distinct from the related construct of outcome expectations (Bandura, 1989). Outcome expectations (OE) are beliefs about what will happen upon performance of certain behaviors. For example, an outcome expectation of physiological relief after enacting behaviors that bring BG back into a target range is predicted to support treatment adherence. See Figure 1 in Appendix A for a representation of the effects of SE and OE on behavior (adapted from Bandura, 1997).

Figure 1

Bandura's Triadic Reciprocity Model



There is substantial evidence supporting the influence of outcome expectations on an individual's goals in a specific domain, as well as how likely one is to take action to achieve desired outcomes in those domains, including health-maintenance and health-seeking behaviors

(Strecher et al., 1986; Vogel et al., 2005). The consequences of behavior influence SE and OE, such as when a diabetic is able to stay in glycemic target range after regularly administering insulin or consuming carbohydrates as appropriate. In such a case, feedback from the sense of glycemic well-being would be expected to elevate both DSMSE and OE for adherent behaviors. Interventions based on SCT that seek to improve treatment adherence should account for both SE and OE.

Summary of extant research

Diabetes treatment adherence is a challenging goal due to the vast array of factors needed for BG regulation within individuals without endogenous BG regulation. However, since its isolation in 1922, insulin therapy has turned T1D into a chronic and manageable condition. Diabetes makes life more stressful and complicated and poses significant risks to long term health and even mortality, especially during critical periods. Normative, non-diabetic development, therefore, must not be the goal. Good-enough adherence, ideally resulting in HbA1c values of less than 7% as set forth by the DCCT, should be acknowledged as adequate adherence that can support families with diabetes to build the DSMSE to engage and persist with treatment over a lifetime. Efforts to acknowledge and capture the complexities of diabetes management benefit from acknowledging how diabetic stressors interact with other stressors, such as beauty standards that overwhelmingly harm women and girls (e.g., contributors to diabulimia), poverty that limits access to treatment materials (e.g., CGM and insulin pump supplies), and racism that leads to worse health outcomes (Scott et al., 2017).

Interventions targeting DSMSE have been shown to be effective at reducing BG over time, as seen by reductions in glycated hemoglobin (Jiang et al., 2019; Grey et al., 2000; Nansel et al., 2007). Most interventions for greater adherence are targeted towards Type 2 diabetics

(e.g., Sturt et al., 2006). These interventions tend to be short-term (see Jiang et al., 2019 for a review of such studies), highly individualized or expensive (Nansel et al., 2007), and do not show consistent improvements over time (e.g., Wu et al., 2011), such that greater monitoring, more funding, and more research are needed to more fully understand the potential benefits of SE as an intervention target.

T1D is one of the most common childhood chronic illnesses and is inherently complex and hard to manage. Unsurprisingly, there have been dozens of diabetes-focused interventions developed for diabetics and their families. While comparatively few specifically target or measure DSMSE, SE is often at the heart of many interventions that focus on related constructs, like diabetes self-management. An intervention based in Philadelphia, PA, found that participation in a 1-week intervention was not associated with change in DSMSE or T1D quality of life (QoL; Charny, 2021), and its author suggested that brief interventions are not always effective for this target. Very short-term interventions are unlikely to have significant effects on DSMSE, given that SE requires exposure to experiences of mastery and success that can be difficult to acquire over the course of one week. Other studies of diabetes psychosocial interventions indicate that DSMSE as well as diabetes health OE are malleable and subject to change following interventions focused on education and support (see Zhao et al., 2019).

Purpose of the present study

The purpose of this study was to develop and pilot a novel group psychological intervention for people with Type 1 diabetes and caregivers of children with T1D with a focus on improving DSMSE for both groups. Separate intervention groups were developed for each type of participant (diabetic or caregiver). The pilot intervention was intended to accomplish the following: provide diabetes education to participants (e.g., topics like food and nutrition, effects of biological processes like stress on BG regulation, and best practices for treatment adherence); provide instruction in emotion regulation and coping skills; improve family dynamics for participants in diabetic families; and increase social connectedness and DSMSE and OE for diabetics and caregivers. Although not measured in this pilot intervention, I also hoped that participation in the intervention would contribute to reductions in feelings of shame, guilt, and social isolation, but did not evaluate due to concerns about overwhelming participants with too many measures.

Group interventions, as opposed to an individual or family intervention, have the potential to achieve several outcomes that are hard to achieve in other modalities. As detailed in the work of Irving Yalom and colleagues, groups create social structures that activate different psychological processes (see Yalom & Leszcz, 2020). Yalom identified curative factors of group therapy that include opportunities to build Cohesion (e.g., being an active participant in the group as opposed to a passive consumer of information), engage in Altruism (e.g., taking on a productive role in a group by acting as a peer supporter providing insights to other participants), experience Imitative Behavior (i.e., vicarious learning), encounter Existential Factors (i.e., meaning making) and Universality of experiences. Groups also offer individuals all the means of increasing SE described by Bandura (Bandura, 1977; Bandura et al., 1999), particularly via

vicarious learning and verbal persuasion. Group interventions also allow for greater ease of administering interventions to multiple people at once rather than on an individual basis.

Given this was a pilot intervention, evaluating the efficacy of the intervention was a secondary goal after evaluating the feasibility and qualitative experiences of participants and interventionists of the intervention. The intervention, named "Tools for Tackling Type 1" (3T1), was developed and implemented in collaboration with a local diabetes nonprofit organization. The development of the intervention and further details about the collaboration are detailed in the Methods chapter.

Research Questions

Using a mixed method design, I carried out this research to answer the following questions:

1. What were participants' beliefs about 3T1's acceptability, appropriateness, and feasibility of the intervention over the course of the intervention?
2. What were interventionists' beliefs about 3T1's acceptability, appropriateness, and feasibility over the course of the intervention?
3. What were the qualitative experiences of participants in 3T1?
4. What were the qualitative experiences of interventionists in 3T1?
5. Was there change in participant psychosocial measures of diabetes management and family stress, including DSMSE, diabetes self-management outcome expectations, perceived diabetes self-management, diabetes distress, diabetes self-management behaviors, and family quality of life and functioning after being exposed to the 3T1 intervention?

6. Was there change in participant biological measures of stress, including HbA1c, hair cortisol, inflammation markers, and allostatic load score after exposure to the 3T1 intervention?

Hypotheses

Based on the research questions, I generated the following hypotheses:

1. Participants will have favorable ratings of the acceptability, appropriateness, and feasibility of 3T1.
2. Interventionists will have favorable ratings of the acceptability, appropriateness, and feasibility of 3T1.
3. Participant scores on psychosocial measures of diabetes management and family stress, including DSMSE, diabetes self-management outcome expectations, perceived diabetes self-management, diabetes self-management behaviors, and family quality of life and functioning will increase by the end of the 3T1 intervention compared to the beginning.
4. Participant diabetes distress will decrease by the end of the 3T1 intervention compared to the beginning.
5. Participant biomarkers of stress, including HbA1c, inflammation markers, and hair cortisol, will decrease by the end of the 3T1 intervention compared to the beginning.

There were no specific research hypotheses associated with qualitative findings, as this dissertation was developed without a priori expectations of what participants and interventionists would say about their experiences of the intervention.

CHAPTER II

METHODS

In this chapter I describe the pilot intervention design, development of the intervention, participant demographics, measures used in the intervention, other sources of data, plans of analysis, and provide a qualitative researcher reflexivity statement. The study development is presented chronologically, starting with an overview of the intervention, a review of the collaboration that led to this program, a review of the Institutional Review Board (IRB) application, intervention design, recruitment, interventionist training, intervention procedures, and focus group protocol. I chose this format to most accurately reflect the process of developing and implementing the intervention. As will be noted in the participant section, the number of participants in the intervention was lower than anticipated. As such, the study was underpowered for addressing the quantitative research questions and hypotheses addressing change over time. The quantitative analyses are therefore only briefly summarized in the Results chapter, but presented in detail in Appendix F.

Intervention design

My Co-PI Tian Walker and I co-designed this intervention and determined to provide useful information to enhance participant DSMSE and well-being. We separated curriculum development into our areas of expertise, as Tian Walker identified what material would be appropriate to adapt from the Association of Diabetes Care & Education Specialists 7 Self-Care Behaviors curriculum (ADCES7; ADCES & Kolb, 2021) while I focused on support for the development of self-efficacy (Bandura, 1982). We designed a multi-session group intervention where participants either received the group intervention for diabetics or for caregivers of people with T1D, depending on their status.

The group interventions were facilitated by two kinds of facilitators. Psychology interventionists (*n*=3) were trained psychotherapists with master's degrees in counseling psychology. For the purposes of this study, they used their skills as group therapy facilitators and imparted general psychology coping skills, rather than conducting conventional outpatient psychotherapy (i.e., they did not develop individual treatment plans or provide psychiatric diagnoses). The second group of interventionists were diabetes educators. Diabetes educators (*n*=2) had completed the Diabetes Community Care Coordinator Certificate Program offered by the Association of Diabetes Care & Education Specialists (ADCES). ADCES training imparts diabetes education knowledge commensurate with basic diabetes training for healthcare professionals, including how to use the ADCES7 Self-Care Behaviors toolkit, which describes seven diabetes management behaviors and concepts shown to improve diabetic quality of life and health (ADCES & Kolb, 2021). I have also completed this Certificate Program but served in the intervention as a psychology interventionist. Diabetes educators provided participants with information about living with diabetes, health guidelines, and advice based on their professional and personal experiences (e.g., which pharmacies in the area had greater facility with filling diabetes-related prescriptions). When describing either kind of facilitator below (including Tian Walker and me), I refer to them as "interventionists" to distinguish them from focus group facilitators (described later in this chapter).

Each group (consisting of diabetics or caregivers) was co-facilitated by one psychology interventionist and one diabetes educator. Tian Walker and a psychology interventionist facilitated the group for diabetics while the other diabetes educator and I each facilitated the caregiver group. The two groups were conducted concurrently to facilitate family (diabetic and caregiver) participation. Sessions were structured to allow participants to learn or refine

adherence behaviors and develop greater DSMSE by making concrete plans to engage in treatment-adherent behaviors between sessions using SMART goals (i.e., goals that were Specific, Measurable, Attainable, Relevant, and Time-bound, usually doable within one week; Bajaj et al., 2026). At the start of every session, participants discussed the execution of SMART goal behavior plans with their groups. 3T1 took place for six 90- to 120-minute sessions on consecutive weeks on a Friday evening with up to seven participants and five interventionists (four at a time). Each session had a unique primary focus, and each session outline was developed prior to each session based on 3T1 objectives and hypotheses (see Appendix C for session outlines). Friday evenings were selected because it was the only time when all interventionists were available.

Study Development

Community Partnership

In 2023, I was approached by a Type 1 diabetes education nonprofit called Diabetes Community Care Team. Because this organization shares the acronym of the famous DCCT study, I have abbreviated it as DCCT-Nonprofit or DCCT-NP. DCCT-NP serves families with diabetes (mostly T1D) in the greater Eugene Springfield community in Oregon, USA. DCCT-NP Community Engagement staff member Tian Walker (then a doctoral candidate in the UO Anthropology program and 3T1 co-PI) approached me with the idea of developing a program to enhance the overall well-being of families with T1D in the area. Tian Walker has T1D and was a T1D researcher and educator who provided diabetes education to families connected with DCCT-NP. Upon further consultation over two years, we determined that a multi-family group intervention model could be appropriate to meet needs identified by DCCT-NP staff members

and reports from families about feelings of low DSMSE and difficulty with diabetes treatment adherence.

I met with DCCT-NP's Executive Director and other DCCT volunteers to discuss what might be most useful for the community they served. Concerns discussed included the appropriateness of having separate T1D and caregiver groups and training needed to facilitate a psychosocial intervention. DCCT-NP was determined to be a good partner for the proposed intervention as it appeared to have existing programming and contacts with community members with T1D. It was expected that between DCCT-NP outreach to families known to have T1D and outreach to care providers in medical settings and schools, there would be sufficient snowball sampling to recruit participants to 3T1. I presented the intervention to the DCCT-NP governing board and signed a memorandum of understanding approximately 6 and 2 months before the intervention began, respectively.

Institutional Review Board application

An application for approval for human subjects research involving minors and biohazardous waste was initiated in September 2024. The process took approximately six months due to ongoing negotiations about the scope and nature of the study with DCCT-NP. Tian Walker and I met repeatedly to discuss the nature of the program through co-development of the IRB study protocol. Key points of discussion included the timing of data collection and the focus of the intervention. We were granted initial IRB approval on April 16, 2025, and I filed five IRB protocol modifications following initial approval, to report closing the study to recruitment after the second week of the intervention and to add interventionists to the IRB protocol.

Study funding

Funding for interventionist and participant compensation and to carry out the intervention was provided through a $2,500 grant from the Society for the Psychological Study of Social Issues (SPSSI), a $5,000 grant from the American Psychological Association (APA), and in-kind contributions from DCCT-NP in the form of free meeting space at their offices.

Study intervention elements

The primary tool used across sessions was the SMART goal framework, which was taught to participants and utilized each week for implementing target behaviors, alongside diabetes education and psychological coping skills. Intervention elements included mindfulness techniques (i.e., exercises designed to reduce distress, see CBTm, 2024) and communication strategies derived from Dialectical Behavioral Therapy (Linehan, 2025; see Appendix C for sessions outlines). Sessions were not audio or video recorded. Each of the six group sessions lasted between 90-120 minutes during which time participants were offered light refreshments and snacks (in part to treat possible hypoglycemia).

The first session focused on introductions between participants and interventionists and gathering biological data. The second through the fifth sessions focused on facilitating interactions between participants, reviewing coping strategies, and collaborative problem-solving. The sixth and final session focused on collecting biomarker data and summarizing intervention content. I curated the psychological content used in sessions 2-5, and diabetes education content was drawn from ADCES7 curriculum and Tian Walker's diabetes educator knowledge. I created rough session outlines at the outset of the project and then updated session outlines week by week to incorporate feedback, observations, and any concerns from the previous week's sessions. After the first four sessions, Tian Walker and I met with the

interventionists to discuss both interventionists and participants feedback derived from weekly session written responses to open-ended questions about the intervention and to make modifications to the final two sessions. Interventionists otherwise did not provide any consultation about the structure or content of the intervention once it began.

Interventionist recruitment

All 3T1 interventionists (psychology interventionists and diabetes educators) were affiliated with the University of Oregon. Besides me, two psychology trainees in the UO Counseling Psychology doctoral program were recruited to serve as psychology interventionists, neither had T1D, and neither had extensive history working with people with T1D. Initially just one, but then a second psychology interventionist was recruited when the first had to leave the intervention after four sessions due to other commitments. Both psychology interventionists had worked with me in separate professional capacities. A pharmacist who knew Tian Walker, had T1D, and worked closely with UO students with T1D agreed to serve as the other diabetes educator for the study. Interventionists were offered cash payments for their services, and all interventionists subsequently agreed to participate as research subjects by giving impressions of 3T1 via a focus group, for which they received no additional compensation.

Among interventionists, all five identified as White, three as female, one as male, and one as non-binary. Both diabetic educators and I were diabetic, while the other two psychology interventionists were non-diabetic and denied having any family members with T1D. The mean age of the interventionists was 32.60 years with a standard deviation of 5.59 years, four of five were graduate students pursuing PhDs with existing master's degrees, and one was a professional who had been working for years since getting her advanced degree. The average time with T1D for those with it was 23 years with an SD of 6.5 years. Three interventionists were married, and

two were single and partnered. The mean median income of zip codes of the interventionists was $74,404. See Table 1 below for a review of interventionist demographic data.

Table 1

Interventionist demographics

	n	%	min	max	mean	SD
Gender						
Female	3	60%	-	-	-	-
Male	1	20%	-	-	-	-
Non-binary	1	20%	-	-	-	-
Race						
White	7	100%	-	-	-	-
Marital status						
Single	2	40%	-	-	-	-
Married	3	60%	-	-	-	-
Age (in years)	5	-	27	42	32.60	5.59
T1D status						
Diabetic	3	60%	-	-	-	-
Non-diabetic	2	40%	-	-	-	-
Years with T1D	3	-	17	30	23	6.50
Education attainment level						
Master's degree	4	80%	-	-	-	-
Professional degree	1	20%	-	-	-	-
Vocation						
Counseling grad student	3	60%	-	-	-	-
Anthropology grad student	1	20%	-	-	-	-
Pharmacist	1	20%	-	-	-	-
Median income ± ME of residential Zip code	5	-	$36868 ± 12005	$93136 ± 7595	$74404 ± 7392	$26504 ± 3489

Interventionist training

Three of the four initial interventionists met prior to the first session to discuss goals for the session and to review roles. In that first meeting, interventionists were also given an overview of research questions and goals of the study, as well as the key hypotheses underlying

the research (i.e., that increasing self-efficacy would be helpful). Interventionists reviewed objectives and were asked to give their thoughts and opinions on the lesson plans that were developed for the first session. They also agreed to focus on psychoeducation and diabetes education and to use interventions that would be helpful at their discretion (e.g., using distress tolerance or behavior activation interventions). Interventionists were taught how to facilitate SMART-goals based training using best practiced identified by brief diabetes interventions and recommendations from the American Diabetes Association (Sarteau et al., 2020). The replacement psychology interventionist, who joined the team for the final two sessions, met with me via teleconference approximately two weeks before her first intervention session (session 5 of 6) to discuss goals and progress on 3T1 to date.

I emailed session outlines to each interventionist approximately 48 hours prior to each session and requested that they review the material in advance of each session. Sessions outlines were printed out and given to interventionists at each session. Team members met on site 30 minutes prior to each of the six sessions to discuss approaches to support participant needs and adherence to study session outlines. Team members also met during two team meetings, prior to the 3T1's initial session and prior to session 4 of 6, respectively. Topics in the pre-session meetings included things like how to introduce SMART goals, which components of ADCES7 Behaviors would be reviewed in that day's session, and what were signs of a productive discussion between participants versus when an interventionist should direct conversation. To ensure interventionists were adequately prepared for sessions, interventionists were asked to describe how they would address objectives from the session outline prior to the beginning of every 3T1 session. Interventionists provided feedback on 3T1 through these pre-session meetings, when responding to qualitative open-ended implementation questions (described in

Sources of Qualitative Data section below), and during the interventionist focus group. Interventionists were asked to take field notes which were based on what they observed during the intervention sessions to answer open-ended questions related to study implementation and experiences (see Sources of Qualitative Data section below). These included written notes made during sessions as well as reactions and reflections from memory. The interventionist discussion that took place after session 4 was transcribed but not coded as part of the same corpus as other data due to its incidental nature and lack of structured questions. Key takeaways from this meeting influenced the subsequent sessions (see Results section).

Participant recruitment

Participants were eligible to participate if: (1) they were Type 1 diabetics ages 12 and up who assented to participate and had parent/guardian consent; or were Type 1 diabetics aged 18 or older; or if they reported being caregivers for Type 1 diabetics of any age; (2) reported they are willing to participate in 6 consecutive weekly in-person research/intervention sessions in Eugene, Oregon at the offices of Diabetes Community Care team; and (3) spoke English, as 3T1 was conducted in English and non-English speakers would not be able to fully participate in or benefit as anticipated from this study. Age 12 was the cut-off based on previous studies of diabetic adolescents (Survonen et al., 2019; Zhao et al., 2019) and concerns that younger children would not easily tolerate the 90-minute intervention sessions. Only families with at least one member with T1D, as opposed to other forms of diabetes, were eligible to participate in this evaluation. Participants in caregiver-diabetic dyads were prioritized for recruitment in messages to recruitment partners.

Participants were recruited through direct message campaigns (i.e., email and texts from the DCCT-NP), via flyers in endocrinologist office waiting rooms, via flyers and via social

media (on DCCT-NP accounts). Following receipt of IRB approval for this study, flyers and information about the study were distributed via emails drawn from publicly available online records to all public-school nurses in the Eugene 4J, Bethel, and Springfield school districts (15 school nurses). Tian Walker also sent email messages to community members who had been involved with DCCT-NP through the nonprofit's listserv, to a regional diabetes support organization (Breakthrough T1D, PNW region), to members of a community support group hosted by co-PI Tian Walker, and to the University of Oregon undergraduate student association for students with T1D (Ducks for Diabetes). All email messages contained a digital copy of a flyer advertising the nature and structure of the study, as well as information about expected compensation for participation. At least one flyer was also displayed in a local physical therapist's office who agreed to display it, and at least 3 flyers were displayed at the University of Oregon student health center's main lobby and at the UO Health Center pharmacy (see Appendix C for flyer and recruitment messages).

Potential participants were invited to complete an online survey to indicate their interest and share email contact information. Fourteen individuals responded to the survey. A total of twelve individuals were deemed eligible from screener responses between April 25, 2025, and May 16, 2025, and indicated via email that they would be available to meet for an intervention on Friday evenings. Of these, seven individuals, four with T1D (one minor), and three mothers of minors with T1D (one mother-child dyad), ultimately enrolled in the study. Among those who were eligible but did not enroll, at least three were university students and three were caregivers (total n=6) who later stopped replying to invitations to participate or emailed to inform me that their schedules had changed and they were no longer available on Friday evenings. Emails were used in lieu of other forms of communication (i.e., phone calls, text messages, or social media

communications) due to precautions in place to protect participant privacy. The sole minor enrolled in the study was always emailed in tandem with her mother. Participant recruitment lasted until the end of the second 3T1 session, by which time seven community members enrolled as study participants.

Participants were offered financial compensation for completing measures and participating in the study in the form of digital Amazon gift cards. They were offered $25 for completing biomarker collections (up to three) and $10 for completing weekly survey measures (up to seven, 6 weekly sessions and a follow session), as well as $25 for participating in a focus group and a bonus of $25 for participating in all six intervention sessions for a possible total of $195. Participants were only instructed to complete self-report measures for the weeks they were present for the intervention and completed paper surveys at the end of sessions. Survey responses were entered digitally by me into a .csv file stored on a secure cloud drive for future analysis. Participants who did not complete all measures for sessions at which they were present were invited by email within 24 hours after the session to complete them through an online survey within 72 hours of the previous session.

All seven participants identified as cis-gendered and female and White or Caucasian, one was a minor, four were caregivers and three were diabetics (see demographics in Table 2 below). The mean age of participants was 35.86 years with a standard deviation of 14.68 years, while the average time with T1D within a family or individual was 10.14 years with a standard deviation of 13.06 years. All caregivers were separated or divorced, two diabetics were married, and two diabetics were single (one was a university student, the other a minor in high school). There was a broad range of educational attainment, ranging from “Some high school” to “Professional

degree". The mean median income of zip codes in which participants resided was $68,542. Three of seven participants lived in zip codes with higher than mean median income.

Table 2

Sample demographics

	n	%	min	max	mean	SD
Gender						
Female	7	100%	-	-	-	-
Race						
White	7	100%	-	-	-	-
Marital status						
Single	2	28.6%	-	-	-	-
Married	2	28.6%	-	-	-	-
Divorced	2	28.6%	-	-	-	-
Separated	1	14.2%	-	-	-	-
Age (in years)	7	-	14	52	35.86	14.68
T1D status						
Diabetic	4	57.1%	-	-	-	-
Caregiver	3	42.9%	-	-	-	-
Years with T1D (Self or family member of those with T1D)	7	-	1	39	10.14	13.06
Education attainment level						
Some high school	1	14.2%	-	-	-	-
Some college	2	28.6%	-	-	-	-
Associate's degree	1	14.2%	-	-	-	-
Bachelor's degree	1	14.2%	-	-	-	-
Master's degree	1	14.2%	-	-	-	-
PhD / Professional degree	1	14.2%	-	-	-	-
Median income ± ME of residential zip code	7	-	$47103 ± 9873	$93136 ± 7595	$68542 ± 5941	$19472 ± 1844

Procedures

Sessions ranged in their content and tone but usually involved participants talking about their mood and experiences in the past week, and from sessions 2 onwards, sharing about their progress towards accomplishing SMART goals (see session outlines in Appendix C). Sessions ended with participants and interventionists completing paper surveys and discussing plans for

the coming week. At the end of sessions, participants and interventionists completed paper questionnaires. At the end of 3T1 sessions when questionnaires were distributed, Tian and I requested that participants and interventionists write as much as possible and complete all relevant questionnaires, but participants were not penalized for failing to complete any measures or minimal written responses. Interventionists were also encouraged to incorporate field observations and reflections into written responses to open-ended questions.

I transcribed all written responses by participants and interventionists and entered these electronically into a .csv spreadsheet. I separated responses by participant and by week into distinct text documents that were entered into qualitative analytical software for further analysis. I sought clarification as needed from the participants or interventionists and no responses were deemed illegible or unable to be transcribed. Below I describe the other primary source of qualitative data, the interventionist- and participant-specific focus groups conducted after session 6 of 3T1.

Focus group facilitator recruitment and training

Two counseling psychology doctoral students with experience leading groups in psychological and educational settings facilitated the focus groups. One is female, the other male, both are Hispanic, and I paid each of them a stipend for their services. Another psychology interventionist and I knew them prior to the focus group they facilitated, but all other focus group members denied previous acquaintance with them. My relationship with the focus group facilitators was known to the other interventionists. The focus group facilitators and I met once to review proposed focus group questions and collaboratively identify strategies to elicit informative responses. We collaboratively agreed that facilitators would use Motivational Interviewing methods (Miller, & Rollnick, 2012) to elicit and validate responses from group

members, review the facilitator guidelines, ask questions we agreed upon, and ask follow-up questions at their discretion to get more details about experiences of participating in 3T1 and living with T1D (see Focus Group Outline in Appendix C).

Focus group development

I developed an initial guideline to introduce the focus group and a set of focus group questions based on the study's research questions to learn about qualitative experiences of participating in 3T1. After the consultation with the focus group facilitators, we agreed on a set of open-ended questions (see Appendix C for the focus group outlines). Interventionists were asked about their experiences in the groups as well as an additional set of questions, including "What were the easiest aspects of implementing 3T1? The most challenging?", "What would you change about the training and planning around 3T1 implementation?" and "What are things you would add to the program to improve or change the dynamic?"

Focus group recruitment

Ten days after the final intervention session, a participant virtual focus group was conducted. Recruitment for the participant focus group consisted of verbal reminders at the end of the final intervention session, as well as two reminder emails and online polling to determine when respondents would be available. Four participants (two adult diabetics and two caregivers) opted to participate in a single combined participant focus group. As noted above, compensation consisted of a $25 Amazon gift card. Approximately 10 days after the participant focus group, interventionists participated in a separate virtual focus group. Four of five interventionists (including me) opted to participate.

Focus group protocol

The focus group began with introductions between facilitators and group members and a review of the goals of learning more about experiences of participating in 3T1. Participants were informed that focus group facilitators were from the same graduate program as me and had been asked to facilitate the discussion as impartial outsiders. To mitigate bias, the focus group facilitators emphasized the importance of direct critique and communication, and I likewise encouraged honest feedback in the interventionist group. During the interventionist focus group I also waited to speak until others contributed, for the most part. Focus group members were not redirected if they responded to one another but were encouraged to only speak from their own experiences rather than perceptions about the experiences of others.

Both focus groups lasted approximately 90 minutes and were video recorded and transcribed. Participants and interventionists were each asked if they wanted to review their transcripts at the end of focus groups and no one asked to review their transcripts. All participants requested that their involvement in the study end after the final data collection, although several indicated interest in future iterations of the intervention. Below is a review of the measures used for data collection in this study.

Quantitative Measures

The following self-report measures were administered via paper forms at the first session participants/interventionists attended and intermittently at subsequent sessions. All measures that were designed for just one subgroup (diabetics or caregivers) were minimally re-worded to reflect the new intended audience as specified below (see Appendix C for copies of the questionnaires). Approximately six weeks after the intervention sessions were completed, all measures were administered again to participants when they came to the University of Oregon

Global Health Biomarker Laboratory for blood and hair sample collection. Below first I present demographic questions, then the self-report measures including implementation and study-specific measures, followed by psychosocial measures related to living with diabetes, and finally biological measures.

Demographic information

The following demographic characteristics were reported by all participants during the first session: age, race, gender, T1D status (caregiver or diabetic), years with T1D (if less than 1 year, months), zip code, marital status, and highest education degree obtained. Participants reported their primary address zip codes, which were referenced against median household incomes (U.S. Census Bureau, 2025) with the latest data available (year 2023) from the American Community Survey.

Implementation Measures

I used three implementation measures from Weiner et al. (2017) to evaluate the implementation of 3T1: the Acceptability of Intervention Measure (AIM), Intervention Appropriateness Measure (IAM), and Feasibility of Intervention Measure (FIM). Each has 4 items using 5-point Likert-type response options from 1 (Completely disagree) to 5 (Completely agree), with higher mean scores representing higher approval of the study. Sample items, respectively, included "Tools for Tackling Type 1 meets my approval", "Tools for Tackling Type 1 seems fitting", and "Tools for Tackling Type 1 seems doable". The scales demonstrated good reliability (α = 0.85-0.91), good test-retest reliability coefficients (r = 0.73-0.88), and good structural validity (λ = 0.75-0.89; Weiner et al., 2017). Both intervention participants and the interventionists were asked to complete these measures weekly.

Study Specific Measures

I developed seven study-specific questions to evaluate the acceptability of the 3T1 intervention, all of which used 5-point Likert-type response options from 1 (Completely disagree) to 5 (Completely agree). The questions were divided into three subscales: Ease of Participation, with 3 items (e.g., “This week’s content was easy to understand”); Appropriateness of 3T1 Pacing, with 2 reverse-scored items (e.g., “This week’s content was delivered at a slow and inappropriate pace”); Behavioral Outcome of 3T1, with 3 items, which referred to translating 3T1-related content into behaviors outside of sessions (e.g., “I have a plan to incorporate this week’s content into my daily diabetes management”). Scores were averaged for each subscale with higher scores indicating greater ease of participation, more appropriate pacing, and more implementation of content out of session, respectively. All seven items were averaged for a Composite 3T1 Study Measure. Both intervention participants and the interventionists were asked to complete these measures weekly.

Psychosocial Measures

Diabetes Self-Efficacy and Outcome Expectations Scales

Self-efficacy and outcome expectations related to diabetes management were assessed using the Diabetes Self-Efficacy (DSES) and Outcome Expectations Scales (DOES; Iannotti et al., 2006). They are respectively a 10-item and 24-item scale that use, respectively, 10-point Likert-type response options ranging from 1 (“not sure at all” and “not at all”) to 10 (“completely sure” and “a lot”). The DSES had good internal consistency (α=.90), as did the DOES Negative subscale (12 items, α=.89), and DOES Positive subscale (12 items, α=.84). Scores were averaged for each scale/subscale. The DSES included items such as, "Adjust insulin correctly when eating more or less than usual”, the Negative DOES subscale had items such as, "Adjust insulin

correctly when eating more or less than usual", and the Positive DOES subscale had items like "Keep my diabetes in better control".

In children 13 and older, the self-efficacy subscale was significantly correlated with youth- and parent-reported management behaviors and HbA1c. In a regression analysis, the three variables accounted for significant variance in youth-reported management behaviors (R^2 = 19%), parent-reported management behaviors (R^2 = 13%), and HbA1c (R^2 = 12%), with self-efficacy being the only significant first-order term variable in the regression (Iannotti et al., 2006). High scores reflect greater self-efficacy and outcome expectations, as Negative DOES items are reverse scored. An example modification for caregivers is that "Talk to a doctor or nurse about any problems I am having with taking care of diabetes" was changed to, "Talk to a doctor or nurse about any problems the person with diabetes you're caring for is having with taking care of diabetes". See Appendix C for all modifications made to both scales for administration to caregivers.

Perceived Medical Condition Self-Management Scale

The Perceived Medical Condition Self-Management Scale (PMCSMS; Wild et al., 2018) was included as an additional means of evaluating DSMSE. The PMCSMS is an 8-item measure with 5-point Likert-type response options ranging from 1 (Strongly Disagree) to 5 (Strongly Agree) for all items such as, "It is difficult for me to find effective solutions for problems that occur with managing diabetes". Item responses were averaged to make a composite PMCSMS score. The PMCSMS has a high degree of internal consistency (α = 0.70-0.90, using Item Response Theory and classical test theory, respectively) and a high degree of temporal stability (test-retest r = 0.81 after 2 to 4 weeks; Wild et al., 2018). Higher scores reflect greater self-confidence in one's ability to manage T1D and greater DSMSE. An example modification for

caregivers is that “It is difficult for me to find effective solutions for problems that occur with managing my medical condition” was changed to “It is difficult for me to find effective solutions for problems that occur with managing my child’s medical condition”. See Appendix C for modifications made to both scales to be applicable to caregivers.

Diabetes Distress Scale

The Diabetes Distress Scale (DDS; Polonsky et al., 2005) was used to assess mood and affect of all participants. It is a 17-item scale with 4 subscales (emotional burden, physician-related distress, regimen-related distress, and interpersonal distress), although only the composite scale was reported for this study. The scale employs Likert-type response options ranging from 1 (Not a problem) to 6 (Serious problem) with items like, “Feeling that diabetes is taking up too much of my mental and physical energy every day” and “Feeling that I am often failing with my diabetes routine”. Its initial validation study in 2005 demonstrates strong internal consistency ($\alpha = 0.93$) and good validity compared with measures for depression like the Center for Epidemiological Studies Depression Scale ($r = 0.56$) among Type 2 and Type 1 diabetics (Fisher et al., 2012). Mean scores of <2.0 indicate little to no distress, scores between 2.0 and 2.9 indicate moderate distress, and scores ≥3.0 indicate high distress. An example modification for caregivers is that “Feeling that my diabetes is taking up too much of my mental and physical energy every day” was changed to “Feeling that my child’s diabetes is taking up too much of my mental and physical energy every day”. See Appendix C for modifications made to both scales to be applicable to caregivers.

Diabetes Self-Management Questionnaire-Revised

The Diabetes Self-Management Questionnaire-Revised (DSMQ-R; Schmitt et al., 2022) is 27-item scale with five subscales (Eating behavior, Medication taking, Glucose monitoring,

Physical activity, and Cooperation with diabetes team) that measures adherence to treatment and difficulties with treatment regimen, with higher scores indicating greater adherence. Consistent with Schmitt et al. (2022), only the mean total score was reported in this study. The DSMQ-R is composed of 4-point Likert-type response options from 0 (Does not apply to me) to 3 (Applies to me very much). Sample items include, "The foods I choose to eat make it easy for me to achieve good glucose levels" and "I am regularly physically active to improve my diabetes and health". In Schmitt and colleagues' (2022) analysis of five studies, the DSMQ-R was shown to have good reliability across the studies for participants with T1D (α = 0.91-0.94) for the four studies that examined T1D, as well as fair test-retest reliability, (r = 0.61-0.64) for the two studies that examined reliability among T1D participants. An example modification for caregivers is that "I take diabetes medication (e.g., insulin) consistently and reliably" was changed to "My child/person with diabetes takes diabetes medication (e.g., insulin) consistently and reliably". See Appendix C for modifications made to both scales to be applicable to caregivers.

PedsQL Family Impact Module

The PedsQL Family Impact Module (PedsQL FIM) is a 36-item measure using 5-point Likert-type response options from 0 (Never a problem) to 4 (Always a problem) about family problems and dysfunction due to chronic illness in the past week and the same questions about experiences in the past month. Sample items included, "I feel anxious", "I feel that others do not understand my family's situation", and "I worry about whether or not my child's medical treatments are working". The PedsQL FIM has 8 dimensions: Physical Functioning (6 items), Emotional Functioning (5 items), Social Functioning (4 items), Cognitive Functioning (5 items), Communication (3 items), Worry (5 items), Daily Activities (3 items), and Family Relationships (5 items). All items are reverse scored, such that higher scores indicate better family functioning.

Varni et al. (2004) showed that it has strong internal reliability (α = .90) and deemed it suitable for instances like short interventions. Due to its length, it was administered only in sessions 1, 6, and 12 (follow-up). PedsQL Total FIM score, Parent Health-Related Quality of Life (HRQL), and Family Functioning (FF) subscales were reported, respectively representing: mean scores across all dimensions; mean Physical, Emotional, Social, and Cognitive Functioning scores; and mean Daily Activities and family Relationships scores. This instrument was not modified to be different between caregivers and diabetics, but I explicitly instructed all participants to answer all items as though they applied to them, though some are phrased for caregivers.

Biological Measures

Biological samples were gathered in accordance with the University of Oregon's 2025 Global Health Biomarker Laboratory's dried blood spot collection procedures and the WHO's World Health Survey and procedures for point of care testing (See Appendix E). Biological samples were collected at the start of 3T1 sessions for weeks 1 and 6 at the DCCT-NP offices and at the follow-up, week 12, at the Lab itself. Samples were collected by me and by Tian, a diabetes educator, and a lab technician from the UO Global Health Biomarker Lab. Tian transported biological samples to the UO Global Health Biomarker Lab after each collection for secure storage and sample preservation.

Glycated hemoglobin (HbA1c)

HbA1c is represented as a measure of the percentage of hemoglobin that has been glycated/glycosylated (i.e., glucose binds to the protein). T1D is usually deemed to be in good control when HbA1c is equal to or less than 7.0%, as diabetes complications become increasingly prevalent at higher values (Nathan, 2014). HbA1c was measured using a PTS Diagnostics A1CNow Self Check device (model #B07FMLTTH6) which involves pricking the

side of a finger with a disposable lancet and collecting blood onto a test strip which is then immediately inserted into a point of care device.

Blood Pressure (BP)

The amount of pressure within the arterial walls of the brachial artery (colloquially known as blood pressure) is a common measure of cardiovascular function and health and is composed of systolic BP (the highest pressure when ventricles in the heart push blood into the arteries) and diastolic BP (the lowest pressure when the heart is filling with blood). BP was collected twice in succession and then after five minutes of rest using an Omron 3 automated blood pressure device (Hoffman Estates, IL) to generate a mean BP level measured in millimeters of mercury (mmHg). Participants were informed of their mean BP and typical ranges for BP based on age and sex.

Heart Rate (HR)

Heart rate, or the number of times the ventricles contract in 60 seconds, is another measure of cardiovascular health and stress. HR was collected twice in succession and then after five minutes of rest using an Omron 3 automated blood pressure device (Hoffman Estates, IL) to generate a mean HR level, represented as beats per minute (bpm). Participants were informed of their mean HR and typical ranges for HR based on age and sex.

Lipid levels

Serum lipid levels, including triglycerides, high-density lipoprotein cholesterol (HDL), low-density lipoprotein cholesterol (LDL), and total cholesterol levels were gathered from finger pokes using a point-of-service device (CardioChek PA). All measures were represented as milligrams per deciliter (mg/dL). Out-of-range lipid levels can be indicative of metabolic distress

and increased allostatic load. Participants were informed of each of their lipid levels and typical ranges for levels based on age and sex.

C-Reactive Protein (CRP)

C-reactive protein (CRP) is a protein produced in the liver in response to inflammation, both to reduce (pentameric CRP) and to promote (monomeric CRP) inflammatory responses based on tissue damage (Du Clos, 2000; Singh et al., 2025). CRP levels can therefore be indicative of systemic inflammation, disease, levels of physical activity, and cardiovascular distress. CRP levels were obtained by drawing approximately 3 drops of blood from a capillary finger poke onto a collection filter paper (Whatman 903 blood collection filter paper). Dried blood spot cards were allowed to dry completely and folded to reduce the sample being disturbed before being placed in separate sealed plastic bags with desiccant and stored with unique participant ID labels in the Global Health Biomarker Lab freezer where they were kept at approximately –50 °C to preserve sample integrity. CRP samples were analyzed at the Northwestern University Laboratory of Human Biology using protocols described by McDade and colleagues (2004). See Appendix E for specifics on how CRP was analyzed.

Hair Cortisol (HC)

Cortisol is an adrenal steroid hormone associated with allostatic load and is released into blood serum in response to adrenocorticotropic hormone from pituitary gland (Igboanugo et al., 2024; Kaur et al., 2025). It is involved in numerous processes, including mediating stress across the body, metabolism, inflammation, and immune responses. Cortisol is a small compound that can concentrate in many different tissues and bodily fluids, including hair cells, blood, and saliva. Human scalp hair grows at a rate of approximately 1cm per month and cortisol will remain in the tissue, meaning that hair can be collected and analyzed to estimate average

concentrations of cortisol across different time periods based on the length of hair (with hair closer to the scalp representing more recent cortisol levels). For the current analyses, the length of hair analyzed was approximately 1.5cm long to estimate the past six weeks of hair growth and cortisol levels in those past six weeks (see Appendix E for a full description of the HC assay procedures). The HC assays generated six-week-average cortisol levels for each of the three timepoints (week 1, week 6, and six-week follow-up, week 12), which were used to estimate physiological stress levels of participants at each time point.

Composite allostatic load score (ALS)

Composite allostatic load scores (ALS) are used to estimate the amount of distress and potential inflammation or cellular damage an individual is experiencing due to physiological responses to perceived stressors in daily life (Duong et al., 2017). ALS is calculated using measures from cardiovascular, immune, and metabolic biomarkers, as all are susceptible to change due to stress. Elevated stress responses, particularly when sustained over long periods of time, can lead to illness, so ALS can be used as a measure of risk for current or future illness (Duong et al., 2017). While there are different methods of weighting items that contribute to a total ALS (see Li et al., 2019), it is widely accepted to transform all biomarker values into dichotomous variables and label them as in-range or elevated (0 or 1), based on age and sex. There are no universally agreed-upon cut-offs for elevated biomarkers, but values are typically considered elevated if in the top quartile of a sample or are above clinically significant levels (Duong et al., 2017; Li et al., 2019). For the present study, cutoff values were derived from top quartile data from Li and colleagues (2019), which analyzed biomarker data of 4,319 women of reproductive age from the 2001–2006 US National Health and Nutrition Examination Survey. ALS scores were computed from 8 biomarkers, resulting in possible scores of 0 to 8, with higher

numbers representing a higher stress. Metabolic markers were lipid levels (except LDL) and HbA1c, cardiovascular markers were blood pressure and heart rate, and the sole immune marker was CRP (Duong et al., 2017; Howard & Sparks, 2016; Li et al., 2019). Cortisol was not used in calculating ALS but is presented instead as an additional estimate for stress.

See Table 3 below for a summary of measures and when they were administered.

Table 3

Measure administration by week

	1	2	3	4	5	6	12
Biomarker measures	X					X	X
DSES	X	X		X		X	X
DOES	X	X		X		X	X
PMCSMS	X	X		X		X	X
DDS	X		X		X	X	X
DSMQ-R	X		X		X	X	X
PedsQL FIM	X					X	X
Implementation measures	XX	XX	XX	XX	XX	XX	X
3T1 Study Specific measures	XX	XX	XX	XX	XX	XX	

Note: X = Participants completed measure; XX = Participants and interventionists completed measure; DSES: Diabetes Self-Efficacy Scale; DOES: Diabetes Outcome Expectation Scale; PMCSMS: Perceived Medical Condition Self-Management Scale; DDS: Diabetes Distress Scale; DSMQ-R: Diabetes Self-Management Questionnaire-Revised; PedsQL FIM: PedsQL Family Impact Measure.

Sources of Qualitative Data

Qualitative data was generated from four primary sources: open-ended demographic/diabetes belief questions, implementation questions that required written responses, interventionist field notes, and focus group transcripts. The focus group protocol is described above in the Procedures section. Descriptions of the other data sources are provided below.

Pre-intervention diabetes belief questions

Upon enrolling in the study, participants and interventionists answered open-ended questions about beliefs and attitudes about diabetes. They were asked: “What gets in the way of

diabetes adherence?", "What would good diabetes control look like this week for you?", What about your diabetes management is going well this week?", and "How do you feel about managing diabetes?", with the last three questions listed as optional for interventionists, reflecting that not all interventionists live or have outside relationships with T1D.

Open-ended implementation questions

In addition to quantitative measures about the implementation of 3T1, participants were asked to write as much as they wanted in response to three study-specific open-ended questions: "What gets in the way of diabetes adherence?", "What about diabetes management is going well this week?", and "What has been the most helpful aspect of this intervention so far? The least helpful?". Interventionists were asked to answer the same questions, with the difference that the second question was replaced with, "How do you think about managing diabetes?"

Approach to Qualitative Analysis

In this section I describe the qualitative analysis that I conducted and relevant considerations regarding my own and my research team's backgrounds. This section is organized as follows: first, I present information about my own background, followed by my approach to the analysis of qualitative data, descriptions of my thematic analysis, considerations about the study sample, and conclude with a researcher reflexivity statement concerning factors that potentially affected the qualitative coding process. To ensure sufficient attention was paid to important characteristics in my reflections, I consulted the Consolidated Criteria for Reporting Qualitative research (COREQ; Tong et al., 2007) and reporting guidelines from O'Brien and colleagues (2014). These guidelines seek to identify significant components of focus groups and other qualitative methods that bear reporting. I also consulted guidelines on reflexivity statements from Braund and colleagues (2024).

Prior to commencing with qualitative data analysis, I consulted with Tian Walker, and we reflected on how our backgrounds, interests, and perspectives influenced the project's data collection and analysis at the start and end of the project. For example, we discussed how my history of working with diabetes in resource-deprived settings in Latin America had led me to develop a program aimed at addressing deficits (e.g., how working in a context where there was minimal diabetes education led me to assume that psychoeducation and diabetes education are usually valuable interventions). Tian Walker and I also discussed how our status as diabetics might lead us to assume familiarity with the lived experiences of our participants, which may have affected how we interpreted the qualitative data (i.e., assuming we could personally empathize with experiences that may have actually been very different from our own). Below are descriptions of key aspects of the study identified by COREQ as critical to contextualizing qualitative research, discussed in the following order: researchers' personal characteristics, approach to data analysis, and sample engagement with the study.

Personal Characteristics of Research Team members and Relationship with Participants

I am male and Tian Walker is female, we were respectively ages 32 and 31 at the time of the intervention, we each identify as cis-gendered White graduate students with master's degrees in our respective fields of counseling psychology and anthropology, and each have experience conducting interviews and soliciting data with diabetic participants for research. Participants knew that both of us have T1D, were diabetes researchers and graduate students at UO, that this was part of my dissertation research, and that I was less interested in the intervention's efficacy than in "quality improvement" and general impressions of the study. Participants also knew that Tian Walker had extensive diabetes knowledge and had a history of hosting diabetes education events in the community which some participants had previously attended. This may have

created a situation in which Tian Walker seemed or felt like an authority figure who was doing participants a favor and whose favors needed repayment in the form of greater or even complete participation. We attempted to address this with verbal reminders to participants that any contributions were optional and that the nature of their contributions was not linked to their continued eligibility or compensation for this project. We encouraged participants to ask us questions about the intervention and research, but few did so. Participants were explicitly informed of our qualifications and interests in running the study (i.e., that this was a "passion project" for us both and that we were invested in supporting the local diabetes community with evidence-based novel interventions).

Our other team members consisted of a 42-year-old White female pharmacist (our second diabetes educator) who had lived with T1D for 30 years at the time of the intervention, a 31-year-old White non-binary, non-diabetic graduate student in counseling psychology with a master's degree, and a 27-year-old White female non-diabetic graduate student in counseling psychology with a master's degree. None had previous involvement in T1D-specific research, although each had at least five years of combined research and clinical experience. Team members were introduced to the research participants as either psychology interventionists or diabetes educators, while Tian Walker and I were identified as co-PIs, and perhaps as a result, almost all questions about the study and intervention were directed to me and Tian Walker. Participants were informed of the team's interest in serving as interventionists based on their relationships with Tian Walker and me and their expertise in health interventions. Apart from professional credentials, names, and diabetes status, no personal identifying information was explicitly shared with participants.

Regarding the relationship that Tian Walker had established with participants, she had already developed and facilitated mutual aid groups where topics such as diabetes history, medical management, and emotion regulation were discussed. This appeared to put Tian Walker in the role of a trusted community resource and diabetes expert. Tian Walker endorsed that she occasionally disclosed her own experiences with T1D to the participants in sessions and in the final two sessions talked about challenges she had experienced. In my case, I had met three of the adult participants (two caregivers and one diabetic) at DCCT-NP events in the past. As such, I introduced myself to the entire participant group at the beginning of the intervention and disclosed that I had been diabetic since I was a child.

Theoretical foundations

Prior to coding any qualitative data, I consulted Braun and Clarke (2006) and determined it would be most appropriate to approach my dataset using an essentialist/contextualist and semantic approach that was largely inductive (i.e., I approached the data without any presumptions about how they would support or challenge pre-existing theoretical frameworks and analyzed data for explicit rather than deeper socially constructed/latent content). This approach was based on the study's comparatively narrow questions around study implementation and the paucity of longer responses to open-ended questions about the study from weekly post-session data collection. For the purposes of this implementation study, Tian and I determined that meaning and experience were closely reflected in the word choice and responses of participants (Braun & Clarke, 2006) when we coded the data. The Discussion of this paper features observations contextualizing the data to elaborate on how the responses were generated.

Thematic analysis

The qualitative data was analyzed using the recursive process laid out in Braun and Clarke (2021a), which involves phases of, "familiarisation; coding; generating initial themes; reviewing and developing themes; refining, defining and naming themes; and writing up" (p. 39). I first familiarized myself with the qualitative dataset by checking the accuracy of focus group transcripts and reflected on my own utterances as a focus group member.

Both focus group transcripts were divided into distinct respondent-specific transcripts, such that each speaker's utterances were analyzed separately. Qualitative responses to the post-session write-in implementation measures were also divided by week and by participant. All responses were grouped into distinct units delineated by my impressions of when an idea began or ended. Some excerpts were very short (e.g., when responding to the question, "What gets in the way of diabetes adherence?", one laconic respondent repeatedly wrote "life") and others were very long (e.g., some respondents wrote paragraphs in answer to the same question). In such cases, discrete ideas within these paragraphs were split into excerpts up to several sentences long elaborating on a single idea. Coding was done using Dedoose qualitative coding software (v. 10.0.59).

The codebook was developed by completing initial coding of all transcribed written and spoken responses, generating novel codes using a topic/descriptive coding method. I generated descriptive codes by first coding all utterances (from focus group transcripts) and written responses (from weekly session questionnaires) with codes reflecting the understood meaning in context (Saldaña, 2013) or semantic analysis (Braun & Clarke, 2006). This involved creating a new code to describe what the excerpt said about the individual or 3T1 program. For example, "Just being in a room with others that get it instantly just is soothing and helpful" was coded first

as “Combined group was beneficial”. If an excerpt appeared to have multiple interpretations, it was given an additional code (e.g., “Just being in a room with others that get it instantly just is soothing and helpful” was also coded as “T1D relief”). Participants and interventionists responded to the same structured and semi-structured questions about experiences with diabetes and 3T1 and I applied the same codebook to all respondents except where noted (see Sources of Qualitative Data section). I coded primarily for content at the surface level at first but soon began to create codes that were more reflective of my psychological training, such as trying to map emotions and beliefs onto excerpts (e.g., “Diabetic joy” and “T1D relief" as opposed to “mention of food”). Stemming from my training as a therapist, I tended to focus primarily on feelings and tended to infer emotions from most excerpts, particularly ones that I was explicitly assessing.

After a first round of coding excerpts and generating codes, I compared codes with one another and as appropriate, merged them (e.g., “Diabetes adherence is hindered by small details” was subsumed into “Adherence is hard or feels impossible”). After I completed an initial round of coding, co-coder Tian Walker repeated the process blind (i.e., without seeing which codes had been used on a given excerpt), using the codebook I had created but with the freedom to create new codes. Discrepant codes were then flagged, and we discussed all codes until we reached consensus on which codes should be applied to each excerpt. Next, I sorted codes into superordinate themes, presented these to Tian, and we discussed until we achieved consensus on the superordinate themes.

Sampling and participation

In keeping with COREQ reporting recommendations of study design, non-participation was not a significant issue in the study but was during enrollment (see Participant recruitment above). No non-participants were present during the intervention or data collection stages. Time

commitment barriers are reviewed in the Discussion section. Reflecting on how much participants engaged in the study, the only non-participation observable during the intervention was when participants did not show up. Several participants emailed me after receiving reminder emails to attend the upcoming session to indicate whether they would or would not be in attendance. Participation was high overall: even participants who were occasionally silent during the intervention contributed to sessions and engaged with group discussion prompts. No new codes emerged after the interventionists' focus group and the first five participants' data were analyzed. Since no themes were established a priori and since some participants' qualitative datasets were quite small, it was not possible to determine whether data saturation was achieved. However, the fact that no new codes were generated, and that codes continued to be sufficient to describe responses as the process of coding continued, there is a case to be made that data was sufficiently saturated (Kerr et al, 2010).

Researcher Reflexivity Statement

In order to effectively report how I influenced the study and thematic analysis, I used Braund et al. (2024)'s guidelines. Per these guidelines, I discuss below how team members related to this implementation research, how my underlying assumptions about DSMSE affected the research process, how the research affected study stakeholders, how ethical considerations were made, how contextual factors affected the research process, and how Tian Walker and I engaged in researcher reflexivity.

Both Tian Walker and I have previous experience researching diabetes populations in the US and abroad, respectively. Prior to creating 3T1, we firmly believed that even if the intervention did not generate desired increases in DSMSE, it would be worthwhile to bring people with T1D together to offer mutual aid and understanding. The pharmacist who was

recruited as a diabetes educator also had T1D since she was a child. She was the only parent on the intervention team, and her identity as a caregiver may have also allowed her to connect with caregiver-participants in ways that other interventionists could not.

All interventionists endorsed that cognitive and behavioral changes come from without and from within. They endorsed that changing material circumstances for diabetic families (by offering them a milieu in which they could connect, learn from, and change alongside others) and changing internal attitudes and beliefs (by providing education and skills) were essential for long-term change. All team members identified that community was important to them personally, and by the end of the intervention mentioned that they saw community as the most transformative component of 3T1. Finally, all research team members identified as educators and this perspective appears to have influenced initial goals to provide education when the intervention began (as opposed to just facilitating discussion between participants). I believe that my and Tian's interests affected our coding process by leading us to focus on ways to critique and improve the intervention and take feedback at face value, rather than trying to analyze underlying motivation behind utterances from participants.

Regarding how my underlying assumptions affected the research, 3T1 was developed with a medical model of illness in mind which, while accounting disabling environments (Shakespeare, 2006), assumes that more treatment adherence always leads to better health outcomes and quality of life. This created an imperative to overcome diabetic problems, which reflects the martial ("Tackling") metaphor in the intervention's name, as the idea of fighting diabetes assumes that there will be conflict and that the solution to managing diabetes is additive (i.e., adding more tools rather than letting go of stress with a subtractive logic). Over the course of coding the qualitative data, Tian Walker and I both initially used codes that reflected the view

the diabetes was a battle too (e.g., frequent use of the code "Diabetes is a battle"). In later discussions it became apparent that this was not what participants were expressing. Rather, participants were describing things that were challenging, and so new codes were developed to reflect the challenges of life with T1D and replaced some of the martial codes (e.g., "Adherence is hard or feels impossible"). Similarly, while initial sessions were developed with certain themes based on assumptions from extant research, after several sessions the structure and content of sessions became more fluid and responsive to what was occurring in session (see Appendix C for a full list of session outlines). When coding, we used an inductive approach that allowed us to make fewer assumptions without a priori themes, although this came at the expense of coding for the underlying self-efficacy theory behind 3T1. Given that DSMSE was not emphasized in qualitative materials, it did not feel appropriate to focus on it. Instead, greater attention was paid to the implementation of the intervention, about which participants were asked specific questions (see Discussion).

In considering how 3T1 influenced all stakeholders, 3T1 was conceived as a pilot developed at the urging and with the support of DCCT-NP. Research team members were expected to develop greater empathy for people with T1D while improving their group facilitation skills. Tian and I hoped that 3T1 would be pleasant such that participants and interventionists would want to take part again. The results of the intervention, particularly notes on implementation, were a focus in the coding process in order to offer DCCT-NP specifics about how nonprofit staff could support or facilitate such group interventions in future.

In considering the research ethics of 3T1, I focused on ways to minimize distress to participants and interventionists, even as difficult topics emerged. As an example, one of the reasons for having separate diabetic and caregiver groups was to enable participants, particularly

those in dyads, to discuss their relationships with one another and to be able to vent frustrations away from one another. Additionally, there was discussion between me and Tian, as well as DCCT-NP staffers about the prospect of having older diabetics and much younger diabetics mingle, due to concerns that the experience could be too alienating for either group. For this reason as well, only diabetics ages 12 and over were eligible to participate due to beliefs that people of that age could communicate adequately with adults. Efforts were therefore made to attend to participant and researcher affect and to develop responsive curriculum that iterated on participant needs. As the intervention progressed, more time was spent preparing and debriefing with interventionists, who reported that they valued time as a research team to discuss their own observations and to share with one another their thoughts about the program (see Results).

Regarding the context in which this research was conceived and executed, I first considered microsystemic factors and then broader factors. On a personal level, my demographic background as a White cis-gendered male with a master's degree and role of PI meant that I appeared, including to myself, as an authority figure in a society that conventionally recognizes White male authority figures. Counseling is a predominantly female field, and while I am comfortable working with women, I do not assume the inverse is true. Furthermore, with the exception of one male focus group facilitator, one non-binary interventionist, and two male members of my dissertation committee (neither of whom interacted with participants during the intervention), all other stakeholders were cis-gendered women. I felt curious as to how the intervention would have been different with men present as well as how desirable the intervention appeared to men (see Discussion section for further reflections). I determined to adjust my tone and speech in communications with participants (e.g., focusing on listening and not interrupting others except when needing to redirect participants, not cursing) with the belief

that such behaviors are sometimes experienced as alienating attempts at male dominance. Over the course of the intervention, as caregivers shared their experiences in group, I became aware that I had not anticipated the struggles that families with T1D face in the current sociocultural landscape and took more time developing codes before consolidating them into themes.

As for broader systemic factors, this research was aimed at collecting person-level data and did not specifically attempt to link individual experience to societal factors that affect diabetics like healthcare spending. This research was sponsored by two national research organizations and I felt pressure to produce a high quality intervention, and I believe this led me to have a positivist framework to try to find results and to frame events as generally positive and pleasant, even when I personally was deeply saddened by the reported experiences of participants (e.g., when one participant described feeling she could not sleep more than a few hours uninterrupted for fear that her child with T1D would die in their sleep from low BG).

When considering the context in which this intervention took place, the place and time of this intervention greatly shaped how it transpired. Eugene, Oregon, is not representative of Oregon as it racially slightly skews White (83.1% compared with 77%) and has a lower median household income ($45,200 compared with $53,300) according to Statistical Atlas (2024). Participant zip codes reflected higher and, in some cases, double the median household income of Eugene as a whole, possibly suggesting that they came from comparatively privileged or well-resourced settings. That said, they came to an intervention at a time when DCCT-NP's nonprofit activities had been significantly reduced since the COVID-19 pandemic, as had other T1D groups in the area (e.g., “Momma I’m Low”), and all participants went on to report that they felt a lack of in-person supports and group activities for T1D families (see Results). This intervention also came at a time of increased financial precarity for many families and concerns about

increased costs of diabetes care (Kim et al., 2025), particularly to pay for insulin, insulin pump, and continuous glucose monitoring supplies. Concerns about increases in costs of healthcare and fewer health services in public schools, along with general attitudes about dim financial prospects, led to an atmosphere of increased uncertainty and anxiety about managing diabetes and to feeling families had to embark on health management alone.

Around the time of this research project in Eugene and Springfield, Oregon, some healthcare specialty and primary care physicians were closing their practices following the acquisition of medical practices by a national conglomerate (Blow, 2025), further augmenting anxiety about access to care, particularly for minors. While not explicitly anti-capitalistic, it was important to my values that participants would not be required to pay to participate. That mindset encouraged me to try to identify strengths of the intervention and participants during the analysis and reflects my bias that groups are essential factors for interventions, as I believe they are more sustainable through low barriers to entry and curative factors like opportunities for belonging.

My circumstances and awareness of the phenomena described above affected both the implementation of the study and its analysis. There were significant pivots in the delivery of the intervention, such as combining caregiver and T1D groups after the 4th session and there was a move away from providing skills and towards providing validation of feelings in sessions. The data for the qualitative intervention was analyzed after I had moved away from Oregon, with the result that collaborating with Tian Walker and other colleagues was harder because it had to be done remotely via phone, teleconference, and email/text message. This slower process may have been helpful in allowing certain ideas to be processed between discussions, such as which codes were appropriate, but also meant that making immediate changes to codebooks was virtually

impossible and some information was lost between discussions, which further slowed the analysis process.

Finally, the primary means by which Tian Walker and I engaged in reflexivity came from moments in which I debriefed with my team and by asking participants to rate and provide feedback about the intervention at the end of every session. In coding data, Tian and I regularly talked about which codes were appropriate and how to increase agreement about their application. It is our mutual hope that this research process itself can be iterated upon to make ever more effective interventions.

CHAPTER III

RESULTS

In order to contextualize the findings of this study, I begin this chapter with a note about the process of updating the intervention in the middle of the study, as this influenced the structure of the study and data that was collected. Following a review of study attendance and missing data, I present findings in order of the research questions presented in Chapter I. Specifically, I describe how participants and interventionists rated the intervention and present the qualitative themes that emerged from codes Tian Walker and I developed. Next, I describe the findings associated with the psychosocial measures and diabetes-specific measures and close this chapter with results of the analyses of the biomarker samples of participants.

Process of Updating the Intervention

As noted in the Methods section above, developing 3T1's structure and content was an iterative process. After initiating the intervention, I sought input from participants and interventionists to tailor 3T1 content so that it would be maximally beneficial to participants, rather than adhering strictly to the initially planned session outlines. Specifically, I reviewed interventionist field notes regarding participant goals and experiences as well as weekly written open-ended implementation prompts that participants answered themselves and sought input in a mid-intervention meeting with interventionists prior to the fourth of six sessions. As a result, I adjusted the curriculum between sessions.

The parent group meetings consisted of 2-3 mothers for every session. In field notes about the first three sessions, I observed that at the start of caregiver sessions, mothers tended to appear reluctant to engage in proscribed topics, even when they had previously requested a particular topic of discussion. During sessions, mothers reported that they had problems that

were not amenable to interventions, such as being unable to sleep through a night in order to be able to wake up and check their children's blood sugar or feeling compelled to let younger diabetic children sleep alongside them to monitor them. When I asked them about the experiences of living with diabetes, they noted that diabetes treatment adherence was anathema to quality of life and that they were troubled by poor sleep, constant anxiety, and non-specific stress. They were disinterested in specific kinds of problem-solving or coping strategies and requested to spend more time with one another and the other groups to be able to process their feelings with those who might understand their distress.

In the diabetic group, Tian Walker's field notes also reflected that narrow topics focused on the ADCES7 diabetes curriculum or coping skills were sometimes "met with blank stares" and that participants preferred to exchange tips on treatment and commiserate about "diabetes woes". Tian wrote about perceived participants' desire to "come together" and exchange information, as participants appeared more engaged when moving away from topics like "avoiding burnout" towards the topic of more general distress from diabetes.

Participants in each group, particularly parents, requested more contact with the other group, citing a hope to learn from them and observe how they described life with T1D, as well as a desire to participate in larger group discussions. The intervention team met on June 5, 2025, prior to the fourth session and discussed the reactions and feedback of the group. In the interest of creating more engagement with the content, we determined that interventionists could offer a menu of topics for discussion, noted that participants appeared to prioritize interactions with each other, and hypothesized that combining groups would generally increase participant engagement and satisfaction. Tian Walker noted concerns about the nature of curriculum development and implementation and that it would be hard to replicate 3T1 since the content of sessions was often

more narrowly tailored to participants, rather than closely adhering to written curriculum, a point to which I return in the discussion.

Study Attendance

Three of seven participants attended all six sessions, one missed one session, two missed two sessions, and one missed four sessions. All participants attended an individually scheduled follow-up session approximately six weeks post-intervention to complete post-intervention biomarker and psychosocial data collection (see Table 4). The same four interventionists were present for the first four sessions, at which point one psychology interventionist left due to other commitments and was replaced by another psychology interventionist who also was not diabetic.

Table 4

Participant attendance

ID	Wk1	Wk2	Wk3	Wk4	Wk5	Wk6	Total %	Follow up
#1	Yes	No	Yes	No	Yes	Yes	66%	Yes
#2	Yes	Yes	Yes	Yes	Yes	Yes	100%	Yes
#3	Yes	Yes	Yes	Yes	Yes	Yes	100%	Yes
#4	Yes	Yes	No	No	Yes	Yes	66%	Yes
#5*	Yes	No	Yes	Yes	Yes	Yes	83%	Yes
#6*	Yes	Yes	Yes	Yes	Yes	Yes	100%	Yes
#7	No	Yes	No	Yes	No	No	33%	Yes
Total	86%	71%	71%	71%	86%	86%	79%	100%

*Participants #5 and #6 were respectively part of the sole caregiver/diabetic-minor dyad

Missing data

Most participants completed measures as requested, but there were some missing data and some very brief written responses, perhaps in part because participants completed these measures at the end of sessions when they were about to leave. Out of 40 (the number of times there was a participant-session interaction) 34 implementation questionnaires (Weiner et al., 2017) were completed. Four participants were missing data after session 1 and subsequently two

completed measures electronically on their own; two participants were missing data after session 2 and thereafter one participant completed a measure electronically; finally, one participant was missing data after session 3 and the participant completed the missing measure electronically.

Planned and Actual Quantitative Analysis

An initial power analysis using G*Power software (Version 3.1.9.6) indicated that the seven participants would be insufficient to power statistical tests to find significant differences in the results of the data (e.g., assuming 0.05 α error rate probability and even a moderate effect size of 0.5 with a two-tailed t-test, power would only be 0.24 instead of accepted 0.8), indicating that while trends could be discernable, they would represent non-generalizable findings using frequentist statistical models (Siebert & Siebert, 2017; Kanyongo et al., 2007). As such, regression modeling and multilevel modeling were excluded from the plan of analysis, and descriptive statistics were reported for all quantitative measures. The data was analyzed using IBM SPSS Statistics 31 software (version 31.0.1.0).

To screen outliers or anomalous data that could affect statistical associations, Median Absolute Deviation (MAD) values were calculated in addition to standard deviations. Data with triple the MAD scores (≥3) were identified as possible outliers and dealt with on a case-by-case basis (Mellenbergh, 2019). Since much of the data had non-normal residuals and sample sizes were small, I used nonparametric statistical tests. I conducted non-parametric two-tailed Wilcoxon sign tests (Siebert & Siebert, 2017) to examine change between the beginning, end, and follow-up of the 3T1 in: measures of 3T1's acceptability, appropriateness, and feasibility, measures of diabetes management and family stress, including DSES, DOES, PMCSMS, DSMQ-R PedsQL-FIM, and DDS, and measures of physiological stress including HbA1c and hair cortisol. When the Wilcoxon test's assumptions were not met due to unequal distribution of

differences around median scores for the Wilcoxon tests, I used a two-tailed paired sign test or, for analyses of implementation measures, Kendall's coefficient of concordance (Kendall's W; Siebert & Siebert, 2017). Due to the small sample size and limited power which limits the ability to draw substantive conclusions, analyses of change over time (to address original study questions) are reported only in Appendix F.

Study implementation measures

RQ1 - Participant ratings of 3T1's acceptability, appropriateness, and feasibility over the course of the intervention

All mean ratings of the intervention and design were 3.9 or higher on a scale of 1-5, indicating general satisfaction with the intervention. 3T1's Acceptability (AIM), appropriateness (IAM), and feasibility (FIM) were all above 4 out of 5. Mean study-specific measures of Ease of Participation, Appropriateness of 3T1 Pacing, Behavioral Outcomes of 3T1, and their mean Composite 3T1 measure were favorably rated well too, with all but one score (Pacing in week 6) above 3 (see Table 5 below). The lowest scores were on Pacing at all three time points. There were no significant changes in scores of these measures from the beginning to the end of the intervention (see Appendix F for specific statistical analyses). The positive ratings of 3T1 were consistent with my hypothesis that 3T1 would be perceived as acceptable, appropriate, and feasible for participants. See Figure 2, Appendix A, for standardized implementation measures by week.

Table 5

Descriptive statistics of participant implementation measures

	T_0 (week 1)			T_1 (week 6)			T_2 (week 12)			Total (weeks 1-12)[1]		
	n	mean	SD	*n*	mean	SD	*n*	mean	SD	*n*	mean	SD
Acceptability	5	4.30	.54	6	4.25	.39	4	4.44	.43	34	4.35	.46
Appropriateness	5	4.23	.60	6	4.13	.59	4	4.19	.38	34	4.18	.53
Feasibility	5	4.15	.49	6	4.17	.34	4	4.06	.13	34	4.17	.52
Ease of Participation	5	4.60	.55	6	4.39	.57	-	-	-	30	4.51	.56
Pacing of 3T1	5	3.88	1.21	6	2.83	1.17	-	-	-	30	3.29	1.25
Behavioral Outcomes	5	3.39	1.30	6	4.25	.76	-	-	-	30	4.01	.87
Composite measure	5	4.32	.78	6	3.9	.70	-	-	-	30	4.06	.69

[1] Denotes that the "Total" scores were for all combined data from weeks 1-12. *Note*: There were no 3T1-specific measures in week 12 because they only reflected experiences from the previous week. Scores for all measures ranged from 1-5, with 5 indicating greater favorability.

RQ2 - Interventionist ratings of 3T1's acceptability, appropriateness, and feasibility over the course of the intervention

Interventionists' implementation ratings were gathered at the end of every intervention session and they did not participate in the follow-up session. This data includes responses from Tian Walker and me, as we considered our own ratings of the intervention to be relevant in evaluating 3T1's implementation. While there were five total interventionists, only four were present for any given session, thus for most responses there were four cases or points of data. Non-diabetic interventionists did not answer 3T1 Behavioral Outcome questions about how being part of the intervention affected their diabetes care, but otherwise all measures were completed every week. Total mean ratings by interventionists were favorable, with ratings of intervention acceptability, appropriateness and feasibility all greater than 4.4 out of 5. Study-specific measures also were rated positively by interventionists with respect to Ease of participation, Outcomes of 3T1 on behavior, Appropriateness of pacing, and mean Composite 3T1 measures were all greater than 4 out of 5 (see Table 6 below). There were no significant changes on these measures from the beginning to the end of the intervention (see Appendix F for

specific statistical analyses). The positive ratings of 3T1 aligned with my hypothesis that 3T1 would be acceptable, appropriate, and feasible for interventionists. See Figure 3, Appendix A, for standardized implementation measures by week.

Table 6

Interventionist descriptive statistics of implementation measures

	T_0 (week 1)			T_1 (week 6)			Total (weeks 1-6)		
	n	mean	SD	*n*	mean	SD	*n*	mean	SD
Acceptability of 3T1	4	4.38	.75	4	4.88	.20	24	4.62	.48
Appropriateness of 3T1	4	4.31	.69	4	4.69	.63	24	4.49	.54
Feasibility of 3T1	4	4.31	.85	4	4.75	.50	24	4.47	.55
Ease of participation	4	4.25	.83	4	4.67	.67	24	4.42	.68
Appropriate of Pacing	4	3.75	.96	4	4.38	1.25	24	4.04	1.02
Behavioral Outcomes	4	3.25	.50	3	4.67	.29	19	4.08	.73
Composite 3T1 measure	4	3.82	.65	4	4.61	.60	24	4.24	.57

Qualitative data

RQs 3 & 4 - What were qualitative experiences of 3T1 for participants and interventionists?

Sixty codes were generated from the interventionist and participant data and organized into nine sub-themes clustered within the following four superordinate themes:

- *Benefits of Community* related to benefits and nature of community both in and outside of the 3T1 intervention.
- *Life with Diabetes* related to experiences of living with T1D, including desire for perfect adherence, joy at pleasant experiences, and benefits of adherence.
- *Structure* related to the internal organization, logic, and design of 3T1.
- *Evaluation of 3T1* related to critiques about the content of 3T1 or what might be needed to improve it.

Below I describe the sub-themes that made up these superordinate themes. Sub-themes and the codes from which they were derived are presented in Tables 7-10 below, first for interventionists

and then for participants, along with illustrative excerpts. I have included the number of instances codes were applied to illustrate which themes were more ubiquitous and which were rarer. Of note is that while there were five interventionists whose responses are reviewed below, one of them was only present for two data collection points (i.e., she provided field notes and answered open-ended questions for two 3T1 sessions and did not participate in the focus group). As such, most qualitative data only reflects the experiences of the initial team of four interventionists. Quotes are presented unedited except for bracketed words to clarify meaning or protect anonymity. (See Appendix D for the complete codebook with descriptions of codes).

Benefits of Community theme

The most significant superordinate theme that we identified from feedback on the experience of the intervention was the *Benefits of Community* (see Table 7 below for codes and example excerpts). This superordinate theme was manifest in almost every piece of feedback about what went well about 3T1, to the point that it seemed important to disambiguate it from any other evaluations of 3T1. The *Benefits of Community* superordinate theme had no subthemes and was derived from codes related to community, positive outcomes, support in and outside of the intervention. It was composed of five codes: “Diabetes community is essential”, “Breaking isolation”, “Knowledge transfer”, “Need for desired support”, and “Sources of support.” See Figure 4 in Appendix A for the Benefits of Community coding tree.

Table 7

Benefits of Community theme

Benefits of Community theme		
Participants		
Code	Code distribution	Excerpt examples
Diabetes community is essential (78 instances)	7 participants, 18-39 instances	• "Hearing all the other Type 1 stories [especially those about resilience and funny pump/CGM stories]. The shared understanding has been really nice/refreshing to be around!" (Diabetic participant, week 6)
Breaking isolation (72 instances)	7 participants, 2-29 instances	• "I think the big thing that's lacking is just that type 1 community [in daily life]...that's what I was really, you know, hoping for" (Diabetic participant, focus group) • "The most helpful aspect is having others to talk to about this invisible disease" (Caregiver participant, week 6)
Knowledge transfer (39 instances)	7 participants, 3-14 instances	• "Sharing ideas with other Type 1s" (Diabetic participant, week 2) • "Having community with other T1Ds. Sharing ideas for managing BGs" (Diabetic participant, week 5)
Sources of support (8 instances)	2 caregivers and 1 diabetic, 1-5 instances	• "The type 1 group [separate from 3T1] that Tian has formed that meets once a week, that has become a big support as long and you know, the couple friends that I've built in there" (Diabetic participant, focus group) • "My partner and close friends are a support I feel, you know, I don't see my endocrinologist very often, but I feel well supported there also. And like I could reach out if I needed to, you know, in between appointments" (Caregiver, focus group)
Need for desired support (7 instances)	1 caregiver and 3 diabetics, 1-3 instances	• "I really realized that because of the medical things that I've fought and went through that this [community of diabetics] is just truly what I have missed" (Diabetic participant, focus group)
Interventionists		
Code	Code distribution	Excerpt examples

Diabetes community is essential (42 instances)	5 interventionists, 4-16 Instances	• "Talking about [diabetes] with others and watching the participants connect and share diabetes woes is a very joyful experience" (Diabetes educator, week 4) • "[3T1 enabled] casual communication with other diabetics" (Diabetes educator, week 3)
Breaking isolation (22 instances)	5 interventionists, 3-6 Instances	• "Hearing about other people's diabetes struggles makes me feel like we all have the power to do more if we share our information and stories with each other" (Diabetes educator, week 3) • "Knowing that I'm not alone" (Psychology interventionist, week 6 field notes) • "Community feels good in the moment [in sessions]" (Psychology interventionist, week 6 field notes) • "Diabetes pride and acceptance" (Psychology interventionist, week 6 field notes) • "Embracing the value of spontaneous interactions and bonding between T1Ds in public, e.g., commenting on strangers' Dexcoms [continuous glucose monitors] and pumps" (Psychology interventionist, week 6 field notes)
Need for desired support (13 instances)	5 interventionists, 1-5 Instances	• "Diabetes can be an isolating experience, but [it is] buffered by community and emotional support" (Psychology interventionist, week 5)
Knowledge transfer (13 instances)	2 diabetes educators and 2 psychology interventionists, 2-6 Instances	• "Hearing everyone talk about what is hard about diabetes" (Diabetes educator, week 4)
Sources of support (5 instances)	2 diabetes educators and 2 psychology interventionists, 1-3 Instances	• "Some bright spots included encouragement from a parent with an older diabetic saying that parental independence would increase as children mature" (Psychology interventionist, week 4)

Note: An "instance" refers to an occurrence of a code being applied to an excerpt. The range reflects the smallest to the largest number of instances per person.

Life with Diabetes theme

The next superordinate theme, *Life with Type 1 Diabetes*, captured experiences about what it is like to have diabetes (see Table 8 below for codes and example excerpts). It was composed of the four sub-themes “Negative relationship with diabetes”, “Diabetic pain”, “Positive relationship with diabetes”, and “Diabetes lifestyle”. The “Negative relationship with diabetes” sub-theme was composed of four codes that captured descriptions of experiences that were unpleasant or painful and usually involved affective states in and outside of 3T1: “Adherence is hard or feels impossible”, “Perfectionism”, “Diabetes is a battle", “Adherence versus quality of life.” The “Diabetic pain” sub-theme was composed of four codes that captured descriptions of experiences of how T1D became a source of pain (e.g., in relationships with other people): “Diabetes distress comes from without”, “Diabetes frustration”, “Lack of understanding in daily life” and “T1D is a family disease.” The “Diabetes lifestyle” sub-theme was composed of seven codes that captured descriptions about how T1D significantly affects lifestyle and vice versa: “Food”, “Value of adherence behaviors”, “Schedule”, “Medical guidelines vs. lived experience”, “Exercise is helpful", “Diabetes supplies”, and “Other health issues.” Finally, the “Positive relationship with diabetes” sub-theme was composed of two codes that captured descriptions of positive experiences or emotions related to T1D: “Value of acceptance” and “Diabetic joy.” See Figures 5a and 5b in Appendix A for the Life with Diabetes theme coding trees.

Table 8

Life with Diabetes theme

Life with Diabetes theme			
Participants			
Sub-theme	Code	Code distribution	Excerpt examples
Negative relationship with diabetes	Adherence is hard or feels impossible (62 instances)	7 participants, 1-18 instances	• "This week was a hard one! Sports, outside temperature changes, and whatever else made numbers all over the place" (Diabetes caregiver, week 4) • "Lack of time to properly plan meals/workouts; my pharmacy not having my insulin/CGM/insulin pump in stock; & a packed schedule" (Diabetic participant, follow up session)
	Perfectionism (26 instances)	3 diabetics and 1 caregiver participant, 3-13 instances	• "For my son [good diabetes control] would look like staying in range. Being able to bolus [or administer a large insulin dose] in advance w/out difficulties. The school lunch menu not changing w/out telling us so we are more prepared. My son's stressors would be lowered" (Caregiver participant, intake form) • "Good blood sugars, doing insulin on time, keeping track of eaten carbs for when bolus [or administer a large insulin dose] on pump" (Diabetic participant, intake form) • "I have a pretty high bar for what I want, my time in range and what my blood glucose to be like" (Diabetic participant, focus group) • "Talking about what we would want our life would be like if our diabetes management was exactly how we wanted it. Because it may never be exactly how we want it to be. And even if it was, my life might never be exactly like how I want it to be" (Diabetic participant, week 2)
	Diabetes is a battle (13 instances)	3 diabetic and 2 caregiver participants, 1-4 instances	• "Everybody fights, it's just a normal part of the type 1 life...I really realized that because of the medical things that I've fought and went through that [community] is just truly what I have missed. And that is very, it is very just an important part of the whole Type 1 journey" (Diabetic participant in the focus group)

			• "[Overwhelming concerns include] two homes, school nurse, other illnesses, life, overwhelm, money, time, etc." (Caregiver, week 12 follow up session)
	Adherence versus quality of life (10 instances)	2 diabetic and 3 caregiver participants, 1-5 instances	• "I feel it is not too much to manage this [diabetes] properly. Although, it does require sacrifices elsewhere" (Caregiver participant, week 4) • "I know [adherence is] something I have to do but don't always give it top priority in my daily routine" (Diabetes educator, week 1) • "[Non-adherence is due to] not putting myself first, aka letting conversations with others/being a burden to others to put before dosing or just general diabetes management" (Diabetic participant, week 5)
Diabetic pain	Diabetes distress comes from without (45 instances)	7 participants, 2-12 12 instances	• "Lack of energy and motivation" (Diabetic participant, intake form) • "Once again, having an overpacked college schedule always makes managing diabetes more stressful/overbearing" (Diabetic participant, week 5) • "Other responsibilities, time for work, family, and pets [all interfere with adherence]. It takes a lot of forethought such as meal planning, packing snacks for activities outside of the house. Sometimes it's just too exhausting or tedious to do the prep work" (Diabetic participant, week 12 follow up)
	Diabetes frustration (25 instances)	7 participants, 1-8 instances	• "Generally [I'm] ok, but I get frustrated with Dexcom [continuous glucose monitoring device] beeping highs/lows when I'm at work or the constant beeps when I can't get BG to budge. Irritated when I have to stop what I'm doing to manage BG or worried about bolusing [administering a dose of insulin] when eating at a restaurant/friend's house" (Diabetic participant, intake form) • "Equipment problems" (Caregiver participant, week 5)
	Lack of understanding in daily life (14 instances)	1 caregiver and 3 diabetic participants, 2-5 instances	• "[Diabetes is] difficult, despite what my friends and family say" (Diabetic participant, week 6) • "It's a silent thing that most people really can't understand the weight of" (Diabetic participant, focus group)

	T1D is a family disease (14 instances)	1 diabetic and 2 caregiver participants, 1-9 instances	• "Traveling at times but still not much [would be a sign of good management]. Pretty much living with diabetes is staying on top of diabetes for us" (Caregiver participant, week 6) • "[Diabetes] is part of my life. It takes energy and time, but that's just how it goes" (Caregiver participant, intake form) • "My son was with me so I could keep a closer eye on his numbers, set my phone to intervene sooner, keep a regular schedule [to have good control]" (Caregiver participant, week 12 follow up)
Diabetes lifestyle	Food (23 instances)	3 diabetic and 2 caregiver participants 1-10 instances	• "[Good control would look like] Low carb / Low fat diet. Not eating out and lots of movement" (Diabetic participant, intake form) • "[Challenges include] planning meals and timing meals with consideration of diabetes" (Diabetic participant, week 6) • "[Good control would look like] getting my son to eat more protein prior to other foods" (Caregiver participant, week 3)
	Value of adherence behaviors (14 instances)	2 diabetic and 2 caregiver participants, 1-8 instances	• "[Checking] blood sugars, bolusing [or administering a dose of insulin] prior [to] eating" (Diabetic participant, week 6) • "I have learned a lot more recently about different strategies with dosing, so that has helped to make more informed choices" (Caregiver participant, week 6) • "Following SMART goals...Using insulin pump to bolus for meals" (Diabetic participant, week 3)
	Schedule (6 instances)	2 diabetic and 2 caregiver participants, 1-3 instances	• "Work schedule - irregular breaks/mealtimes" (Caregiver participant, intake form)
	Medical guidelines versus lived experience (5 instances)	1 diabetic and 1 caregiver participant, 1-4 instances	• "I often feel like I don't have enough time to really consult with the medical team, so I really rely on my own research via other T1's to make dosing changes" (Caregiver participant, week 4) • "We know in practice that [some guidelines are] not true, but it's really nice to speak with a group of people with lived experience to really see that that's not true" (Diabetic participant, focus group)

	Exercise is helpful (4 instances)	1 diabetic and 1 caregiver participant, 1-3 instances	• "My lack of exercise from the last 2 weeks caught up with me and my walking has helped so much and my body and mind are relaxing" (Diabetic participant, week 5)
	Diabetes supplies (3 instances)	2 caregiver participants, 1-2 instances	• "This week has been a hard week with lack of supplies" (Caregiver participant, week 3)
	Other health issues (2 instances)	1 caregiver participant, 2 instances	• "Medical conditions of myself or myself [are barriers to treatment adherence]" (Caregiver participant, week 4)
Positive relationship with diabetes	Value of acceptance (29 instances)	2 diabetic and 3 caregiver participants, 4-9 instances	• "It [diabetes management] is part of my life. It takes energy and time, but that's just how it goes" (Diabetic caregiver, intake form) • and "I think about it [diabetes management] all the time but not in an overwhelming sense" (Diabetic participant, week 1) • "Honestly [life is] pretty good on the day-to-day basis. Like all things, I have bad days, but most of the time I feel very good about [diabetes]" (Diabetic participant, intake form) • "Be a little easier on myself in terms of what's going on with diabetes" (Diabetic participant, focus group)
	Diabetic joy (18 instances)	4 diabetic and 2 caregiver participants, 1-8 instances	• "I have been more aware of my [time-in-range] and wanting to stay in range. I had a lot of really long, exciting yet exhausting days this week and my blood sugar was relatively smooth for it" (Diabetic participant, week 6) • "I haven't had too many extreme high or low blood sugars which has been nice" (Diabetic participant, week 2) • "'Diabetic joy' [sharing light-hearted moments] has been some of the highlights of this so far" (Diabetic participant, week 5)
Interventionists			
Sub-theme	Code	Code distribution	Excerpt examples
Negative relationship with diabetes	Adherence is hard or feels impossible (52 instances)	5 interventionists, 2-20 instances	• "I realized tonight that I constantly feel negative about my management of diabetes: like no matter what I do something goes away and yet I am meeting clinical goals & technically doing quite well" (Diabetes educator, week 2)

			• "Life is so inconsistent" and BG control seems to demand perfect constancy, and it is this belief that contributes to burnout. Others not accommodating diabetes also makes management difficult, particularly when this comes from healthcare professionals like doctors and school nurses, or from authority figures, like employers" (Psychology interventionist, week 6 field notes)
	Perfectionism (25 instances)	2 psychology interventionists and 1 diabetes educator, 6-11 instances	• "The other things seem to be a sense that it is too overwhelming due to the belief that one must be perfect, 100% Time in range" (Psychology interventionist, week 6) • "It feels so much easier to focus on what is going wrong or what we "didn't do" as opposed to wins, neutral outcomes, avoided disasters, and positive management practices" (Psychology interventionist, week 4)
	Diabetes is a battle (19 instances)	5 interventionists, 1-9 instances	• "Managing diabetes is hard and wears on the soul" (Diabetes educator, week 6) • "Stories of diagnosis and management often seemed to be about overcoming incompetence from others (like healthcare providers), helplessness, and tolerating ongoing stress" (Psychology interventionist, week 3)
	Adherence versus quality of life (16 instances)	2 psychology interventionists and 2 diabetes educators, 2-7 instances	• "Irritation with lows, especially at night and while sleeping. My stubbornness prevents me from wanting to treat" (Diabetes educator, week 6) • "I know it's something I have to do but don't always give it top priority in my daily routine" (Diabetes educator, week 1) • "[Adherence would mean] being able to tolerate unknowns and balancing 'adherence as opposed to freedom and less anxiety'" (Psychology interventionist, week 3)
Diabetic pain	Diabetes frustration (33 instances)	5 interventionists, 1-14 instances	• "Negative emotions about BG that lead to overreaction and residual feelings of negativity" (Diabetes educator, week 4).
	Diabetes distress comes from without (30 instances)	5 interventionists, 1-13 instances	• "Meetings that run long, sticky highs [high BG that stays high beyond expected timeframes], restaurants that put sugar in their sauces" (Diabetes educator, week 6) • "Life inconsistencies" (Diabetes educator, week 5)

			• "Carb counting gone wrong, stress, chaotic life events, misunderstanding of how insulin works, other people, jobs and school, bad sleep, and any part of life that is unpredictable" (Diabetes educator, intake form).
	Lack of understanding in daily life (13 instances)	5 interventionists, 1-6 instances	• "Since other obligations and systems do not accommodate diabetes management needs, those needs become secondary to other activities, even when those activities become harder or impossible without adequate BG and diabetes care" (Psychology interventionist, week 6)
	T1D is a family disease (6 instances)	1 psychology interventionist and 1 diabetes educator, 1-5 instances	• "When talking as a group, parents said that Type 1 diabetes is not the main impediment in their lives but rather that how complicated life can be leads to burnout" (Psychology interventionist, week 6) • "Parents can try to understand and manage what they can but that at certain ages diabetics may push back against sympathy and attempts at understanding from caregivers" (Psychology interventionist, week 6).
Diabetes lifestyle	Food (8 instances)	1 psychology interventionist and 1 diabetes educator, 2-6 instances	• "Eating less and only eating at regularly scheduled times" (Psychology interventionist, intake form)
	Value of adherence behaviors (8 instances)	2 psychology interventionists and 1 diabetes educator, 1-6 instances	• "I am always sure to check my BG often but not too often" (Psychology interventionist, intake form) • "Diabetes is hard to manage due to the inconsistency and it seems important to mostly manage both expectations and inconsistency that emerge as a result of diabetes and day to day life not built for a life with diabetes" (Psychology interventionist, week 5)
	Schedule (8 instances)	2 psychology interventionists and 2 diabetes educators, 1-3 instances	• "Monitoring and behavior management, as well as identifying ways to develop healthy routines" (Psychology interventionist, week 1)
	Medical guidelines versus lived experience (2 instances)	1 psychology interventionist and 1 diabetes educator, each with 1 instance	• "Others' not accommodating diabetes also makes management difficult, particularly when this comes from healthcare professionals like doctors and school nurses, or from authority figures, like employers" (Psychology interventionist, week 6)

	Exercise is helpful (2 instances)	1 psychology interventionist and 1 diabetes educator, each with 1 instance	• "[Adherence is enhanced by] exercise and consulting with diabetic/trained healthcare professionals (e.g., a diabetic physical therapist in town)" (Psychology interventionist, week 5)
	Diabetes supplies (2 instances)	2 psychology interventionists, each with 1 instance	• "Other barriers included significantly higher allostatic load due to issues with technology" (Psychology interventionist, week 4)
	Other health issues (2 instances)	1 psychology interventionist and 1 diabetes educator, each with 1 instance	• "Other health concerns" (Diabetes educator, week 6) • "Mental health" (Psychology interventionist, week 6)
	Value of acceptance (16 instances)	2 psychology interventionists and 2 diabetes educators, 2-7 instances	• "Finding solidarity, considering new ways to look at diabetes management and attitudes, e.g., celebrating the 'smaller' wins, such as remembering to pre-bolus" (Psychology interventionist, week 4) • "Diabetes management is about accepting that things will go awry and going with that flow. I think adequate management is about learning what is 'good enough' and how to achieve it while managing the anxiety of always being one meal or workout away from 'bad' BG and its concordant pain and risk of long-term health issues" (Psychology interventionist, week 6)
	Diabetic joy (12 instances)	(2 psychology interventionists and 1 diabetes educator, 1-6 instances	• "Talking about [life with T1D] with others and watching the participants connect and share diabetes woes is a very joyful experience" (Diabetes educator, week 4) • "Things [participants] are grateful for, both related and unrelated to T1D: resilience, empathy, modern medicine, care for our bodies, lower drug prices, Dexcom CGMs, when others 'get what it's like to have T1D', and being able to be mad about diabetes" (Psychology interventionist, week 6)

Note: An "instance" refers to an occurrence of a code being applied to an excerpt. The range reflects the smallest to the largest number of instances per person.

Structure of 3T1 theme

Evaluating how the intervention was designed, rather than how the content was delivered, became of great interest as we analyzed the data (see Table 9 below for codes and example excerpts). Tian and I identified two sub-themes of "3T1 was well-structured" and "3T1 was poorly structured". These sub-themes were composed of codes that reflected what respondents thought about the structure of the 3T1 intervention, including how sessions were organized, how interventionists and participants were prepared, and what content was selected prior to being implemented. The "3T1 was well-structured" sub-theme was composed of four codes: "3T1 was strengthened by interventionist collaboration", "3T1 structure was helpful", "3T1 benefited from being flexible", and "Addressing broad concerns surpassed diabetes education." The "3T1 was poorly structured" sub-theme was composed of seven codes: "Lack of intervention target clarity", "3T1 structure was inconsistent", "Need for session zero", "3T1 structure was unhelpful", "3T1 had a deficit framework", "3T1 needed more participant input", and "Need for prior group intervention education". See Figure 6 in Appendix A for the Structure of 3T1 theme coding tree.

Table 9

Structure of 3T1 theme

Structure of 3T1 theme			
Participants			
Sub-theme	Code	Code distribution	Excerpt examples
3T1 was well-structured	3T1 structure was helpful (11 instances)	2 diabetic and 2 caregiver participants, 1-6 instances	• "Developing SMART goals" (Diabetic participants, week 3) • "Just having dedicated time/space to talk about it helps to bring to light what the struggles are and identify possible solutions" (Caregiver participant, week 4) • "I'm still working on my SMART goal. That's kind of an, just an ongoing thing. I really enjoyed the focus on it, and it really helped me like narrow down, be super specific about 1 area to work on. So that's been super helpful for me" (Diabetic participants, focus group)
	3T1 was strengthened by interventionist collaboration (1 instance)	1 diabetic participant, 1 instance	• "Tian has type 1 and is a researcher, so she's got a wealth of perspectives. But it was really nice having her along with a psychologist because, you know, Tian could kind of translate some of our diabetes lingo that we're kind of throwing around that, you know, are not necessarily realizing is not maybe common language to people who haven't spent time in the community" (Diabetic participant, focus group)
3T1 was poorly structured	3T1 structure was unhelpful (6 instances)	3 diabetic and 1 caregiver participants, 1-2 instances	• "Least helpful was just the time we met each week. At times, it was hard to make plans around [the intervention]" (Diabetic participant, week 6)
	Lack of intervention target clarity (1 instance)	1 caregiver participant, 1 instance	• "Not really sure [what 3T1 was even trying to accomplish]" (Caregiver participant, week 2)
Interventionists			
Sub-theme	Code	Code distribution	Excerpt examples

3T1 was well-structured	3T1 was strengthened by interventionist collaboration (33 instances)	2 diabetic and 2 caregiver participants, 5-10 instances	• "It was very helpful for me to have Tian there as somebody who had kind of more knowledge and background information and maybe more implementable and relevant strategies kind of as well as, you know, my side and feeling like I had the backup was very helpful for me" (Psychology interventionist, focus group) • "Talking about dynamics, I always felt very comfortable asking for and giving feedback to this team...there was this sense of like, 'Oh, yeah, this is going to be a group of people that if I throw something out there, no one's ego is going to get bruised'. It's going to be like, OK, like, let's talk about that and think about that. And I think that made a big deal difference was just that trust that I had in this team" (Psychology interventionist, focus group)
	3T1 benefited from being flexible (24 instances)	2 psychology interventionists and 2 diabetes educators with 5-7 instances	• "Tailoring the ideas more specifically to diabetes and then the group had a lot to say. There has also been sharing of tips between participants which seems very helpful." (Diabetes educator, week 3) • "Outlines really did try to specify what was, you know, expected or kind of what the job description was...having more structure may have been helpful, but I don't, I don't know that it would have mattered anyway" (Diabetes educator, focus group)
	3T1 structure was helpful (23 instances)	2 psychology interventionists and 2 diabetes educators with 2-9 instances	• "Everyone talking about the hardest parts of diabetes helped me see what education components we should focus on" (Diabetes educator, week 2) • "Setting up psychoeducation re: goals & self-efficacy" (Psychology interventionist, week 1) • "Discussing our plans for the session seemed to improve the flow of the conversations" (Psychology interventionist, week 4).
	Addressing broad concerns surpassed diabetes education (18 instances)	2 psychology interventionists and 1 diabetes educator with 2-10 instances	• "I think asking folks about, like, kind of bigger struggles and, like, going more topic based with a curriculum rather than skills based is, would be great" (Psychology interventionist, focus group) • "When working with kids, to have like a maximum 10% diabetes education, 90% just being together model" (Diabetes educator, focus group) • "I think maybe there was one book I brought that someone was excited to look at one time...I overprepared, just like wanting to like feel like I was bringing some kind of like formal curriculum to the table, but it really wasn't needed" (Diabetes educator, focus group)

3T1 was poorly structured	Lack of intervention target clarity (30 instances)	2 psychology interventionists and 2 diabetes educators with 1-17 instances	• "I felt very unprepared often coming into the session" (Diabetes educator, focus group) • "I can relate to [diabetes educator] in terms of that sort of feeling a little bit blind about like what really we were for sure trying to do in the session versus letting it take its own course" (Diabetes educator, focus group) • "Something that I really noticed, like there was in the curriculum, like a lot of talk about like SMART Goals and things like that. And something that I noticed with our Type 1's was a focus on like perfection and like SMART goals being really big. And so and like, you know, obviously we tried to kind of tamp it down and make them a little bit more realistic" (Psychology interventionist, focus group) • "Had it been clear that psychotherapy was going to be the, you know, the 80% weight and then diabetes education was 20%, that may have eased some of that feeling [of unease] for me" (Diabetes educator, focus group)
	3T1 structure was inconsistent (26 instances)	2 psychology interventionists and 2 diabetes educators with 3-9 instances	• "I didn't know how it was going to which way it was direction it was going to take each week" (Diabetes educator, focus group) • "In reflecting on [how curriculum wasn't closely followed] at least the group we had with the caregivers, I felt one of the most challenging things for me was, and I think I mentioned this was just kind of, you know, we had it very structured, but it, it rarely followed that structure" (Diabetes educator, focus group)
	Need for session zero (22 instances)	2 psychology interventionists and 1 diabetes educator with 3-12 instances	• "I think like having not met each other before this study and, like, just not even having coffee to, like, know how we communicated did pose a challenge. But, like, again, not in a, not a huge issue. But I definitely can see the difference between, like, this new friend and, like, [Psychology interventionist], who I've been like having diabetes conversations with for three years" (Diabetes educator, focus group) • "I don't know that this study included a really great system of debriefing or even having a session zero where we could, like, mockup what was going to happen or practice" (Psychology interventionist, focus group)
	3T1 had a deficit	1 psychology interventionist and 1 diabetes	• "I thought that that was really interesting, particularly kind of, I think that the adherence model kind of assumes the deficit framework. It's like you just need

	framework (15 instances)	educator with 4-11 instances	more adherence. The more adherence, the better. If you lack adherence, it's because you're lacking skills" (Psychology interventionist, focus group) • "There was a bit of a deficit framework that came in, by which I mean a lot of the curricula that it had in the first several weeks, probably 3, maybe even 4 weeks, really was focused on 'let's give you skills.' And my experience with the caregiver group was that they're like, 'we don't need skills'" (Psychology interventionist, focus group) • "I think framing tonight around 'burnout' was not the right fit. Diabetes distress leading up to burnout resonated more with the group and led to more discussion" (Diabetes educator, week 4)
	3T1 structure was unhelpful (11 instances)	2 psychology interventionists and 1 diabetes educator with 1-8 instances	• "Least helpful [thing about 3T1] was organization / setup for the biomarkers, we were not prepared for this work, and it slowed things down considering the need to introduce concepts to people" (Psychology interventionist, week 1) • "Some issues included: focusing too much on content in an un- or under-structured way and at times too much following up on individual concerns, rather than group themes or session focus" (Psychology interventionist, week 3)
	3T1 needed more participant input (8 instances)	1 psychology interventionist and 2 diabetes educators with 1-4 instances	• "I would also add, and again, I don't think this was possible with this pilot version, but having a curriculum that we share with people and whether that's like a directed curriculum of like this is what we're doing or if it's like these are the topics that we want to cover with you and getting some feedback on which ones we prioritize. But I think having a little bit more of an iterative relationship with people and actually like being a little more transparent about like the topics of the curriculum that we're, you know, bringing to the table would be really helpful" (Diabetes educator, focus group)
	Need for prior group intervention education (7 instances)	2 psychology interventionists and 1 diabetes educator with 1-5 instances	• "There are some educational videos that show, you know, mock group therapy kind of sessions…something like that might be helpful. Like this is what a support group can look like" (Psychology interventionist, focus group) • "I love that idea of a crash course and having a little more idea of what it is that we're going along with ahead of time would have been cool" (Diabetes educator, focus group)

Note: An "instance" refers to an occurrence of a code being applied to an excerpt. The range reflects the smallest to the largest number of instances per person.

Evaluation of 3T1 theme

The most critical reason to gather qualitative data from participants was to ascertain the qualitative experiences of participants and interventionists during 3T1 sessions and at follow up. These experiences were captured in the superordinate theme "Evaluation of 3T1" (see Table 10 below for codes and example excerpts). This theme was composed of three distinct sub-themes: "Negative evaluations of intervention", "3T1 generated positive emotions", and "Positive evaluations of the intervention". The "Negative evaluations of the intervention" sub-theme related to negative comments about how the 3T1 was implemented and was composed of four codes: "Interventionist uncertainty", "Poor coordination between interventionists", "Non-generalizable study" (12 instances across all participants and interventionists), and "3T1 content was unhelpful".

The "3T1 generated positive emotions" sub-theme referred to descriptions of fun, positive, interesting, or otherwise pleasant experiences. This theme often related to emotional/affective language used by participants and while related to "Positive evaluations of 3T1", Tian and I decided to keep separate it as it connected with more affective states was composed of six codes: "T1D relief", "Interventionist personal growth", "Empathy", "Participant strengths", "Giving grace", and "Interventionist enjoyment." The "Positive evaluations of the intervention" sub-theme was composed of 17 codes related to positive comments about how 3T1 was implemented: "Interventionists had expertise", "Combined group was beneficial", "3T1 had value", "3T1 Psych content was helpful", "Value of debriefs", "3T1 addressed unmet needs", "Future orientation and planning / problem solving", "Value of T1D education", "SMART goals helpful", "Nondiabetic interventionists helped", "Transparent curriculum", "Interventionists redirected participants", "Skills training was useful", "Small group was good", "Diabetic

Interventionists Helped", "Big Wins", and "Strategizing T1D management". See Figures 7a and 7b in Appendix A for the Evaluation of 3T1 theme coding trees.

Table 10

Evaluation of 3T1 theme

Evaluation of 3T1 theme			
Participants			
Sub-theme	Code	Code distribution	Excerpt examples
Negative evaluations of 3T1	3T1 content was unhelpful (3 instances)	2 diabetic participants, 1-2 instances	• "I guess just to add on to that, it doesn't have to be like a learning thing, [3T1 can serve as] just a place where people can meet." (Diabetic participant, focus group)
3T1 generated positive emotions	T1D relief (21 instances)	7 participants, 1-5 instances	• "I'm looking forward to my husband being gone for a business trip - I get to focus on self-care for 6 days [smiling emoticon]" (Diabetic participant, week 6) • "What went well [this past week]: my kids have a great attitude about T1D and are great at sharing with their friends how they manage" (Caregiver participant, week 4) • "It's pretty profound how helpful it was just to be around other Type 1 diabetics like that alone, walking into a room and not feeling insecure about alarms going off and having to explain it or worrying about, you know, a high or a low and having to keep it secret and just seeing other people in real time also managing their diabetes or their kids is. It's such a simple thing, but it's so profound" (Caregiver participant, focus group)
	Empathy (4 instances)	3 diabetic participants, 1-2 instances	• "Knowing that we all have stress with our diabetes. We are all different yes, but we are all the same about the stress that type 1 causes with our life and not being the same as other people" (Diabetic participant, week 3)
	Giving grace (3 instances)	1 diabetic and 1 caregiver participant, 1-2 instances	• "I can maybe just like, relax a little bit about not having, you know, normal blood sugars, like somebody without diabetes because, you know, I have diabetes. So I have crazy numbers sometimes" (Diabetic participant, focus group).

	Participants identified personal strengths (1 instance)	1 diabetic participant, 1 instance	• "I think about it all the time but not in an overwhelming sense" (Diabetic participant, week 1)
Positive evaluations of 3T1	3T1 had value (15 instances)	3 diabetic and 2 caregiver participants, 1-5 instances	• "I did this specifically because I wanted to meet people in the community and, you know, definitely had success with that. And I think it was really great too, again, you know, having the psychologist perspective, being able to, you know, ask some questions that I had not thought of myself, bringing in that different perspective" (Diabetic participant, focus group) • "Community. Every bit of it was helpful. Thank you" (Diabetic participant, week 6) • "Hearing others' stories and helpful input. Very helpful and comforting. Very educational" (Caregiver participant, week 3) • "Hearing tips & tricks from other people with Type 1 has been neat. Like I didn't know you could refill Dexcoms [CGM devices] after only 23 days" (Diabetic participant, week 2)
	3T1 Psychology content was helpful (14 instances)	1 diabetic and 2 caregivers participants, 1-11 instances	• "Learning all the coping tools and hearing others' perspectives and thought and teachings surrounding T1D" (Caregiver participant, week 6)
	Combined group was beneficial (12 instances)	3 diabetic and 2 caregiver participants, 1-6 instances	• "I also really liked when we brought the two groups together" (Diabetic participant, focus group)
	SMART goals were helpful (10 instances)	(2 diabetic and 1 caregiver participants, 1-8 instances	• "I think it was really great having psychologists involved...it was nice to have a few, you know, interventions that we practiced it kind of just, you know, reframing some thoughts and specifically like writing SMART goals was really great" (Diabetic participant, focus group) • "Referring back to [SMART goals] in the following meetings, like continuously referring back to them. It's not just like, oh, we talk about it, we'll do one follow up and be done. But it was a continuous thing. So that was really great" (Diabetic participant, focus group)

	3T1 addressed unmet needs (6 instances)	3 diabetic and 1 caregiver participants, 1-2 instances	• "I think the big thing that's lacking is just that type 1 community" (Diabetic participant, focus group) • "I have learned a lot more recently about different strategies with dosing, so that has helped to make more informed choices" (Caregiver participant, week 6)
	Future orientation and planning / problem solving (6 instances)	1 diabetic and 1 caregiver participants, 2-4 instances	• "I really enjoyed the focus on it [a specific health target] and it really helped me like narrow down, be super specific about 1 area to work on" (Diabetic participant, focus group)
	Interventionists had expertise (5 instances)	1 caregiver participant, 5 instances	• "I think it was really great having psychologists involved so they could a, just ask some really like great questions and you know, kind of synthesize information really well" (Diabetic participant, week 3)
	Value of T1D education (5 instances)	2 diabetic and 2 caregiver participants, 1-2 instances	• "Tian has type 1 and is a researcher, so she's got a wealth of perspectives" (Diabetic participant, focus group) • "I regret that I missed part of [3T1] because I think it would have brought more to the plate and been more educational" (Diabetic participant, focus group)
	Big Wins (4 instances)	(2 diabetic and 2 caregiver participants, 1 instance per participant	• "I actually was able to let it [hypervigilance around BG regulation] go for about 6 hours" (Diabetic participant, focus group) • "Managing independently [which is atypical]" (Caregiver participant, week 2
	Small group was good (2 instances)	1 diabetic participant, 2 instances	• "One of the things that wasn't helpful was mixing caregivers and diabetics for a day, maybe I just think it wasn't helpful for me because my mother, but just think they thought, they knew what it's like to have diabetes, when they only know some parts" (Diabetic participant, week 6)
Interventionists			
Sub-theme	Code	Code distribution	Excerpt examples
Negative evaluations of 3T1	Interventionist uncertainty (26 instances)	2 diabetic and 2 caregiver	• "Honestly, it did sometimes feel like me and [Diabetes educator] were kind of like along for the ride" (Psychology interventionist, focus group)

		participants, 1-10 instances	• "I did have some trepidation about prolonging too much of my diabetes experience, in part because I was like, 'I don't know if I can model the same way'" (Psychology interventionist, focus group)
	Poor coordination between interventionists (20 instances)	2 diabetes educators and 2 psychology interventionists, 1-8 instances	• "We weren't really sure like who was driving, almost like we're throwing the steering wheel back and forth a little bit" (Diabetes educator, focus group) • "I think like a clearer relationship between the, the like psychotherapy interventions and the diabetes education components would have been helpful" (Diabetes educator, focus group) • "I definitely feel like there were a lot of moments where we were looking at each other like this, like kind of like 'you're gonna, you're gonna [say something]?' And I think also part of it was that we were throwing things that we were hoping somebody in the group would catch and they didn't" (Psychology interventionist, focus group)
	Non-generalizable study (12 instances)	2 diabetes educators and 2 psychology interventionists, 1-4 instances	• "[A] definite improvement would be in, in the, the size of the study group, just would offer a lot of different improvements" (Diabetes educator, focus group) • "I think small group sizes meant there was just less like less bouncing off of. And I really felt that when we had the full group, even though we lost some of the ability to really open up with the type 1s, I thought that like the, the feeling of that number of people was really powerful" (Diabetes educator, focus group) • "I feel like that was part of it [uncertainty between interventionists] as well was like small group sizes people like especially there was one [time] when I think we only had two people and like you could tell they were just sort of fatigued talking" (Psychology interventionist, focus group)
	3T1 content was unhelpful (4 instances)	1 diabetes educator and 1 psychology interventionist, 2 instances each	• "The DBT DEARMAN skill may not always work based on low or insufficient motivation from others to engage in critical conversations, i.e., hard for some participants to imagine using DEARMAN with their partners or healthcare providers" (Psychology interventionist, week 3)
3T1 generated	Interventionist personal growth (24 instances)	2 diabetic and 2 caregiver	• "Hearing about other people's diabetes struggles makes me feel like we all have the power to do more if we share our information and stories with each other" (Diabetes educator, week 3)

positive emotions		participants, 3-9 instances	• I honestly feel like you two [diabetes educators] kind of got a little crash course in support group psychotherapy facilitation because like, I mean, Tian, it felt very much like it would have felt with a another like psychotherapist in the room of like just kind of the way that you were able to like bounce off experiences and empathize is like such a huge part of it (Psychology interventionist, focus group)
	Empathy (16 instances)	5 interventionists, 2-5 instances	• "Just hearing from other diabetics, different perspectives and insight" (Diabetes educator, week 2) • "[3T1] has opened my eyes to different views, hardships, successes, struggles of others" (Diabetes educator, week 5) • "I felt very empathetic towards the parents who I was just like, wow, you have it as bad as, you know, we do or as I did as a kid, but for different reasons. And, you know, it just made me feel a lot more empathetic towards them. And I felt like that was really powerful. Just for me, thinking as, like, this is, I'm an interventionist, but like, I'm also affected by this intervention" (Psychology interventionist, focus group)
	Participants identified personal strengths (4 instances)	1 diabetes educator and 1 psychology interventionist, 1-3 instances	• "Being in a room with other Type 1's builds resilience and emotional strength" (Diabetes educator, week 6) • "There has also been sharing of tips between participants, which seems very helpful" (Diabetes educator, week 3)
	T1D relief (3 instances)	3 psychology interventionists, each with 1 instance	• "It seems like parents of people with type 1 diabetes largely accept [having T1D after processing it] and [the] embrace of T1D increases independence from their children" (Psychology interventionist, week 3)
	Interventionist enjoyment (3 instances)	2 psychology interventionists, 1-2 instances	• "I think this has been a really beautiful project and everyone involved has brought a really important component" (Diabetes educator, focus group) • "Yeah, I'll echo that. I had so much fun doing this with y'all and thanks for letting me be your resident non-type 1 sneaking into the space. But I really enjoyed it and I've learned a lot" (Psychology interventionist, focus group)
	Giving grace (2 instances)	1 diabetes educator and 1 psychology	• "Currently, my closed loop [insulin delivery system] is turned off because the sensor I am wearing has proven to be unreliable and so I will give myself more grace in how I define 'good'" (Diabetes educator, intake form)

		interventionists, each with 1 instance	
Positive evaluations of 3T1	Interventionists had expertise (27 instances)	1 diabetes educator and 2 psychology interventionists, 4-13 instances	• "Advice from interventionists included information about BG range and what good control actually is (e.g., perfectionism vs. 70% time in range)" (Psychology interventionist, week 5) • "You just have all this knowledge that you can then impart" (Psychology interventionist, focus group) • "I really can't tell you enough how incredible it was [to have you as an interventionist] not just as a diabetes educator, but in particular as your role as a pharmacist, given who we were working with. It felt so perfect...many of the things that you were able to speak to, particularly when someone was just like, 'my kid and, you know, his sister get insulin at different pharmacies or at different times and it's confusing'. And you're able to be like, 'Oh yeah, that pharmacy, here's what you got to do' was just incredible" (Psychology interventionist, focus group)
	Value of debriefs (20 instances)	2 diabetes educators and 2 psychology interventionists, 4-6 instances	• "Well, yes, like feels like a longer time commitment might also be helpful in like keeping our time as interventionists, like boundaried in that way. And I think it was really valuable having those chats as well." (Psychology interventionist, focus group)
	Combined group was beneficial (13 instances)	2 diabetes educators and 2 psychology interventionists, 4-6 instances	• "I also really liked when we brought the two groups together" (Diabetic participant, focus group) • "I really liked being in the full group tonight. I think a larger group is beneficial" (Diabetes educator, week 6)
	Nondiabetic interventionists helped (9 instances)	1 diabetes educator and 1 psychology interventionist, 2-7 instances	• "Like [diabetes educator] said, I think probably just makes you more of a human and less of like a scholar who's trying to do this big, you know, like like, sort of untouchable" (Psychology interventionist, focus group)
	3T1 had value (8 instances)	2 diabetes educators and 2	• "Social interaction, hearing others' experiences, some of the stress management tools" (Diabetes educator, week 6)

		psychology interventionists, 1-4 instances	• "We had a fruitful conversation about stress this put on their bodies and careers, as well as their romantic relationships, and other carryover health effects" (Psychology interventionist, week 4) • "We are doing a good job of covering context that resonates with at least 1 person deeply" (Diabetes educator, week 5)
	3T1 addressed unmet needs (8 instances)	1 diabetes educator and 1 psychology interventionist, 1-7 instances	• "It also appeared beneficial for parents to develop goals like streamlined pharmacy organization (i.e., sitting down to coordinate diabetes supply delivery from a pharmacy for two children with T1D) and crafting more durable and suitable diabetes kits" (Psychology interventionist, week 4) • "But the, yeah, the perfectionism thing, again, also in the literature, it's huge problem with Type 1 because just like the nature of the way that they measure blood sugar, right? It's a percentage out of 100. It often reflects, it invokes a grade sensation, but the goal is 70%. So, like, you're, you know, there's just, there's a lot of tension. And then people typically have relationships with their doctors that are very evaluative, very blaming of the person when things aren't going well. And so, I think that it's a safe, like, place to start to assume that everyone's trying to achieve a higher goal than what's practical and what's good for their mental health" (Diabetes educator, focus group).
	3T1 Psychology content was helpful (7 instances)	3 psychology interventionists, 1-4 instances	• "Emphasis on making goals manageable and not striving for perfection" (Psychology interventionist, week 3)
	Future orientation and planning / problem solving (7 instances)	2 diabetes educators and 2 psychology interventionists, 1-3 instances	• "The most helpful was hearing from parents and doing real-time problem solving" (Psychology interventionist, week 3) • "Perhaps a goal for me would be to dedicate time to think about it [change]" (Diabetic educator, week 5)
	Transparent curriculum (7 instances)	1 diabetes educator and 1 psychology interventionist, 2-5 instances	• "Discussing our plans for the session seemed to improve the flow of the conversations" (Psychology interventionist, week 4)

	Value of T1D education (6 instances)	2 diabetes educators and 2 psychology interventionists, 1-3 instances	• "I was able to serve as a launching pad by responding to some of the interventionists' prompts: Tailoring the ideas more specifically to diabetes and then the group had a lot to say" (Diabetes educator, week 3)
	Interventionists redirected participants (6 instances)	1 diabetes educator and 2 psychology interventionists, 1-4 instances	• "I think MI was used effectively in the last 20 or so minutes of the intervention to have participants identify what worked and didn't for them with diabetes management" (Psychology interventionist, week 1) • "In support groups, like my typical like modus operandi is to just be really silent and let them fill the silence" (Psychology interventionist, focus group)
	Skills training was useful (5 instances)	1 diabetes educator and 2 psychology interventionists, 1-2 instances	• "Key benefits of the intervention highlighted by participants were that this was a dedicated time to consider diabetes problem solving" (Psychology interventionist, week 4) • "Learning new coping mechanisms" (Diabetes educator, week 5)
	Small group was good (4 instances)	2 diabetes educators and 1 psychology interventionist, 1-2 instances	• "I think just the small groups, like, I appreciate what you were saying, [Diabetes educator], that like maybe it facilitated some more openness and like communication" (Diabetes educator, focus group)
	Diabetic interventionists helped (4 instances)	2 psychology interventionists, 1-3 instances	• "I think the importance of understanding, like, the rollercoaster-ing of blood sugar and the relationship between how much investment you put in doesn't equal at all what you get out. And I think there's a lot of stigma, that can just, I see it in a lot of interventions that are designed by care providers that don't have Type 1. And I think that the beauty of this was that, like, it was just not there because we, like, as the designers, like, we're living it" (Diabetes educator, focus group)
	Strategizing T1D management (4 instances)	1 diabetes educator and 1 psychology interventionist received 2 instances each	• "This week I am thinking about how nuanced diabetes care needs to be. Diabetes constantly throws curve balls and handling them needs to be part of the plan rather than an unwanted pesky disturbance" (Diabetes educator, week 4) • "You had shared a story in Group about, you know, somebody very well versed in the biological side of diabetes, who said that he like advocates

			taking, like, a day, where you just know that you're going to, like, you know, eat a little extra sugar or whatever it is. And I feel, like, when you said that as the diabetes educator, like, the named person who is the expert in the room, I feel, like, there was like a, 'Oh my God, like, we can do that. It's OK to, like, to not adhere.' And I think that also was really powerful of like, yeah, 'It's OK to actually, like, you can slip and it's, you know, not necessarily the end of the world'. And even people very well versed in this agree with that. I think could be a very powerful thing to stick on next time" (Psychology interventionist, focus group)

Note: An "instance" refers to an occurrence of a code being applied to an excerpt. The range reflects the smallest to the largest number of instances per person.

Psychosocial data

RQ5 - Psychosocial measures of diabetes management and family stress over the course of the intervention

Participants completed psychosocial measures related to beliefs and attitudes about managing diabetes every week. All measures were completed in week 1, except for one participant who completed them when she joined the study in the second week. Psychosocial measures were thereafter completed every other week to avoid burnout from excessive questionnaires. Both past-month and past-week ratings of family well-being measures (PedsQL FIM) were completed at weeks 1, 6, and 12 for post-intervention follow-up and had the fewest responses (14 out of a possible 21), due in part to its length. Means and standard deviations for participant psychosocial measures at weeks 1, 6, and 12 are reported in Table 11 below. See Figures 8a-c in Appendix A for standardized psychosocial measures.

Mean scores indicate that throughout the intervention and into the 6-week follow-up (week 12) participants endorsed high levels of DSMSE and diabetes outcome expectations. They also had moderate levels of perceived diabetes self-management with both PMCSMS and DSMQ-R measures, as well as moderate levels of diabetes distress. Finally, participants reported moderate levels of family functioning in the past month that were slightly higher in the past week. Due to the small sample size and low power, these findings neither disconfirm nor are consistent with my hypotheses that participants would report positive changes in psychosocial well-being. Analyses of change over time are reported in detail only in Appendix F.

Table 11

Participant descriptive statistics of psychosocial measures

	T_0 (Week 1)			T_1 (Week 6)			T_2 (Week 12)		
	n	Mean	SD	*n*	Mean	SD	*n*	Mean	SD
T1D Self-Efficacy	5	7.26	1.89	7	7.20	1.85	4	6.95	1.03
Neg Outcome Expectations	5	7.34	2.10	7	6.60	2.91	4	4.98	2.17
Pos Outcome Expectations	5	6.46	2.06	7	5.77	1.90	4	6.85	1.92
Total Outcome Expectations	5	6.88	1.64	7	6.17	1.35	4	5.93	1.39
PMCSMS	5	3.90	.98	7	3.64	1.10	4	3.18	.94
Total Diabetes Distress	5	2.90	.70	7	2.87	.53	4	2.85	.62
Diabetes Self-Management	5	2.24	.35	7	2.10	.30	4	2.13	.24
Total monthly PedsQL	6	60.63	18.76	7	54.86	18.43	3	55.32	27.70
Monthly Health-Related QL	6	60.42	19.26	7	55.48	17.79	3	52.09	29.03
Monthly Family Fx PedsQL	6	61.01	25.18	7	52.68	23.49	3	66.67	23.46
Total weekly PedsQL	4	70.83	14.88	7	59.33	21.62	3	62.96	34.18
Weekly Health-Related QL	4	70.54	12.22	7	59.06	19.92	3	60.12	36.43
Weekly Family Fx PedsQL	4	71.88	25.90	7	60.27	29.79	3	72.92	26.58

Note: The measures above have the following response ranges (higher values indicate higher levels of functioning): T1D Self-Efficacy (1-10); Outcome Expectations measures (1-10); Perceived Medical Condition Self-Management Scale (PMCSMS; 1-5); Diabetes Self-Management (0-3); PedsQL measures (0-100). The Total Diabetes Distress scores can range from 1-6, with higher values indicating greater distress and dysfunction and 2-2.9 indicating moderate distress.

Biomarker data

RQ6 – Biological measures change over the course of the intervention

Biomarker data was collected to identify signs of stress and well-being in participants during their first week participating in the session (one participant did not have biomarkers collected until she began week 2), during the final session (week 6), and at follow-up (week 12). One participant was not available to complete a cortisol hair analysis and as such cortisol analyses reflect only six participants. Participants' biomarker values were mostly within normal range (WNR, per the American College of Physicians, 2015) for adult women, with relatively little variability across weeks. Healthy adult hair cortisol levels are expected to range from 17.7-153.2 pg/mg (Sauvé et al., 2007). Coefficients of variance (CV) were reported for hair cortisol and CRP analyses and were considered acceptable if under 7%. While some CVs for cortisol

were elevated, they were mostly within range for the analysis at 450nm wavelengths, suggesting that the data are usable. Allostatic load scores (ALS) do not include cortisol values. See Table 12 for mean and standard deviation values for all biomarker collections, as well as for diabetic-caregiver and diabetic-only values for HbA1c and ALS. See Figure 9, Appendix A, for standardized participant HbA1c, cortisol, CRP, and ALS.

HbA1c was elevated for diabetic participants but only three values were above the recommended <7% (at T_0 and T_1 for one participant and T_2 for another, with the highest value at 8%). Diabetic ALS values were slightly higher across all weeks compared with diabetic-caregiver ALS values. Values were WNR across weeks, suggesting that the sample was healthy and did not have many significantly elevated biomarkers. See Table 12 for descriptive statistics of biomarkers at the start, end, and follow-up 3T1 sessions. Due to the small sample size and low power, these findings cannot be interpreted as either disconfirming or being consistent with my hypotheses that participants would report positive changes in psychosocial well-being. Findings neither disconfirm nor are consistent with my hypotheses that participants would experience positive changes in diabetic and stress-related biomarkers. Analyses of change over time are reported in detail only in Appendix F.

Table 12

Participant descriptive statistics of biomarkers data

	T_0 (week 1)			T_1 (week 6)			T_2 (week 12)		
	n	mean	SD	*n*	mean	SD	*n*	mean	SD
SBP, WNR < 120 mmHg	7	109.43	15.11	7	109	9	7	100	6
DBP, WNR < 80 mmHg	7	75.71	10.61	7	73	8	7	75	11
HR, WNR = 60-100 bpm	7	74	11	7	77	14	7	73	13
HDL, WNR > 55 mg/dL	7	69	17	7	59	11	7	60	11
LDL, WNR < 130 mg/dL	7	79	52	6	78	51	7	75	30
TG, WNR = 35-135 mg/dL	7	109	30	7	103	60	7	86	15
TC, WNR < 200 mg/dL	7	169	57	7	161	52	7	152	37
Hb, WNR = 12-16 g/dL	7	13	1	7	12	1	7	13	1
HbA1c, WNR = 4.0-5.9%	7	5.73	1.23	7	5.53	.94	7	5.66	.99
HbA1c, T1D, WNR <7%	4	6.33	1.35	4	6.10	.87	4	6.23	.90
CRP,WNR < 8.0mg/L	7	.634	.540	7	.784	.812	7	1.297	1.13
CRP CV, WNR<7%	7	1.77	1.81	7	1.78	2.99	7	5.12	10.10
HC, WNR = 17.7-153.2 pg/mg	6	8.91	4.783	6	7.88	3.33	6	9.75	4.36
HC CV, WNR<7%	6	8.65	6.67	6	12.73	8.48	6	12.51	14.23
HC CV at 450nm, WNR<7%	6	1.09	.644	6	1.39	.67	6	1.79	1.48
ALS, WNR < 4 out of 8	7	2.43	1.72	7	2.43	1.13	7	2.00	1.31
ALS, T1D, WNR < 4 out of 8	4	3.25	.50	4	2.75	.50	4	2.25	.96

Note: WNR = Within normal limits of adult women; SBP = Systolic blood pressure; DBP = Diastolic blood pressure; HR = Heart rate; HDL = High-density lipoprotein; LDL = Low-density lipoprotein; TG = Triglycerides; TC = Total cholesterol; Hb = Hemoglobin; HbA1c = Glycated hemoglobin; CRP = C-reactive protein; CV = Coefficient of variance; HC = Hair cortisol; ALS = Allostatic load score; T1D = Type 1 diabetic

In sum, findings are consistent with the hypotheses that both participants and interventionists would rate the intervention favorably. Due to the small sample size, hypotheses regarding changes in psychosocial measures and biomarkers over time could not be sufficiently evaluated to conclude whether findings were consistent or contrary to hypotheses. Qualitative analyses indicate that participants were most interested in how 3T1 supported community and they conveyed that T1D is very challenging to manage. Respondents also identified structural and content strengths and weaknesses of the intervention, such as its flexibility and deficit-focus, respectively. All findings are reviewed in the Discussion section below.

CHAPTER IV

DISCUSSION

The goal of this study was to develop, pilot, and assess the implementation of a novel group diabetes psychoeducation intervention for people with Type 1 diabetes and caregivers of children with T1D. A six-week group was conducted with follow-up data collection and focus groups. Seven participants and five interventionists, including me, provided responses to quantitative measures at 2 or more time points. Participants and interventionists rated the intervention's acceptability, appropriateness, and feasibility, as well as study-specific measures (Ease of Participation, Pacing Appropriateness, Behavioral Outcomes, and their mean Composite study score), on a weekly basis. Participants rated their psychosocial well-being and attitudes and beliefs about living with diabetes and participated in biomarker collections to evaluate how health markers changed from the start to end of the intervention and 6 weeks thereafter. Finally, both interventionists and participants were asked to give their impressions of the study through open-ended surveys throughout the duration of the intervention and via separate post-intervention focus groups.

Both participants and interventionists rated the intervention favorably and provided insights into what it is like to live with T1D and participate in the intervention. Due to the small sample size and low inferential statistical power, no conclusions could be reached to confirm or disconfirm the study hypotheses regarding change over time. The nonparametric statistical tests reported in Appendix F are insufficiently powered to draw meaningfully reliable or valid conclusions (Kanyongo et al., 2007). In this chapter, findings associated with each hypothesis or research question are discussed, and then the findings are contextualized in the current literature,

followed by consideration of study limitations and strengths, and recommendations for future interventions and research.

Participants rated 3T1 favorably

Participants rated 3T1 quite favorably. Ratings of acceptability, appropriateness, and feasibility (Weiner et al., 2017) were over 4 on 1-5 scales at all time points, indicating that participants tolerated and at times even enjoyed 3T1 and its evaluative components. This is notable, especially considering potential barriers to the intervention, such as the fact that it was held on a Friday night when people are often busy or tired, and that participants were asked to complete numerous questionnaires and participate in biomarker collection. Responses to 3T1-specific measures of Ease of Participation, Appropriateness of Pacing, Behavioral Outcomes (i.e., self-reported changes in positive treatment adherence made due to 3T1), and the 3T1 Composite scores received slightly less favorable ratings than the implementation measures (e.g., 3.39 out of 5 for the Outcomes measure in week 1, and 2.83 out of 5 for the Pacing measure in week 6). Nonetheless, these mostly favorable ratings suggest that participants did not find it too challenging to participate in 3T1, that pacing was acceptable, and they changed their behaviors by incorporating content from 3T1 into their lives.

It is possible that sample selection effects account in part for the generally high approval ratings and relatively low variance. Participants willing to attend a time-intensive group intervention may have been predisposed to liking such interventions as well. Additionally, given the convenience sampling involved in recruiting participants (i.e., many knew Co-PI Tian Walker personally), some participants may have felt compelled to offer favorable ratings. Additionally, high ratings may have been influenced by acquiescence bias, as participants rated the study favorably except the Pacing measure (which was reverse coded), and it is possible they

may have just been selecting “Agree” and "Completely agree” on their questionnaires at the end of sessions.

However, other evidence suggests that these positive ratings may have reflected genuinely positive views of the intervention. Participants were given verbal instructions for completing the implementation questions and encouraged to be as honest and specific as possible with their feedback for both Likert-type questions and open-ended reflections about the study. Participants continued to attend sessions and participate actively, reflecting an interest in 3T1 that suggests it was satisfactory. Further evidence of participants’ experiences of the intervention is discussed in my discussion of the qualitative themes.

Interventionists rated 3T1 favorably

As with the participants, interventionists gave positive ratings of 3T1 over the course of the intervention, and overall ratings of the intervention were quite favorable. Weiner and colleagues’ (2017) measures of acceptability, appropriateness, and feasibility were all rated as over 4 out of 5 for every week of the intervention (reflecting positive views about its implementation).

The four interventionists present at any given session do not represent a sufficiently robust sample to draw conclusions about 3T1’s suitability more generally, and their favorable ratings present confounds. Selection effects (interventionists agreed to facilitate 3T1) and social desirability bias remain (interventionists were aware their responses would be identified with them, and all interventionists were colleagues or acquaintances of the Co-PIs). That said, Tian Walker and I explicitly asked interventionists to provide honest feedback in order to benefit the development of the intervention and maintain research integrity, and we ourselves were highly critical and reflective of the study’s implementation, particularly focusing on how it departed

from our original vision. Appropriateness of Pacing had the lowest overall rating across all measures, suggesting that pacing is an area of growth for the study. However, given that it was the lowest rated implementation measure and the only one that was reverse-coded, it is also possible that some interventionists did not attend to these items and selected "Agree" or "Completely agree" without reading them. The fact that pacing was not mentioned in any qualitative ratings of 3T1 suggests at least that it did not stand out to participants or interventionists as particularly dire.

Considering both the participants and the interventionists' responses to these measures, it appears that the favorable ratings hypotheses are at least partially supported by the evidence. participants and interventionists expressed eagerness upon starting the study. 3T1 employed popular and widely used group intervention elements (CBTm, 2024; Linehan, 2025; Yalom & Leszcz, 2020), including giving participants opportunities to speak up and guide discussion, consult with subject-matter experts, and learn in a relatively relaxed environment with people who had similar interests and life-experiences. The favorable ratings are therefore unsurprising

Psychosocial measures did not show decreased levels of distress or increase in functioning at posttest or follow up

Due to insufficient power, analyses testing whether there were significant differences between weeks for psychosocial measures were inconclusive with the present sample and power (see Kanyongo et al., 2007 for review of power and reliability for nonparametric tests). While there were significantly significant lower ratings of past-month PedsQL and PMCSMS at 6 weeks (see Appendix F), the small sample size precludes practical significance and it is more relevant to consider that mean ratings tended to be quite favorable. PMCSMS and PedsQL

ratings at week 6 still reflected slightly positive diabetes self-management (3.64 out of 5) and assessment of family functioning (52.68 out of 100).

It is certainly possible that talking about diabetes distress could reduce perceived self-management. For instance, Mattacola (2020) found that youth with T1D did not like talking about diabetes with non-diabetic peers, as it was a reminder of having an unpleasant chronic illness and because support offered often felt insufficient. There is otherwise limited evidence that just talking about an illness will make people feel worse overall. The nonparametric analyses reported in Appendix F did not indicate drops in self-reported measures of DSMSE as measured by the Diabetes Self-Efficacy Scale (Iannotti et al., 2006). I did not find any studies that showed or disproved that in the immediate aftermath of discussing health concerns that ratings of distress increased, however there is evidence that discussing traumatic events, which may have involved experiences with T1D for some participants, is distressing (Duckworth & Follette, 2012). Trauma histories among diabetics and caregivers are associated with worse treatment adherence outcomes (D'Alberton et al., 2012; Horsch & McManus, 2014; Lunkenheimer et al., 2023), and while not evaluated as either as a moderator or intervention target for this study, the influence of trauma cannot be entirely discounted. It should also be noted that average total diabetes distress levels across the study were at or slightly below 3 out of 5, suggestive of moderate levels of distress due to diabetes. This relatively high perceived burden and stress due to T1D suggests that it is very onerous and that participation in 3T1 did not alleviate some of the concerns queried in the diabetes distress measure (e.g., feeling insufficient emotional support in daily life and fearing developing comorbid health problems in the future).

While low power precluded the likelihood of detecting and meaningfulness of significant changes in psychosocial ratings, another possible reason for the lack of improvement on

measures of diabetic well-being is that it takes more than 6 weeks to detect changes in self-reported DSMSE. Previous interventions that found improvements in diabetes treatment adherence self-efficacy and related constructs were observed over months or years, not six weeks (Kichler et al., 2013; Løding et al., 2008; Pate et al., 2015) and another brief intervention also failed to see improvements over the course of a 1-week intervention (Charny, 2021).

Participants did not have improved biomarker levels

Due to insufficient power, analyses testing for significant differences between weeks for biomarkers likewise cannot be interpreted as either disconfirming or being consistent with the hypothesis that biomarkers would improve. That said, both diabetic and caregiver participants had values that were within normal levels and appeared healthy across the intervention and into follow-up. While diabetics had elevated glycated hemoglobin levels compared to caregivers, they were mostly within target levels for diabetics. As with the psychosocial measures, the biomarker data reinforces that this sample had well-controlled diabetes with few indicators of metabolic, cardiovascular, or immunological dysregulation.

Participants shared that they were experiencing a range of stressors that may have coincidentally overlapped with the 3T1 intervention and made it even harder to identify possible associations between 3T1 and changes in health outcomes. Participant stressors included graduating from or moving schools, changes in jobs, and relatives moving into their homes for the first time, all of which could potentially disrupt diabetes treatment adherence behaviors (metabolic health; Saleh, 2015), exposure to pathogens (immunological stress; Du Clos, 2000), and stress (cortisol and cardiovascular health; Igboanugo et al., 2024).

Nature of the sample

The proposed mechanism of action by which 3T1 could improve health outcomes was through increases in diabetes management knowledge, increased diabetes treatment adherence self-efficacy and outcome expectations (Martos-Mendez, 2015; Roncoroni et al., 2019), increases in treatment-adherent behaviors, and reduced levels of stress hormones by interacting with a caring and supportive community (Cryer et al., 2003). Knowledge and behaviors were not explicitly evaluated, and due to the small sample changes in diabetes-related self-efficacy and outcome expectations and s in allostatic load could not be evaluated with confidence. Mean scores on psychosocial measures and biomarkers do suggest, however, that this sample was a relatively healthy and high-functioning sample in spite of moderately elevated mean levels of diabetes distress. As such, had the sample size been sufficient for such analyses, changes in scores on these measures may have been harder to detect or elicit based on the participants' high floor. It is possible that in a sample with lower levels of DSMSE, diabetes, education, or overall health, participation in 3T1 would be associated with improved outcomes.

Review of qualitative findings

Overall, analysis of the qualitative data suggests that the intervention was meaningful to participants. While they may have been able to manage their diabetes effectively and had high levels of skill and confidence in their ability to live with a chronic disease, the themes painted a picture of a group of people who often felt isolated and without strong community. Starting with the "Benefits of Community" theme, it was clear that the main attraction of the intervention was a space where people could talk to each other about life with T1D and feeling part of a community to which they truly belonged. While participants identified some sources of support

that existed outside of the intervention group, the fact that most codes related to a lack of community and desire for it suggests that this intervention addressed participants' sense of isolation. Participant desire for community is consistent with existing literature about diabetics, which has found that peer supports offer management assistance with tasks of daily living for diabetics, support for chronic illness management, emotional support, connections to healthcare resources (Joensen et al., 2016b; Saylor et al., 2018). There is also evidence that parents tend to report better psychological and metabolic health outcomes after participating in groups, though studies that found this association tended to occur with longer term (months to years) interventions (Kichler et al., 2013; Løding et al., 2008; Lohan et al., 2015; Pate et al., 2015; Stanger et al., 2013). Diabetic and caregiver participants appeared interested in continuing with activities such as 3T1 to maintain a sense of togetherness and endorsed wanting to participate in future groups if offered.

The "Life with Diabetes" theme highlighted how for many people diabetes distress comes from multiple directions. There was a sense that since treatment adherence depends greatly on external factors, when circumstances were unpredictable or challenging, participants found it almost impossible to fully adhere to treatment recommendations. This is consistent with prior findings (Fisher et al., 2012; Fisher et al., 2015; Fisher et al., 2019). The belief that T1D is a battle was exemplified by the "Negative relationship with diabetes" sub-theme, as living with T1D was seen as a constant struggle that took away increasingly more as time went on. This study sample was relatively young and healthy and did not endorse any comorbid diabetic health complications. Even this sample, however, endorsed high levels of frustration and diabetes distress, which suggests that even in the best circumstances, diabetes can feel as unmanageable as trying to tamp down an active volcano.

In addition to feeling as though the external world conspires against adequate diabetes care, internal attitudes about diabetes also appeared to interfere with treatment adherence and quality of life. Perfectionism appeared quite challenging for participants and deserves special consideration. While treatment adherence is an indispensable aspect of care, perfect adherence is not feasible, as there are so many factors that can affect BG regulation. Adherence is often framed to diabetics as achieving the goal of keeping BG in-range (close to 100mg/dL, at least between 70-180mg/dL or 3.9-10.0mmol/L) for as long as possible, with recommendations for Time In-Range (TIR) to be at least 70% of the time, which corresponds approximately to an HbA1c of 7%, at or below which long-term diabetic complications become less likely (Dovc & Battelino, 2021; Dovc et al., 2023; Hirsch et al., 2019). Greater TIR is associated with further reductions in risk of comorbid conditions, and whether the 70% TIR / 7% HbA1c benchmarks are met can most easily be ascertained using continuous glucose monitors (CGMs) and blood assays, respectively. Given the increasing prevalence of CGMs, the ability for diabetics and caregivers to observe these benchmarks can create an environment where BG is constantly being checked. A vicious cycle can ensue in which 'perfect adherence' appears within reach but remains forever beyond one's grasp.

In such contexts, perfectionistic beliefs and behaviors can affect T1D treatment adherence and family well-being. Perfectionism is often categorized as adaptive (striving) and maladaptive (concerns) based on the degree of self-criticality (Moran, 2020). Hamachek (1978) describes how "normal" or more adaptive striving perfectionism is characterized by a desire for self-improvement accompanied by cognitive flexibility to be more forgiving towards the self and less precise regarding certain outcomes. Conversely, 'neurotic' perfectionism is more closely associated with rigidity and tendencies towards self-criticism deriving from attempts to achieve

unrealistic or unsustainable goals. There is a tendency for people with T1D to engage in regular self-monitoring (i.e., of BG, hypo/hyperglycemia symptoms) and to be rewarded with praise from others and symptom reduction when BG is in range. As such, almost constant BG monitoring becomes reinforced as a behavior and can exacerbate perfectionistic tendencies and attitudes (Moran, 2020).

Moran (2020) examined the role of perfectionism in chronic disease management and found that perfectionism was a significant predictor of avoidance in diabetes self-management and positively correlated with diabetes-related distress. Other findings linking perfectionism, self-criticism, and diabetes-related distress (Hinds, 2023; Powers et al., 2017; Ruiz-Aranda et al., 2025) support these associations. In the present study, participants often expressed a sense that one needed to constantly do better, such that with sufficient adherence or control, life would be undisturbed by diabetes. It is not just diabetics who believe that adherence is challenging and is associated with perfectionistic attitudes and behaviors. The present sample described as a family disorder that caused high levels of stress for all concerned (Bassi et al., 2021; Hilliard et al., 2011), further highlighting the importance of having supportive diabetic and caregiver groups.

To my initial surprise, there were many instances of codes concerning acceptance and diabetic joy. These codes were applied to comments that seemed to go beyond resignation towards a more profound sense that living with diabetes was both worth it and manageable. It was even expressed that living successfully and meaningfully with a disorder made life more enjoyable, and that participants could take pride and pleasure in their accomplishments of living well and adhering to challenging treatment regimens. While there is a rich extant literature about the value of disease acceptance among diabetics, most of these studies concerned Type 2 diabetics or else sampled both people with T1D and T2D. Research shows strong associations

between diabetes acceptance and glycemic control (Schmitt et al., 2014; Schmitt et al., 2018), general and disease-specific coping (Richardson et al., 2001), self-care (Gregg et al., 2007), and quality of life (Lewko et al., 2007). However, I was unable to find research specifically describing pleasant or joyful diabetic experiences and research into acceptance of T1D is still emerging (see Gailard & Beran, 2025; Stefanowicz-Bielska et al., 2025).

As both a diabetic myself and a researcher, I was not surprised that life with T1D would be experienced as so challenging, but I was intrigued that this sample, which at its surface appeared high functioning and quite healthy, also experienced high levels of distress and readily identified common trends that make life with diabetes so painful, confusing, and difficult. The shift in focus over the course of 3T1, most obvious through the request to combine caregiver and participant groups in weeks 5 and 6 to increase community, reflected this awareness of diabetic struggle and a desire to break isolation. By the end of the intervention, there were more discussions about managing feelings of burnout and finding joy when feeling down. Over the course of the six-week intervention, participants appeared increasingly comfortable with each other and with talking about their challenges, as well as offering possible solutions to problems others raised. It seems possible that a longer intervention (e.g. 12 weeks instead of 6 weeks) would have seen a continued trend of community sharing and interest in focusing on skills and coping resources.

Regarding the intervention itself, participants and interventionists noted that the flexibility and communication between interventionists was very helpful as participants chose to guide much of the discussion that occurred. The fact that this sample did not want a great deal of diabetes education but were eager to discuss their emotional experiences highlights the benefits of interventionist flexibility. This flexibility was initially a challenge as participants and

interventionists alike noted the apparent lack of focus on intervention targets. Interventionists noted the need to both incorporate more participant input prior to such an intervention and the need for an interventionist-only practice session to become more familiar with both the curriculum and one another. In team meetings and in the focus group, interventionists noted how the intervention had a deficit model as it was structured around providing education to increase treatment adherent behaviors rather than building on existing strengths. Beginning with a focus on and assessment of strengths could have enhanced the experience of all stakeholders, I believe that future iterations would benefit from more tailored interventions that take participant needs into account, such as deciding collectively if and how combining diabetics and caregivers would be beneficial.

With regards to the content of the intervention, there were more positive than negative evaluations. There was concern that the intervention was not as helpful as anticipated, but ultimately there were signs that 3T1 was meaningful for all involved. Interventionists noted ways that they personally grew and enjoyed the intervention (e.g., learning about diabetes, practicing facilitation skills), but perhaps more importantly, participants and interventionists alike noted higher levels of empathy for one another and for themselves. The interventionists were seen as having remarkable expertise, and it was seen as mostly valuable to have diabetic interventionists, though having non-diabetic interventionists willing to learn about diabetes was also welcomed. Having at least some diabetes education and spending time identifying specific behavioral targets through SMART goals were also described as valuable, but the most meaningful aspect of the intervention appeared to be offering a space for connection to a sympathetic and relatable community and to safely reflect on ways that life with diabetes might be better.

Given that the primary proposed mechanism of action in this intervention was self-efficacy for managing diabetes, why wasn't self-efficacy highlighted in any of the themes? Coding was completed without a priori assumptions that DSMSE would be a theme, nor was one of the focus group questions explicitly about their confidence in managing DSMSE, which may explain why it was not explicitly mentioned, but themes alluded to it, SE beliefs are derived from four primary sources: direct performance experience, vicarious experience, verbal persuasion, and physiological changes (Bandura, 1989). This group intervention provided multifaceted opportunities to generate SE through sharing performance accomplishments, observing others model management behaviors, and encouragement, all of which can potentially reduce stress (Bandura, 1977; Bandura et al., 1999; Kichler et al., 2013; Løding et al., 2008; Pate et al., 2015; Yalom & Leszcz, 2020). The main theme of this analysis, that community is beneficial, connects to the development of DSMSE as 3T1 offered numerous opportunities for both vicarious experiences and verbal persuasion. Diabetic interventionists were highlighted as a strength for the study, as they were seen as authoritative and trustworthy sources of information by participants, and diabetic interventionists noted feeling empowered in their role. Skills training and SMART goals were also seen as beneficial and related to DSMSE development through direct performance experience. Given that 3T1 was designed to facilitate DSMSE development, more explicit discussions of DSMSE may be necessary to help participants develop or comment on their DSMSE for future interventions.

Contextualizing study findings

Many of the experiences in the present study echoed extant research. Costello (2013) described an exploratory study of 6 diabetes support group facilitators which notes that support groups can enhance diabetic wellbeing, something that has become increasingly popular as an

intervention target since the publication of DCCT and the now widely accepted association between treatment adherence and health outcomes (Nathan, 2014). Costello interviewed six nurses who conveyed themes emphasizing complexity and the broad reach of diabetes, the need to focus on quality of life, a philosophy of shared authority with participants (especially the benefits of not directing conversations solely towards adherence but facilitating topics brought up by participants), and the importance of highlighting how perfectionism is detrimental in the long term to health and quality of life. Participants in Costello's interviews described how over-emphasis on adherence in healthcare results in disappointment and disengagement and could be addressed in group sessions by talking through experiences and setting an authoritative tone for the group. When they occurred, these practices were highlighted by respondents as beneficial in 3T1. As recommended by Costello's paper, 3T1 interventionists also connected participants with one another, exchanged information (including self-disclosure for participants with chronic illnesses like T1D), managed group dynamics (e.g., fostering group roles and selectively speaking and holding back to increase participant engagement), and promoted problem-solving by practicing skills and talking through participant challenges. These strategies appeared via self-report to be effective and mirror principles of group facilitation seen in other treatment guides (Yalom & Leszcz, 2020).

I did not initially design 3T1 to evaluate perfectionism and as such did not include any instruments specifically measuring perfectionism, nor did I know the sample would be so small ahead of time, which further precludes this study's validity to assess general attitudes about perfectionism among people with T1D. The "Perfectionism" code highlights the need for interventions to consider this dimension of life with diabetes, as perfectionism often presented as a maladaptive pursuit of unattainable goals, rather than making progress towards achievable ones

(see Hamachek, 1978) when participants described their efforts never being sufficient. However, qualitative data in the present study suggested there were changes in attitudes and perfectionistic beliefs, and the manner of change is an example of how changes in outcome expectations improved feelings of well-being. Of note were changes reported by the eldest participant, a woman who had diabetes for 39 years. She shared that past experiences combined with continuous glucose monitoring led to significant +avoidance and fear of hyperglycemia, and that the goal for perfect adherence or 100% time in-range led to stress and vigilance which interfered with her activities of daily living and life satisfaction. She set a goal and successfully *raised* her HbA1c over the course of the study, something she reported feeling proud of as it indicated less time fixated on BG levels while still being in an acceptable range and while feeling less anxiety. This change is consistent with findings regarding the association between perfectionism and diabetes related distress (Archer, 2014; Moran, 2020).

The success and challenges of 3T1 are also seen in the literature. For example, Charny (2021) found that a diabetes training intervention did not show significant improvements in DSMSE and attributed it to the sample's pre-existing high levels of glycemic control. The favorable impressions of current study participants of 3T1 and their self-reported behavior changes have also been seen in other settings. Fung et al. (2024) found that health coaching improves behavior change but does not appear to impact QoL in many settings, while Lorig et al. (2009) found that peer-led diabetes programs are associated with better QoL, less depression, and greater treatment adherence among diabetics, even those without elevated HbA1c levels. Receiving social support appears to significantly improve health, mood, and quality of life. Mattacola (2020) found that adolescents often experience diabetes-specific support from peers as less helpful than general, global support, and that the latter is often sorely desired. Similarly,

Saylor et al. (2018) found that participating in diabetes-related groups while in college was associated with less isolation, depression, and anxiety for diabetic college students. It may be the case that any kind of group intervention and participation can reduce negative effects of isolation among diabetics, which makes specific 3T1 components harder to analyze (see Strengths and Recommendations below).

Limitations

There are a number of limitations to the present study. The most salient was the small sample size. This was despite significant outreach and partnership with a local partner agency, as well as outreach school nurses who agreed with the potential benefits and need for programs like 3T1. Due to the small sample size, this study did not address some weaknesses identified in existing literature on diabetes management interventions, such as evaluating the efficacy of joint and concurrent diabetic-caregiver group interventions or the length of time needed to improve DSMSE. Several families who initially indicated interest later had to decline to participate since the time and place were too inconvenient while it was the only time that worked for other participants and interventionists. I was unable to extend my recruitment window because I had to move away from the area and therefore had to expedite the recruitment. A larger recruitment window and more attractive times to meet may have been able to increase participation and make the study more robust.

While overall attendance was fair, all sessions had at least one missing participant, and the small size may have been irritating or interfered with participants' change and engagement. This was reflected in participant feedback who mostly reported that the larger group was better, both because they could interact with the other kinds of participants (caregivers and diabetics) and for the larger group size. Four of seven participants missed at least one session, which also

means that participants received different intervention doses, which further limits the study's validity. Another threat to the study's external validity was that the sample was not representative of the national population of diabetics, as it was derived from a group of people already involved with at least one diabetes education organization and the local population is more White and wealthier than the general diabetes population.

This study's internal validity is threatened by the lack of a control group. The DCCT-NP, our collaborating community organization, did not want any group to receive sub-standard or waitlist control treatment. It is also the case that this was intended to be a pilot study to further develop and assess response to the 3T1 intervention, and as such, the inclusion of a control group at this stage would have been premature.

Participants who were involved in this study were by their very nature a self-selecting sample and do not appear to be representative of the broader T1D community, most glaringly with regards to gender. All participants and three out of five interventionists identified as female. This is consistent with findings of a general reluctance among men to engage in healthcare behaviors (see Yousaf et al., 2015, for a review of barriers to male participation in healthcare services). Second, women are often expected to serve the role of caregivers, even at great personal cost (Revenson et al., 2016), which may explain the skewed sample and high levels of distress caregivers reported. Finally, the means by which participants heard about this study were from school-based referrals from school nurses' offices and from informal care networks developed by Tian Walker, whose network of families was often based on links with mothers. It is likely that a wider variety of recruitment sources and more time to recruit could have resulted in male participants in the study, particularly among those with T1D.

If the study were to have an original sin regarding its curriculum, it might be that "3T1 had a deficit framework", which merited its own code in thematic analysis. 3T1 was initially structured to address deficits held by participants rather than focus on emphasizing or reinforcing participants' strengths. The design of 3T1, based on the extant literature of diabetes above, focused on addressing an assumed skills gap to account for imperfect adherence, with the idea that more adherence would always result in greater quality of life and diabetic health. Yet, as participants shared, adherence was often experienced as opposed to quality of life and was a source of stress. Had the intervention focused more on enhancing existing participant strengths and empowerment, as recommended by Dickinson (2007), it may have been rated more favorably or reduced absences from the study. As it was, the flexible curriculum and approach did not reflect participants' needs until about week 4 of the 6-week intervention. Having more participants' input into curriculum and having a practice session for interventionists may have allowed the 3T1 to be more appropriate for study goals and the target population's needs.

Another limitation concerns the quality of the data. Most of the survey data was collected after 3T1 sessions (with a few being completed online for those who did not complete them in-person) and the focus group was naturally conducted with others. It is possible that some impressions of the intervention were suppressed due to the presence of others. The data collection environment may have unintentionally created a performative aspect to answering questions about personal impressions and made participants oriented towards a perceived audience, as evidenced by occasional utterances from the participant that appeared to display a desire to be agreeable (e.g., "I agree with what [participant 3] said"). That said, interventionist and participant focus groups were conducted separately to avoid eliciting a desire to please me or Tian, and participants were not monitored as they completed surveys.

Another limitation of the study was the fact that there were no measures to evaluate the knowledge or specific behaviors related to treatment adherence of any participant. Measures such as these were not used due to concerns that they would be seen as imposing or shame-inducing. It is also unclear whether such data would have been actionable or clinically significant. Potential diabetes education topics were already identified by the time the IRB application was approved, and while increases in diabetes knowledge are generally considered desirable, it is unclear whether participants would have benefited from community as much if the focus had solely been didactic. More knowledge leading to greater adherence may also be relatively insignificant. As discussed above, less than optimal adherence (e.g., maintaining BG time-in-range at around 70%) has been shown to achieve satisfactory glycemic control and mitigate major complications (Dovc & Battelino, 2021; Dovc et al., 2023; Hirsch et al., 2019). While treatment adherence is associated with diabetic health, the small sample would have likely precluded ability to detect any effects of the study on adherence.

Regarding the quality of qualitative data, one concern emerged from the focus group. My relationship with the focus group facilitators, as a senior student in their graduate program who also paid them to facilitate two focus groups and provided the semi-structured interview outline, doubtless affected our behaviors in the interventionist focus group. Possible effects include not having interrupted me or giving me more time than other interventionists to speak (Tian Walker and I spoke more than other interventionists) and allowing me to ask questions of the group, which while not counter to the interview protocol, may have deviated from questions focus group facilitators intended to ask. To address these possible confounds, the facilitators told both interventionist and participant focus groups that they were hoping to get a broad range of perspectives about their experiences with the intervention (see Appendix C for focus group

facilitator outlines). I considered it possible but unlikely that the focus group facilitators' ethnicity would affect the responses they received from participants. Their status as external to the project and as graduate students may have made them less approachable to certain participants, however their distance from the study was intentional to reduce bias in their questioning and to increase honesty in participant responses.

Finally, I had concerns that interventionists were overrepresented in the thematic analysis process, as they received more codes than any other group. This occurred because there were four interventionists offering feedback every week and four present for the focus group, while there rarely were all four diabetics present at a time for data collection, and there were only three caregivers in total. Interventionists were coded first and then old and new codes were applied to participants with the idea that the interventionist dataset was richer and more likely to contain emergent themes that may have been applicable to both groups. All excerpts were then examined again, and codes were updated and new ones applied, resulting in a shared set of codes that was applied differentially to each kind of stakeholder in the study that still came together to create shared themes. It is possible that the order of coding influenced the results in some way of which I was unaware.

Strengths

Despite its drawbacks, the study had numerous strengths. 3T1 was carried out under the auspices of a trusted local agency, and dedicated volunteers at DCCT-NP, including Co-PI Tian Walker, connected interested participants who benefited from the intervention. The engagement of the participants was remarkable for a 6-week commitment (see Table 4, Appendix B) and all participants participated in a follow-up session. The positive assessment of the intervention indicates that, even with the somewhat onerous collection of biomarker samples and weekly

surveys, it was still deemed acceptable, appropriate, and feasible. The intervention appeared to address an unmet need for T1D community and participants noted that it was helpful to have interventionists with high degrees of expertise.

While the initial deficit focus of the intervention was rated as ineffective or unpleasant, the fact that it was updated with input from interventionists suggests that staying flexible and making changes when appropriate met participant needs. Having interventionists with knowledge of diabetes education and of clinical psychology likewise appeared to make a difference for participants and as a PI, as it was sufficient to offer simple guidance to enable other interventionists to be clinically effective, though some additional training together and clear intervention targets early on would have been helpful.

While it was an unintentional aspect of recruitment, the fact that only people identifying as women enrolled in the study speaks to the elevated needs of diabetic women and caregivers. As noted in Chapter I, diabetic women face additional burdens and worse health outcomes than their male counterparts (Hall et al., 2021; Huxley et al., 2015; Kemp et al., 2007). This self-selection may be because there is greater need and while it uncertain whether 3T1 would be appropriate for other higher-need families with T1D, it at least seems appropriate for women who can benefit from interventions to remediate health outcome disparities.

Finally, while current sample size did not allow for sufficient power to detect statistical differences, the *design* of the study should have permitted detection of changes in ratings of study implementation, psychosocial well-being and diabetes-related attitudes, and biomarkers with more participants. Capturing quantitative measures created a richer view of participants' qualitative experiences and created context for the themes that emerged from qualitative data. Both kinds of data also helped to identify meaningful themes about what to keep and what to

improve in future intervention iterations and provided insights into life with diabetes. Mixed method approaches are particularly helpful for small-n studies and to have richer information about participant and interventionist attitudes that were not captured by survey measures in this study (Henry et al., 2015).

Recommendations for research

Future studies examining the effect of group interventions on diabetic health and well-being can expand on the present research in several ways. The most obvious is that to take advantage of this study's design, future studies should recruit more participants to have a more robust sample. It is possible that with more participants interaction effects between HbA1c or DSMSE and time with T1D, sex, or income may have emerged that could inform future intervention implementation (see Greenbaum & Harrison, 2003 and Greenhill, 2023, for review of research on interventions and time with T1D). More participant data would likewise enable more robust parametric statistical testing that could illuminate the efficacy of interventions like 3T1. Conversely, future studies with similar small sample sizes could use statistical methods more suited to small sample sizes that I did not conduct for the present study (e.g., Bayesian statistics; McNeish, 2016).

The skewed gender composition of support groups seems likely to be repeated in future interventions aimed at supporting families with T1D given gendered caregiving roles. It should be noted that there is tentative evidence that among support groups, challenges to conventional roles may result in more diverse exchanges of ideas and exposure to participants different from oneself, which could increase the benefits of support groups (Rodríguez-Madrid et al., 2019). As such, future support groups are encouraged to explicitly invite men to increase engagement and access for men who do not ordinarily access healthcare and social supports. This would also

address a concern raised by mothers participating in 3T1, namely that their parenting and diabetes care approaches were less effective due to different practices by the fathers of their children, for which there is existing evidence. Berg et al. (2008) found that fathers' acceptance and engagement with their diabetic children have a large impact on treatment adherence, suggesting that paternal care is significant because maternal care is often the default but may not be sufficient for maximal child health outcomes. It is therefore important for implementation studies to emphasize male recruitment for either male-only or mixed-gender interventions to evaluate male perspectives in order to ensure content reflects their education and psychological needs, though careful consideration is needed given mixed-given groups may affect engagement.

If I were to re-do this research, I would attempt to increase the sample size through longer and more extensive recruitment and would try to over-recruit male participants. If this research were iterative, I would be interested in groups of just male caregivers and diabetics to see observe if there were differences compared with the current sample. Other changes based on the present research would be to include measures related to perfectionism, diabetes knowledge, and treatment adherent behaviors which would provide additional measures of adherence. I anticipate that behaviors would be associated with DSMSE and diabetes treatment adherent outcome expectations, and in the long term, with diabetic health like HbA1c.

Recommendations for practice

Recommendations for future interventions involve recruitment, development, and organization. To address recruitment problems, staying connected with community agencies is effective for outreach and community involvement, but future iterations may also need to engage medical and school-based healthcare providers in recruitment, especially those who have regular contact with families with T1D. The recruitment timeline was compressed for this study, but

future iterations would ideally recruit more broadly and for more time. Having more participants could allow for more perspectives and more opportunities to build community between participants, as evidenced of overall favorable ratings of the combined diabetic-caregiver group from 3T1 sessions 5 and 6. While this sample only had one diabetic minor, her feedback suggests that having separate caregiver and adolescent diabetic groups would be advisable for future studies, although combining adult diabetic and caregiver groups might be appropriate and helpful, particularly for caregivers based on their feedback.

In addition to more recruitment, interventionists recommended that in future potential participants get more say in the curriculum's development, as participants in 3T1 endorsed that they liked how the curriculum was updated to suit their needs. Beyond having a say in an intervention's conception, having participants maintain a sense of ownership of the intervention is also key (see Costello, 2013). An example of this in action could be a preliminary assessment for participants to identify which members would prefer to be in a combined diabetic-caregiver group, versus which would prefer separate groups. Given that the only participant who disliked the combined group was the minor in the diabetic-caregiver dyad, it seems most appropriate that adolescents in future iterations of the intervention should have their own group where they don't feel scrutinized by their caregivers.

The intervention would likely have been more effective with more practice for interventionists who could benefit from having a "session zero" in order to get to know one another and identify challenges prior to participants joining the intervention. Having more time for participants to spend with one another just talking about diabetes may also enhance the community benefits that participants reported. Finally, while the 6-week commitment was difficult for some participants, all indicated an interest in continuing to join such groups. An

ongoing informal gathering and discussion space with skilled facilitators may benefit participants and show improvements in health and psychosocial well-being over a longer time frame. Finally, this study highlighted the significant stressors faced by people and caregivers of people with T1D. It is possible that a future group targeting diabetics and their partners may also address unmet needs in the diabetes community.

Having a greater focus on participant strength, a theme that Tian and I identified from interventionist feedback, may also Future iterations of "Tools for Tackling Type 1 (3T1)" might instead be called something like "Connecting, Coping, and Thriving with T1D (2C2T)" based on the feedback that community was the most meaningful aspect of the intervention followed by mutual support and focusing on strengths, not deficits and reducing a focus on perfectionism.

Conclusion

Type 1 diabetes is a challenging, multi-faceted disease that affects every cell in diabetic families' bodies, yet when viewing life with T1D as an ongoing battle, perfectionism, anxiety, exhaustion, and isolation emerge from every attempt to overcome rather than live with the illness. 3T1 was found to be an acceptable and useful intervention, not because it focused on fighting a chronic disease, but by helping individuals and caregivers feel less alone and take inspiration from one another. Themes of community and learning from one another and from skilled facilitators speaks to how diabetes treatment adherence self-efficacy may have been enhanced by participating in the intervention, even as acknowledging the challenges of living with T1D may have induced stress over a 6-week period. Future iterations and studies would do well to explore diabetic joy, acceptance, and strength to enhance life with diabetes to achieve both adequate treatment adherence and quality of life.

APPENDIX A - FIGURES

Figure 1

Bandura's Triadic Reciprocity Model

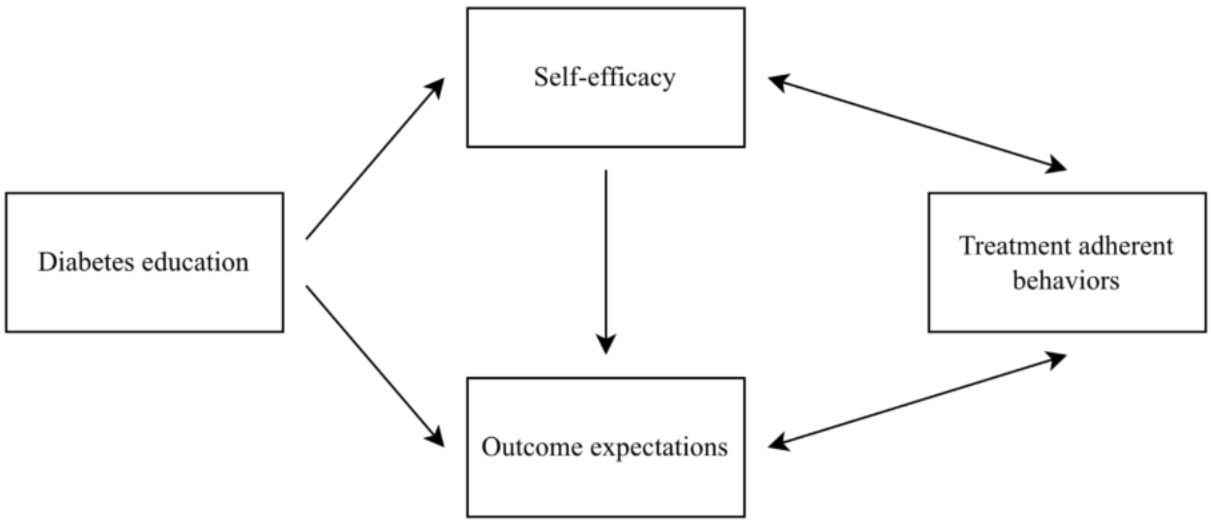
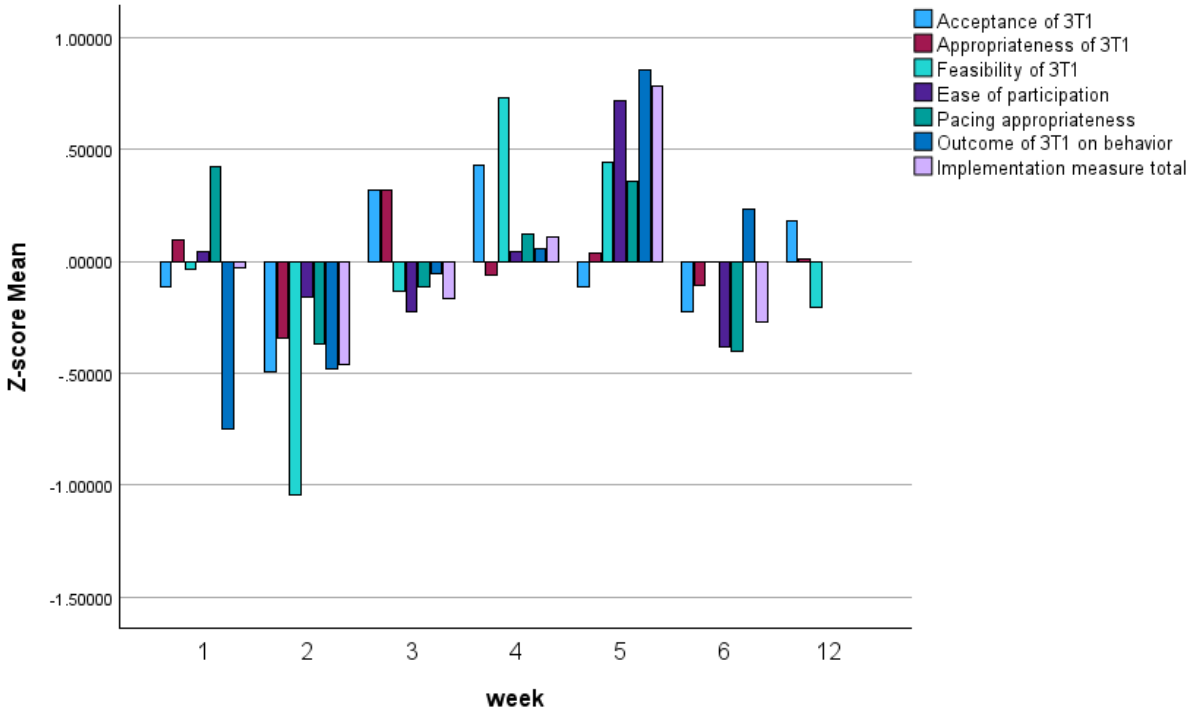


Figure 2

Participant standardized implementation measure mean responses by week



Note: This figure does not include study-specific week 12 measures

Figure 3

Standardized implementation score means of interventionists by week

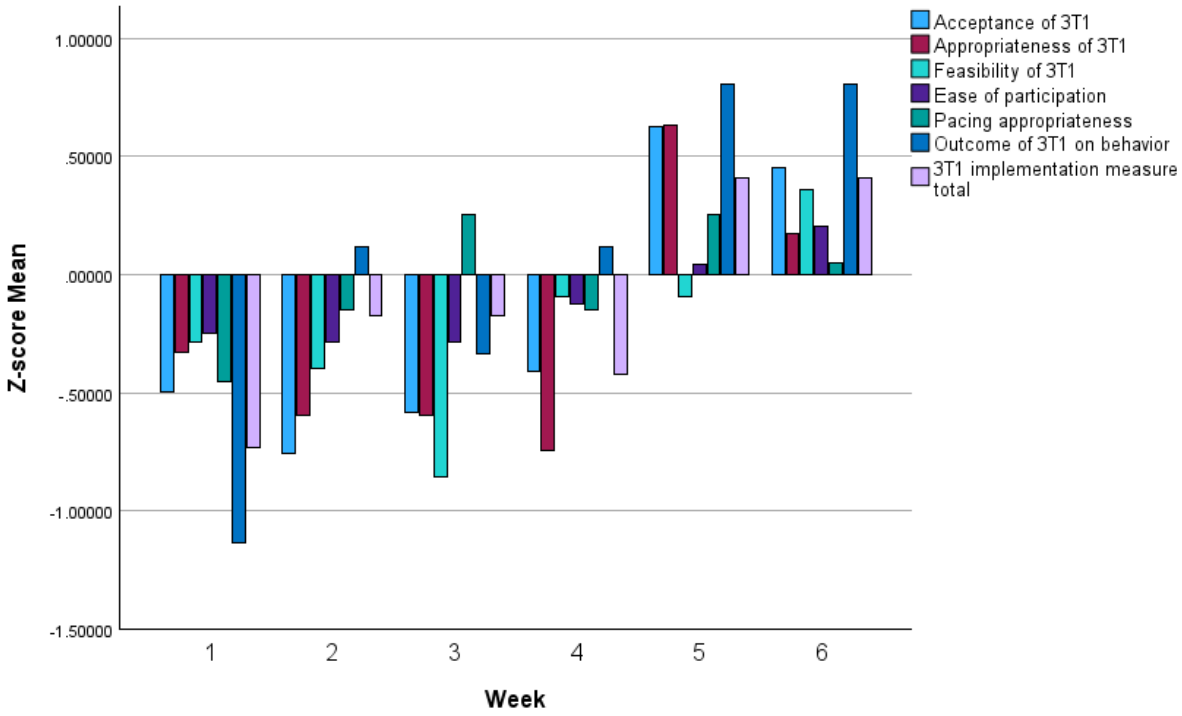


Figure 4

Benefits of Community theme coding tree

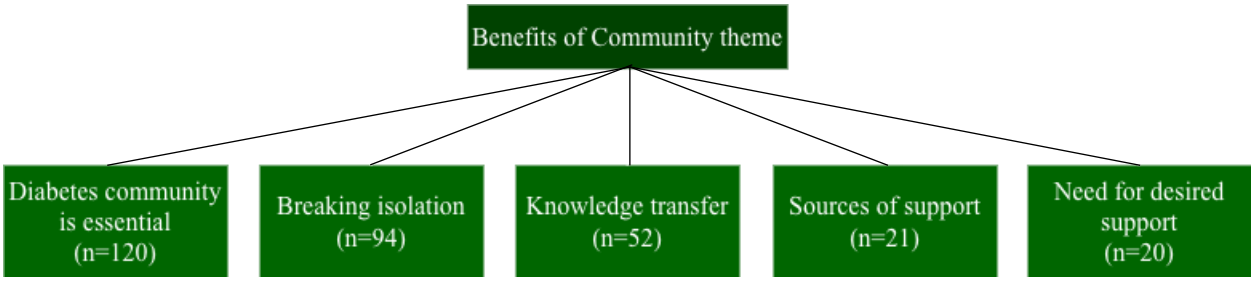
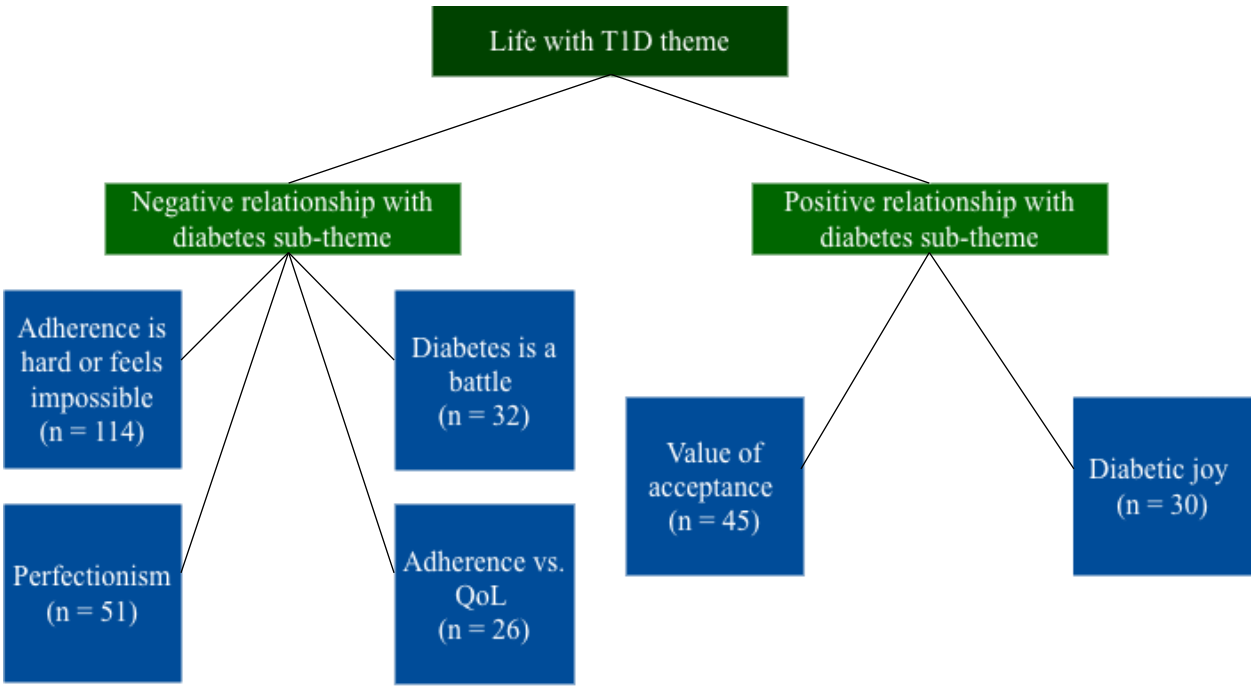


Figure 5a

Life with Diabetes theme coding tree #1



Figures 5b

Life with Diabetes theme coding tree #2

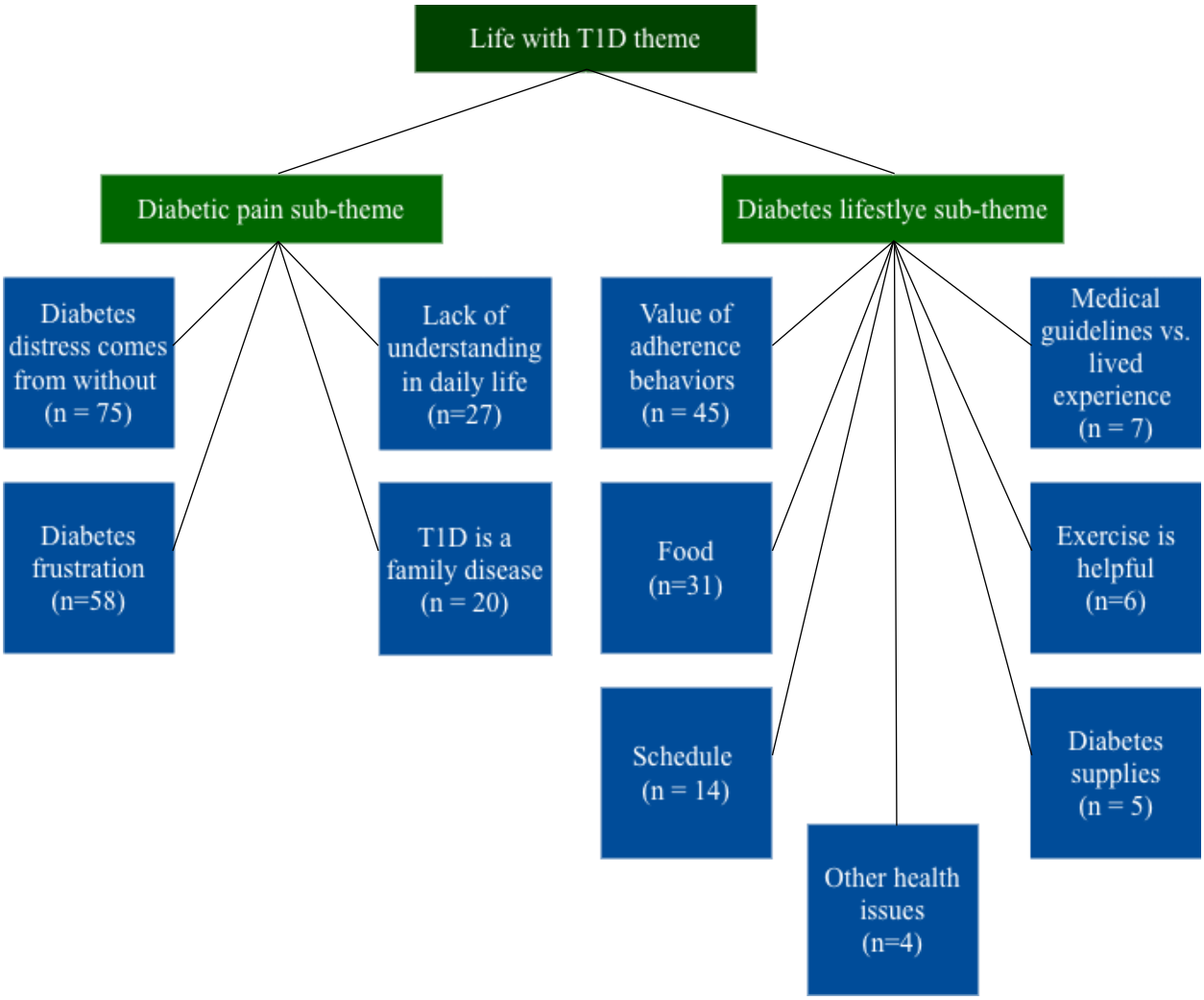


Figure 6

Structure of 3T1 theme coding tree

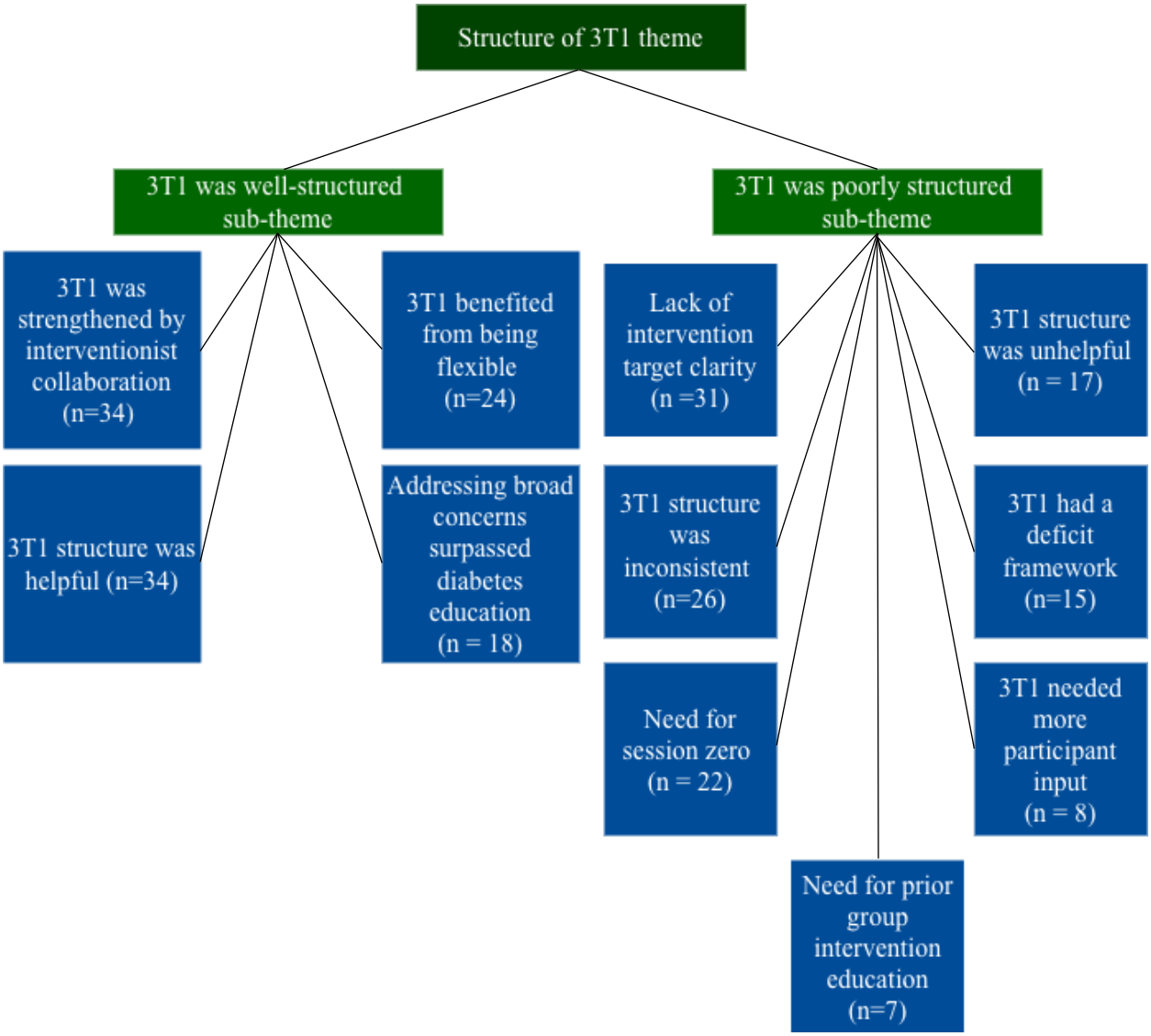


Figure 7a

Evaluation of 3T1 theme coding tree #1

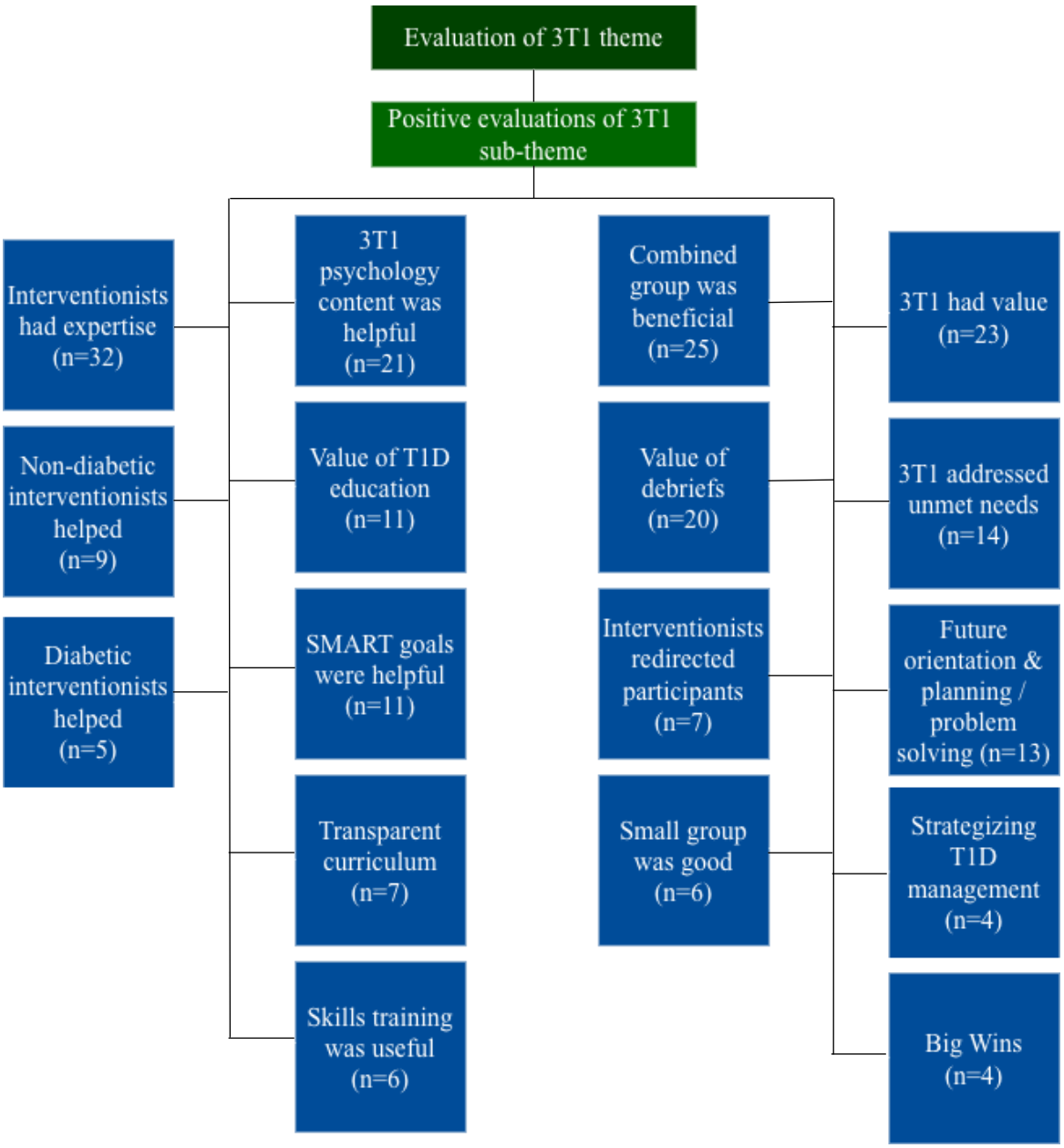


Figure 7b

Evaluation of 3T1 theme coding tree #2

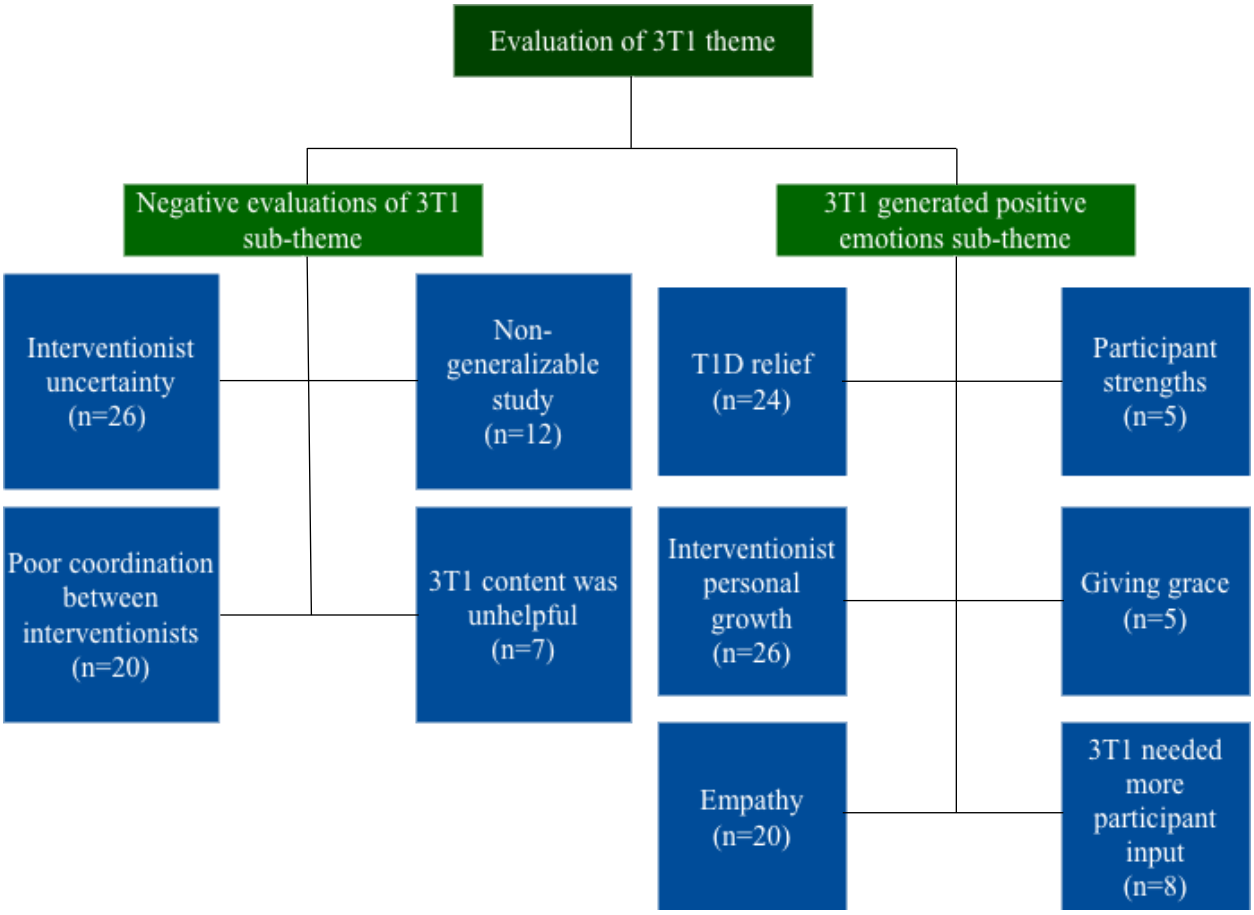


Figure 8a

Participant standardized psychosocial measure mean responses by week, #1

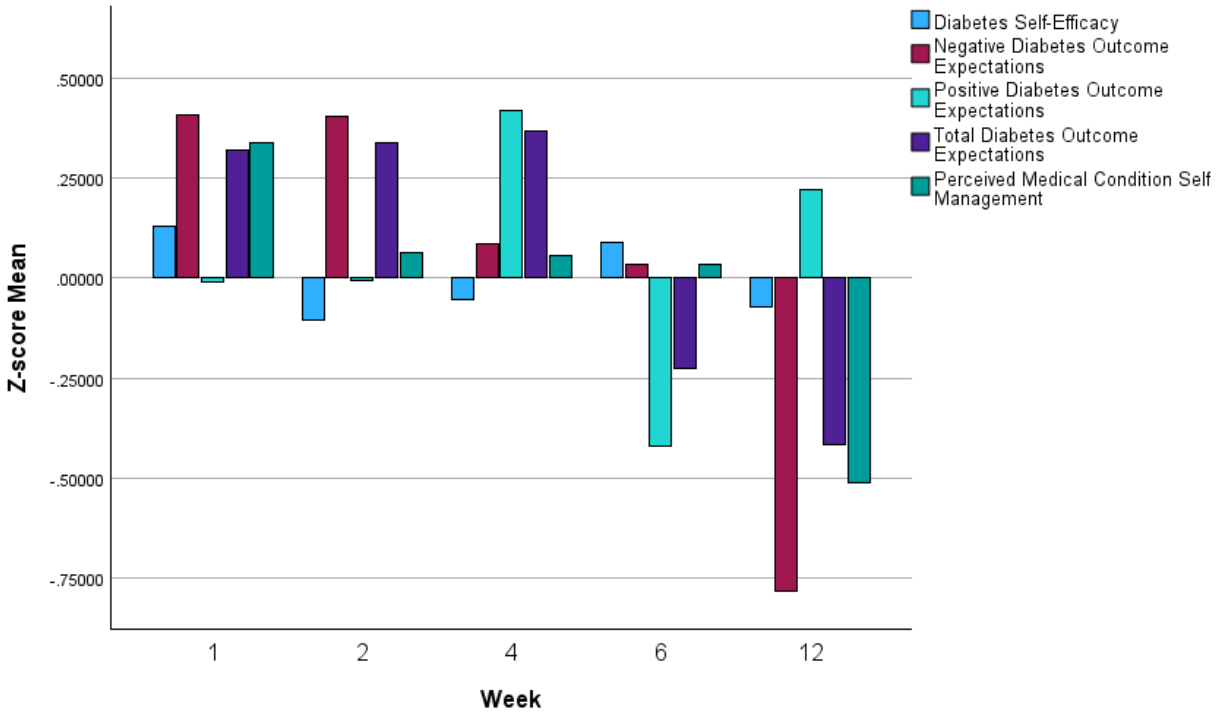


Figure 8b

Participant standardized psychosocial measure mean responses by week, #2

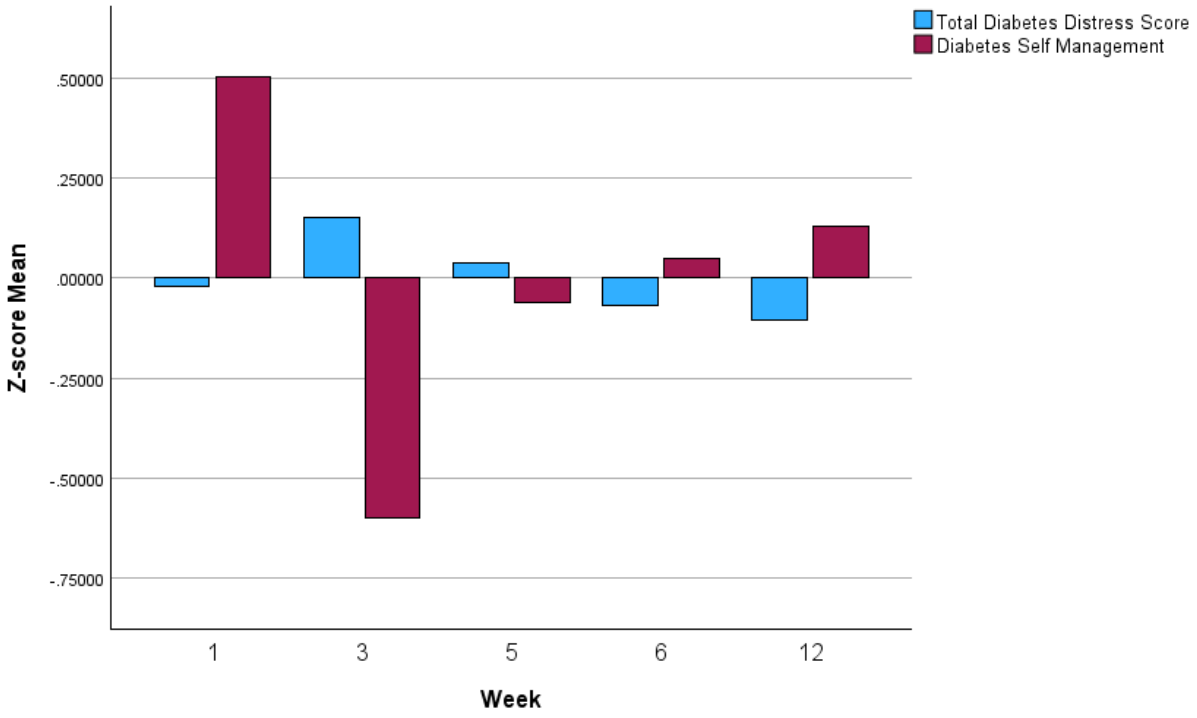


Figure 8c

Participant standardized psychosocial measure mean responses at start, end, and follow-up

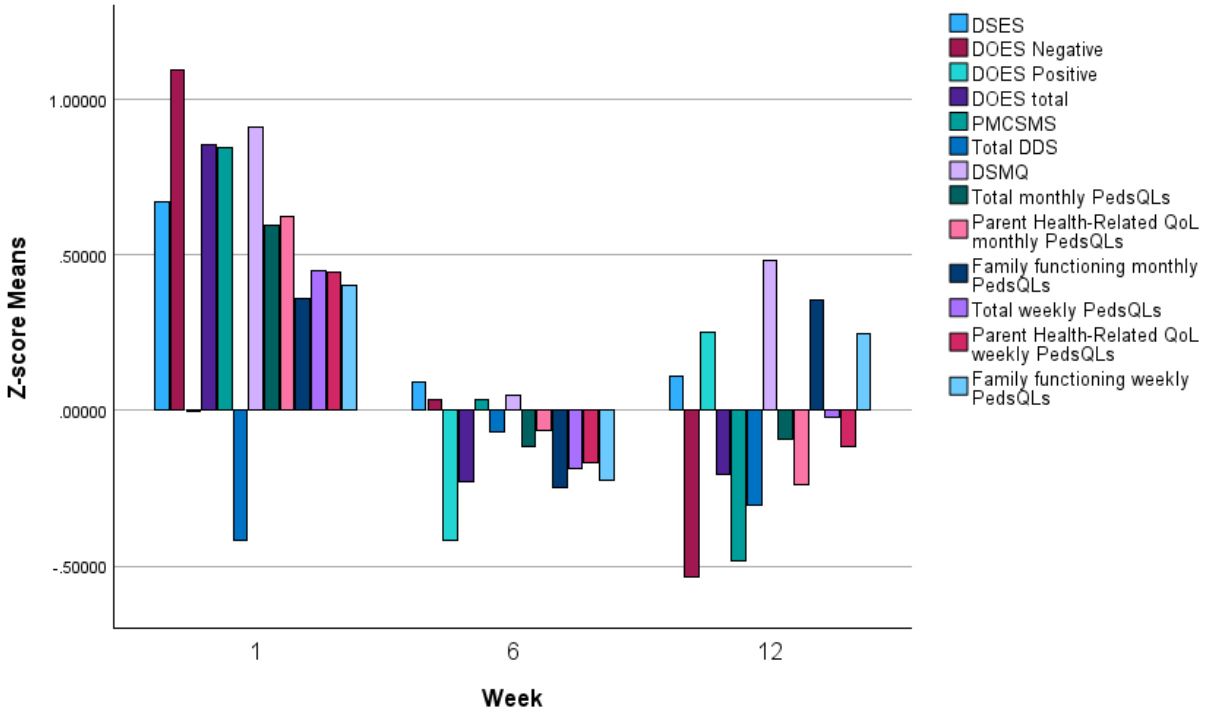
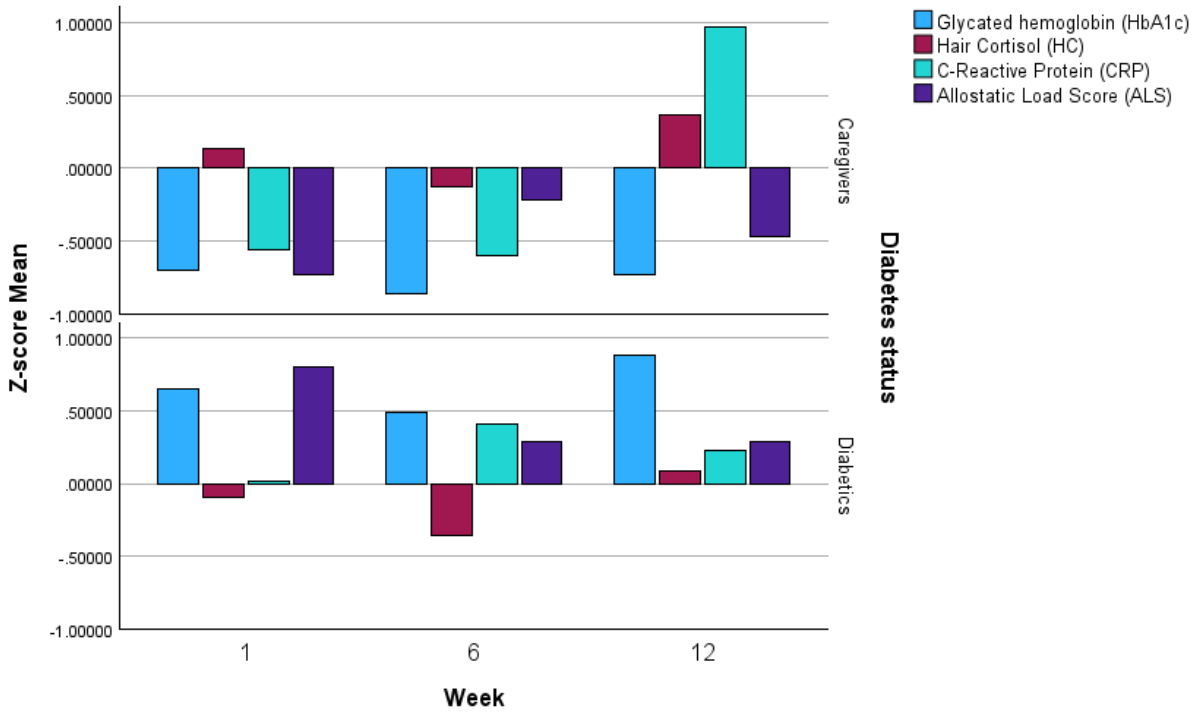


Figure 9

Standardized participant HbA1c, Cortisol, CRP, and ALS mean values



APPENDIX B - TABLES

Table 1

Interventionist demographics

	n	%	min	max	mean	SD
Gender						
Female	3	60%	-	-	-	-
Male	1	20%	-	-	-	-
Non-binary	1	20%	-	-	-	-
Race						
White	7	100%	-	-	-	-
Marital status						
Single	2	40%	-	-	-	-
Married	3	60%	-	-	-	-
Age (in years)	5	-	27	42	32.60	5.59
T1D status						
Diabetic	3	60%	-	-	-	-
Non-diabetic	2	40%	-	-	-	-
Years with T1D	3	-	17	30	23	6.50
Education attainment level						
Master's degree	4	80%	-	-	-	-
Professional degree	1	20%	-	-	-	-
Vocation						
Counseling grad student	3	60%	-	-	-	-
Anthropology grad student	1	20%	-	-	-	-
Pharmacist	1	20%	-	-	-	-
Median income ± ME of residential Zip code	5	-	$36868 ± 12005	$93136 ± 7595	$74404 ± 7392	$26504 ± 3489

Table 2

Participant demographics

	n	%	min	max	mean	SD
Gender						
Female	7	100%	-	-	-	-
Race						
White	7	100%	-	-	-	-
Marital status						
Single	2	28.6%	-	-	-	-
Married	2	28.6%	-	-	-	-
Divorced	2	28.6%	-	-	-	-
Separated	1	14.2%	-	-	-	-
Age (in years)	7	-	14	52	35.86	14.68
T1D status						
Diabetic	4	57.1%	-	-	-	-
Caregiver	3	42.9%	-	-	-	-
Years with T1D (Self or family member of those with T1D)	7	-	1	39	10.14	13.06
Education attainment level						
Some high school	1	14.2%	-	-	-	-
Some college	2	28.6%	-	-	-	-
Associate's degree	1	14.2%	-	-	-	-
Bachelor's degree	1	14.2%	-	-	-	-
Master's degree	1	14.2%	-	-	-	-
PhD / Professional degree	1	14.2%	-	-	-	-
Median income ± ME of residential zip code	7	-	$47103 ± 9873	$93136 ± 7595	$68542 ± 5941	$19472 ± 1844

Table 3

Measure administration by week

	1	2	3	4	5	6	12
Biomarker measures	X					X	X
DSES	X	X		X		X	X
DOES	X	X		X		X	X
PMCSMS	X	X		X		X	X
DDS	X		X		X	X	X
DSMQ-R	X		X		X	X	X
PedsQL FIM	X					X	X
Implementation measures	XX	XX	XX	XX	XX	XX	X
3T1 Study Specific measures	XX	XX	XX	XX	XX	XX	

Note: X = Participants completed measure; XX = Participants and interventionists completed measure; DSES: Diabetes Self-Efficacy Scale; DOES: Diabetes Outcome Expectation Scale; PMCSMS: Perceived Medical Condition Self-Management Scale; DDS: Diabetes Distress Scale; DSMQ-R: Diabetes Self-Management Questionnaire-Revised; PedsQL FIM: PedsQL Family Impact Measure.

Table 4

Participant attendance

ID	Wk1	Wk2	Wk3	Wk4	Wk5	Wk6	Total %	Follow up
#1	Yes	No	Yes	No	Yes	Yes	66%	Yes
#2	Yes	Yes	Yes	Yes	Yes	Yes	100%	Yes
#3	Yes	Yes	Yes	Yes	Yes	Yes	100%	Yes
#4	Yes	Yes	No	No	Yes	Yes	66%	Yes
#5[1]	Yes	No	Yes	Yes	Yes	Yes	83%	Yes
#6[1]	Yes	Yes	Yes	Yes	Yes	Yes	100%	Yes
#7	No	Yes	No	Yes	No	No	33%	Yes
Total	86%	71%	71%	71%	86%	86%	79%	100%

[1]Participants #5 and #6 were respectively part of the sole caregiver/diabetic-minor dyad

Table 5

Descriptive statistics of participant implementation measures

	T_0 (week 1)			T_1 (week 6)			T_2 (week 12)			Total (weeks 1-12)[1]		
	n	mean	SD	*n*	mean	SD	*n*	mean	SD	*n*	mean	SD
Acceptability	5	4.30	.54	6	4.25	.39	4	4.44	.43	34	4.35	.46
Appropriateness	5	4.23	.60	6	4.13	.59	4	4.19	.38	34	4.18	.53
Feasibility	5	4.15	.49	6	4.17	.34	4	4.06	.13	34	4.17	.52
Ease of Participation	5	4.60	.55	6	4.39	.57	-	-	-	30	4.51	.56
Pacing of 3T1	5	3.88	1.21	6	2.83	1.17	-	-	-	30	3.29	1.25
Behavioral Outcomes	5	3.39	1.30	6	4.25	.76	-	-	-	30	4.01	.87
Composite measure	5	4.32	.78	6	3.9	.70	-	-	-	30	4.06	.69

[1] Denotes that the "Total" scores were for all combined data from weeks 1-12. *Note*: There were no 3T1-specific measures in week 12 because they only reflected experiences from the previous week. Scores for all measures ranged from 1-5, with 5 indicating greater favorability.

Table 6

Interventionist implementation measures for the start and end of 3T1

	T_0 (week 1)			T_1 (week 6)			Total (weeks 1-6)		
	n	mean	SD	*n*	mean	SD	*n*	mean	SD
Acceptability of 3T1	4	4.38	.75	4	4.88	.20	24	4.62	.48
Appropriateness of 3T1	4	4.31	.69	4	4.69	.63	24	4.49	.54
Feasibility of 3T1	4	4.31	.85	4	4.75	.50	24	4.47	.55
Ease of participation	4	4.25	.83	4	4.67	.67	24	4.42	.68
Appropriate of Pacing	4	3.75	.96	4	4.38	1.25	24	4.04	1.02
Behavioral Outcomes	4	3.25	.50	3	4.67	.29	19	4.08	.73
Composite 3T1 measure	4	3.82	.65	4	4.61	.60	24	4.24	.57

Table 7

Benefits of Community theme

Benefits of Community theme		
Participants		
Code	Code distribution	Excerpt examples
Diabetes community is essential (78 instances)	7 participants, 18-39 instances	• "Hearing all the other Type 1 stories [especially those about resilience and funny pump/CGM stories]. The shared understanding has been really nice/refreshing to be around!" (Diabetic participant, week 6)
Breaking isolation (72 instances)	7 participants, 2-29 instances	• "I think the big thing that's lacking is just that type 1 community [in daily life]...that's what I was really, you know, hoping for" (Diabetic participant, focus group) • "The most helpful aspect is having others to talk to about this invisible disease" (Caregiver participant, week 6)
Knowledge transfer (39 instances)	7 participants, 3-14 instances	• "Sharing ideas with other Type 1s" (Diabetic participant, week 2) • "Having community with other T1Ds. Sharing ideas for managing BGs" (Diabetic participant, week 5)
Sources of support (8 instances)	2 caregivers and 1 diabetic, 1-5 instances	• "The type 1 group [separate from 3T1] that Tian has formed that meets once a week, that has become a big support as long and you know, the couple friends that I've built in there" (Diabetic participant, focus group) • "My partner and close friends are a support I feel, you know, I don't see my endocrinologist very often, but I feel well supported there also. And like I could reach out if I needed to, you know, in between appointments" (Caregiver, focus group)
Need for desired support (7 instances)	1 caregiver and 3 diabetics, 1-3 instances	• "I really realized that because of the medical things that I've fought and went through that this [community of diabetics] is just truly what I have missed" (Diabetic participant, focus group)
Interventionists		
Code	Code distribution	Excerpt examples

Diabetes community is essential (42 instances)	5 interventionists, 4-16 instances	• "Talking about [diabetes] with others and watching the participants connect and share diabetes woes is a very joyful experience" (Diabetes educator, week 4) • "[3T1 enabled] casual communication with other diabetics" (Diabetes educator, week 3)
Breaking isolation (22 instances)	5 interventionists, 3-6 instances	• "Hearing about other people's diabetes struggles makes me feel like we all have the power to do more if we share our information and stories with each other" (Diabetes educator, week 3) • "Knowing that I'm not alone" (Psychology interventionist, week 6 field notes) • "Community feels good in the moment [in sessions]" (Psychology interventionist, week 6 field notes) • "Diabetes pride and acceptance" (Psychology interventionist, week 6 field notes) • "Embracing the value of spontaneous interactions and bonding between T1Ds in public, e.g., commenting on strangers' Dexcoms [continuous glucose monitors] and pumps" (Psychology interventionist, week 6 field notes)
Need for desired support (13 instances)	5 interventionists, 1-5 instances	• "Diabetes can be an isolating experience, but [it is] buffered by community and emotional support" (Psychology interventionist, week 5)
Knowledge transfer (13 instances)	2 diabetes educators and 2 psychology interventionists, 2-6 instances	• "Hearing everyone talk about what is hard about diabetes" (Diabetes educator, week 4)
Sources of support (5 instances)	2 diabetes educators and 2 psychology interventionists, 1-3 instances	• "Some bright spots included encouragement from a parent with an older diabetic saying that parental independence would increase as children mature" (Psychology interventionist, week 4)

Note: An "instance" refers to an occurrence of a code being applied to an excerpt. The range reflects the smallest to the largest number of instances per person.

Table 8

Life with Diabetes theme

Life with Diabetes theme			
Participants			
Sub-theme	Code	Code distribution	Excerpt examples
Negative relationship with diabetes	Adherence is hard or feels impossible (62 instances)	7 participants, 1-18 instances	• "This week was a hard one! Sports, outside temperature changes, and whatever else made numbers all over the place" (Diabetes caregiver, week 4) • "Lack of time to properly plan meals/workouts; my pharmacy not having my insulin/CGM/insulin pump in stock; & a packed schedule" (Diabetic participant, follow up session)
	Perfectionism (26 instances)	3 diabetics and 1 caregiver participant, 3-13 instances	• "For my son [good diabetes control] would look like staying in range. Being able to bolus [or administer a large insulin dose] in advance w/out difficulties. The school lunch menu not changing w/out telling us so we are more prepared. My son's stressors would be lowered" (Caregiver participant, intake form) • "Good blood sugars, doing insulin on time, keeping track of eaten carbs for when bolus [or administer a large insulin dose] on pump" (Diabetic participant, intake form) • "I have a pretty high bar for what I want, my time in range and what my blood glucose to be like" (Diabetic participant, focus group) • "Talking about what we would want our life would be like if our diabetes management was exactly how we wanted it. Because it may never be exactly how we want it to be. And even if it was, my life might never be exactly like how I want it to be" (Diabetic participant, week 2)
	Diabetes is a battle (13 instances)	3 diabetic and 2 caregiver participants, 1-4 instances	• "Everybody fights, it's just a normal part of the type 1 life...I really realized that because of the medical things that I've fought and went through that [community] is just truly what I have missed. And that is

			very, it is very just an important part of the whole Type 1 journey" (Diabetic participant in the focus group) • "[Overwhelming concerns include] two homes, school nurse, other illnesses, life, overwhelm, money, time, etc." (Caregiver, week 12 follow up session)
	Adherence versus quality of life (10 instances)	2 diabetic and 3 caregiver participants, 1-5 instances	• "I feel it is not too much to manage this [diabetes] properly. Although, it does require sacrifices elsewhere" (Caregiver participant, week 4) • "I know [adherence is] something I have to do but don't always give it top priority in my daily routine" (Diabetes educator, week 1) • "[Non-adherence is due to] not putting myself first, aka letting conversations with others/being a burden to others to put before dosing or just general diabetes management" (Diabetic participant, week 5)
Diabetic pain	Diabetes distress comes from without (45 instances)	7 participants, 2-12 12 instances	• "Lack of energy and motivation" (Diabetic participant, intake form) • "Once again, having an overpacked college schedule always makes managing diabetes more stressful/overbearing" (Diabetic participant, week 5) • "Other responsibilities, time for work, family, and pets [all interfere with adherence]. It takes a lot of forethought such as meal planning, packing snacks for activities outside of the house. Sometimes it's just too exhausting or tedious to do the prep work" (Diabetic participant, week 12 follow up)
	Diabetes frustration (25 instances)	7 participants, 1-8 instances	• "Generally [I'm] ok, but I get frustrated with Dexcom [continuous glucose monitoring device] beeping highs/lows when I'm at work or the constant beeps when I can't get BG to budge. Irritated when I have to stop what I'm doing to manage BG or worried about bolusing [administering a dose of insulin] when eating at a restaurant/friend's house" (Diabetic participant, intake form) • "Equipment problems" (Caregiver participant, week 5)
	Lack of understanding in daily life (14 instances)	1 caregiver and 3 diabetic participants, 2-5 instances	• "[Diabetes is] difficult, despite what my friends and family say" (Diabetic participant, week 6) • "It's a silent thing that most people really can't understand the weight of" (Diabetic participant, focus group)

	T1D is a family disease (14 instances)	1 diabetic and 2 caregiver participants, 1-9 instances	• "Traveling at times but still not much [would be a sign of good management]. Pretty much living with diabetes is staying on top of diabetes for us" (Caregiver participant, week 6) • "[Diabetes] is part of my life. It takes energy and time, but that's just how it goes" (Caregiver participant, intake form) • "My son was with me so I could keep a closer eye on his numbers, set my phone to intervene sooner, keep a regular schedule [to have good control]" (Caregiver participant, week 12 follow up)
Diabetes lifestyle	Food (23 instances)	3 diabetic and 2 caregiver participants 1-10 instances	• "[Good control would look like] Low carb / Low fat diet. Not eating out and lots of movement" (Diabetic participant, intake form) • "[Challenges include] planning meals and timing meals with consideration of diabetes" (Diabetic participant, week 6) • "[Good control would look like] getting my son to eat more protein prior to other foods" (Caregiver participant, week 3)
	Value of adherence behaviors (14 instances)	2 diabetic and 2 caregiver participants, 1-8 instances	• "[Checking] blood sugars, bolusing [or administering a dose of insulin] prior [to] eating" (Diabetic participant, week 6) • "I have learned a lot more recently about different strategies with dosing, so that has helped to make more informed choices" (Caregiver participant, week 6) • "Following SMART goals...Using insulin pump to bolus for meals" (Diabetic participant, week 3)
	Schedule (6 instances)	2 diabetic and 2 caregiver participants, 1-3 instances	• "Work schedule - irregular breaks/mealtimes" (Caregiver participant, intake form)
	Medical guidelines versus lived experience (5 instances)	1 diabetic and 1 caregiver participant, 1-4 instances	• "I often feel like I don't have enough time to really consult with the medical team, so I really rely on my own research via other T1's to make dosing changes" (Caregiver participant, week 4) • "We know in practice that [some guidelines are] not true, but it's really nice to speak with a group of people with lived experience to really see that that's not true" (Diabetic participant, focus group)

	Exercise is helpful (4 instances)	1 diabetic and 1 caregiver participant, 1-3 instances	• "My lack of exercise from the last 2 weeks caught up with me and my walking has helped so much and my body and mind are relaxing" (Diabetic participant, week 5)
	Diabetes supplies (3 instances)	2 caregiver participants, 1-2 instances	• "This week has been a hard week with lack of supplies" (Caregiver participant, week 3)
	Other health issues (2 instances)	1 caregiver participant, 2 instances	• "Medical conditions of myself or myself [are barriers to treatment adherence]" (Caregiver participant, week 4)
Positive relationship with diabetes	Value of acceptance (29 instances)	2 diabetic and 3 caregiver participants, 4-9 instances	• "It [diabetes management] is part of my life. It takes energy and time, but that's just how it goes" (Diabetic caregiver, intake form) • and "I think about it [diabetes management] all the time but not in an overwhelming sense" (Diabetic participant, week 1) • "Honestly [life is] pretty good on the day-to-day basis. Like all things, I have bad days, but most of the time I feel very good about [diabetes]" (Diabetic participant, intake form) • "Be a little easier on myself in terms of what's going on with diabetes" (Diabetic participant, focus group)
	Diabetic joy (18 instances)	4 diabetic and 2 caregiver participants, 1-8 instances	• "I have been more aware of my [time-in-range] and wanting to stay in range. I had a lot of really long, exciting yet exhausting days this week and my blood sugar was relatively smooth for it" (Diabetic participant, week 6) • "I haven't had too many extreme high or low blood sugars which has been nice" (Diabetic participant, week 2) • "'Diabetic joy' [sharing light-hearted moments] has been some of the highlights of this so far" (Diabetic participant, week 5)
Interventionists			
Sub-theme	Code	Code distribution	Excerpt examples
Negative relationship with diabetes	Adherence is hard or feels impossible (52 instances)	5 interventionists, 2-20 instances	• "I realized tonight that I constantly feel negative about my management of diabetes: like no matter what I do something goes away and yet I am meeting clinical goals & technically doing quite well" (Diabetes educator, week 2)

			• "Life is so inconsistent" and BG control seems to demand perfect constancy, and it is this belief that contributes to burnout. Others not accommodating diabetes also makes management difficult, particularly when this comes from healthcare professionals like doctors and school nurses, or from authority figures, like employers" (Psychology interventionist, week 6 field notes)
	Perfectionism (25 instances)	2 psychology interventionists and 1 diabetes educator, 6-11 instances	• "The other things seem to be a sense that it is too overwhelming due to the belief that one must be perfect, 100% Time in range" (Psychology interventionist, week 6) • "It feels so much easier to focus on what is going wrong or what we "didn't do" as opposed to wins, neutral outcomes, avoided disasters, and positive management practices" (Psychology interventionist, week 4)
	Diabetes is a battle (19 instances)	5 interventionists, 1-9 instances	• "Managing diabetes is hard and wears on the soul" (Diabetes educator, week 6) • "Stories of diagnosis and management often seemed to be about overcoming incompetence from others (like healthcare providers), helplessness, and tolerating ongoing stress" (Psychology interventionist, week 3)
	Adherence versus quality of life (16 instances)	2 psychology interventionists and 2 diabetes educators, 2-7 instances	• "Irritation with lows, especially at night and while sleeping. My stubbornness prevents me from wanting to treat" (Diabetes educator, week 6) • "I know it's something I have to do but don't always give it top priority in my daily routine" (Diabetes educator, week 1) • "[Adherence would mean] being able to tolerate unknowns and balancing 'adherence as opposed to freedom and less anxiety'" (Psychology interventionist, week 3)
Diabetic pain	Diabetes frustration (33 instances)	5 interventionists, 1-14 instances	• "Negative emotions about BG that lead to overreaction and residual feelings of negativity" (Diabetes educator, week 4).
	Diabetes distress comes from without (30 instances)	5 interventionists, 1-13 instances	• "Meetings that run long, sticky highs [high BG that stays high beyond expected timeframes], restaurants that put sugar in their sauces" (Diabetes educator, week 6) • "Life inconsistencies" (Diabetes educator, week 5)

			• "Carb counting gone wrong, stress, chaotic life events, misunderstanding of how insulin works, other people, jobs and school, bad sleep, and any part of life that is unpredictable" (Diabetes educator, intake form).
	Lack of understanding in daily life (13 instances)	5 interventionists, 1-6 instances	• "Since other obligations and systems do not accommodate diabetes management needs, those needs become secondary to other activities, even when those activities become harder or impossible without adequate BG and diabetes care" (Psychology interventionist, week 6)
	T1D is a family disease (6 instances)	1 psychology interventionist and 1 diabetes educator, 1-5 instances	• "When talking as a group, parents said that Type 1 diabetes is not the main impediment in their lives but rather that how complicated life can be leads to burnout" (Psychology interventionist, week 6) • "Parents can try to understand and manage what they can but that at certain ages diabetics may push back against sympathy and attempts at understanding from caregivers" (Psychology interventionist, week 6).
Diabetes lifestyle	Food (8 instances)	1 psychology interventionist and 1 diabetes educator, 2-6 instances	• "Eating less and only eating at regularly scheduled times" (Psychology interventionist, intake form)
	Value of adherence behaviors (8 instances)	2 psychology interventionists and 1 diabetes educator, 1-6 instances	• "I am always sure to check my BG often but not too often" (Psychology interventionist, intake form) • "Diabetes is hard to manage due to the inconsistency and it seems important to mostly manage both expectations and inconsistency that emerge as a result of diabetes and day to day life not built for a life with diabetes" (Psychology interventionist, week 5)
	Schedule (8 instances)	2 psychology interventionists and 2 diabetes educators, 1-3 instances	• "Monitoring and behavior management, as well as identifying ways to develop healthy routines" (Psychology interventionist, week 1)
	Medical guidelines versus lived experience (2 instances)	1 psychology interventionist and 1 diabetes educator, each with 1 instance	• "Others' not accommodating diabetes also makes management difficult, particularly when this comes from healthcare professionals like doctors and school nurses, or from authority figures, like employers" (Psychology interventionist, week 6)

	Exercise is helpful (2 instances)	1 psychology interventionist and 1 diabetes educator, each with 1 instance	• "[Adherence is enhanced by] exercise and consulting with diabetic/trained healthcare professionals (e.g., a diabetic physical therapist in town)" (Psychology interventionist, week 5)
	Diabetes supplies (2 instances)	2 psychology interventionists, each with 1 instance	• "Other barriers included significantly higher allostatic load due to issues with technology" (Psychology interventionist, week 4)
	Other health issues (2 instances)	1 psychology interventionist and 1 diabetes educator, each with 1 instance	• "Other health concerns" (Diabetes educator, week 6) • "Mental health" (Psychology interventionist, week 6)
	Value of acceptance (16 instances)	2 psychology interventionists and 2 diabetes educators, 2-7 instances	• "Finding solidarity, considering new ways to look at diabetes management and attitudes, e.g., celebrating the 'smaller' wins, such as remembering to pre-bolus" (Psychology interventionist, week 4) • "Diabetes management is about accepting that things will go awry and going with that flow. I think adequate management is about learning what is 'good enough' and how to achieve it while managing the anxiety of always being one meal or workout away from 'bad' BG and its concordant pain and risk of long-term health issues" (Psychology interventionist, week 6)
	Diabetic joy (12 instances)	(2 psychology interventionists and 1 diabetes educator, 1-6 instances	• "Talking about [life with T1D] with others and watching the participants connect and share diabetes woes is a very joyful experience" (Diabetes educator, week 4) • "Things [participants] are grateful for, both related and unrelated to T1D: resilience, empathy, modern medicine, care for our bodies, lower drug prices, Dexcom CGMs, when others 'get what it's like to have T1D', and being able to be mad about diabetes" (Psychology interventionist, week 6)

Note: An "instance" refers to an occurrence of a code being applied to an excerpt. The range reflects the smallest to the largest number of instances per person.

Table 9

Structure of 3T1 theme

Structure of 3T1 theme			
Participants			
Sub-theme	Code	Code distribution	Excerpt examples
3T1 was well-structured	3T1 structure was helpful (11 instances)	2 diabetic and 2 caregiver participants, 1-6 instances	• "Developing SMART goals" (Diabetic participants, week 3) • "Just having dedicated time/space to talk about it helps to bring to light what the struggles are and identify possible solutions" (Caregiver participant, week 4) • "I'm still working on my SMART goal. That's kind of an, just an ongoing thing. I really enjoyed the focus on it, and it really helped me like narrow down, be super specific about 1 area to work on. So that's been super helpful for me" (Diabetic participants, focus group)
	3T1 was strengthened by interventionist collaboration (1 instance)	1 diabetic participant, 1 instance	• "Tian has type 1 and is a researcher, so she's got a wealth of perspectives. But it was really nice having her along with a psychologist because, you know, Tian could kind of translate some of our diabetes lingo that we're kind of throwing around that, you know, are not necessarily realizing is not maybe common language to people who haven't spent time in the community" (Diabetic participant, focus group)
3T1 was poorly structured	3T1 structure was unhelpful (6 instances)	3 diabetic and 1 caregiver participants, 1-2 instances	• "Least helpful was just the time we met each week. At times, it was hard to make plans around [the intervention]" (Diabetic participant, week 6)
	Lack of intervention target clarity (1 instance)	1 caregiver participant, 1 instance	• "Not really sure [what 3T1 was even trying to accomplish]" (Caregiver participant, week 2)
Interventionists			
Sub-theme	Code	Code distribution	Excerpt examples

3T1 was well-structured	3T1 was strengthened by interventionist collaboration (33 instances)	2 diabetic and 2 caregiver participants, 5-10 instances	• "It was very helpful for me to have Tian there as somebody who had kind of more knowledge and background information and maybe more implementable and relevant strategies kind of as well as, you know, my side and feeling like I had the backup was very helpful for me" (Psychology interventionist, focus group) • "Talking about dynamics, I always felt very comfortable asking for and giving feedback to this team...there was this sense of like, 'Oh, yeah, this is going to be a group of people that if I throw something out there, no one's ego is going to get bruised'. It's going to be like, OK, like, let's talk about that and think about that. And I think that made a big deal difference was just that trust that I had in this team" (Psychology interventionist, focus group)
	3T1 benefited from being flexible (24 instances)	2 psychology interventionists and 2 diabetes educators with 5-7 instances	• "Tailoring the ideas more specifically to diabetes and then the group had a lot to say. There has also been sharing of tips between participants which seems very helpful." (Diabetes educator, week 3) • "Outlines really did try to specify what was, you know, expected or kind of what the job description was...having more structure may have been helpful, but I don't, I don't know that it would have mattered anyway" (Diabetes educator, focus group)
	3T1 structure was helpful (23 instances)	2 psychology interventionists and 2 diabetes educators with 2-9 instances	• "Everyone talking about the hardest parts of diabetes helped me see what education components we should focus on" (Diabetes educator, week 2) • "Setting up psychoeducation re: goals & self-efficacy" (Psychology interventionist, week 1) • "Discussing our plans for the session seemed to improve the flow of the conversations" (Psychology interventionist, week 4).
	Addressing broad concerns surpassed diabetes education (18 instances)	2 psychology interventionists and 1 diabetes educator with 2-10 instances	• "I think asking folks about, like, kind of bigger struggles and, like, going more topic based with a curriculum rather than skills based is, would be great" (Psychology interventionist, focus group) • "When working with kids, to have like a maximum 10% diabetes education, 90% just being together model" (Diabetes educator, focus group) • "I think maybe there was one book I brought that someone was excited to look at one time...I overprepared, just like wanting to like feel like I was bringing some kind of like formal curriculum to the table, but it really wasn't needed" (Diabetes educator, focus group)

3T1 was poorly structured	Lack of intervention target clarity (30 instances)	2 psychology interventionists and 2 diabetes educators with 1-17 instances	• "I felt very unprepared often coming into the session" (Diabetes educator, focus group) • "I can relate to [diabetes educator] in terms of that sort of feeling a little bit blind about like what really we were for sure trying to do in the session versus letting it take its own course" (Diabetes educator, focus group) • "Something that I really noticed, like there was in the curriculum, like a lot of talk about like SMART Goals and things like that. And something that I noticed with our Type 1's was a focus on like perfection and like SMART goals being really big. And so and like, you know, obviously we tried to kind of tamp it down and make them a little bit more realistic" (Psychology interventionist, focus group) • "Had it been clear that psychotherapy was going to be the, you know, the 80% weight and then diabetes education was 20%, that may have eased some of that feeling [of unease] for me" (Diabetes educator, focus group)
	3T1 structure was inconsistent (26 instances)	2 psychology interventionists and 2 diabetes educators with 3-9 instances	• "I didn't know how it was going to which way it was direction it was going to take each week" (Diabetes educator, focus group) • "In reflecting on [how curriculum wasn't closely followed] at least the group we had with the caregivers, I felt one of the most challenging things for me was, and I think I mentioned this was just kind of, you know, we had it very structured, but it, it rarely followed that structure" (Diabetes educator, focus group)
	Need for session zero (22 instances)	2 psychology interventionists and 1 diabetes educator with 3-12 instances	• "I think like having not met each other before this study and, like, just not even having coffee to, like, know how we communicated did pose a challenge. But, like, again, not in a, not a huge issue. But I definitely can see the difference between, like, this new friend and, like, [Psychology interventionist], who I've been like having diabetes conversations with for three years" (Diabetes educator, focus group) • "I don't know that this study included a really great system of debriefing or even having a session zero where we could, like, mockup what was going to happen or practice" (Psychology interventionist, focus group)
	3T1 had a deficit	1 psychology interventionist and 1 diabetes	• "I thought that that was really interesting, particularly kind of, I think that the adherence model kind of assumes the deficit framework. It's like you just

	framework (15 instances)	educator with 4-11 instances	need more adherence. The more adherence, the better. If you lack adherence, it's because you're lacking skills" (Psychology interventionist, focus group) • "There was a bit of a deficit framework that came in, by which I mean a lot of the curricula that it had in the first several weeks, probably 3, maybe even 4 weeks, really was focused on 'let's give you skills.' And my experience with the caregiver group was that they're like, 'we don't need skills'" (Psychology interventionist, focus group) • "I think framing tonight around 'burnout' was not the right fit. Diabetes distress leading up to burnout resonated more with the group and led to more discussion" (Diabetes educator, week 4)
	3T1 structure was unhelpful (11 instances)	2 psychology interventionists and 1 diabetes educator with 1-8 instances	• "Least helpful [thing about 3T1] was organization / setup for the biomarkers, we were not prepared for this work, and it slowed things down considering the need to introduce concepts to people" (Psychology interventionist, week 1) • "Some issues included: focusing too much on content in an un- or under-structured way and at times too much following up on individual concerns, rather than group themes or session focus" (Psychology interventionist, week 3)
	3T1 needed more participant input (8 instances)	1 psychology interventionist and 2 diabetes educators with 1-4 instances	• "I would also add, and again, I don't think this was possible with this pilot version, but having a curriculum that we share with people and whether that's like a directed curriculum of like this is what we're doing or if it's like these are the topics that we want to cover with you and getting some feedback on which ones we prioritize. But I think having a little bit more of an iterative relationship with people and actually like being a little more transparent about like the topics of the curriculum that we're, you know, bringing to the table would be really helpful" (Diabetes educator, focus group)
	Need for prior group intervention education (7 instances)	2 psychology interventionists and 1 diabetes educator with 1-5 instances	• "There are some educational videos that show, you know, mock group therapy kind of sessions. And I feel like almost seeing something like that might be helpful. Like this is what a support group can look like" (Psychology interventionist, focus group) • "I love that idea of a crash course and having a little more idea of what it is that we're going along with ahead of time would have been cool" (Diabetes educator, focus group)

Note: An “instance” refers to an occurrence of a code being applied to an excerpt. The range reflects the smallest to the largest number of instances per person.

Table 10

Evaluation of 3T1 theme

Evaluation of 3T1 theme			
Participants			
Sub-theme	Code	Code distribution	Excerpt examples
Negative evaluations of 3T1	3T1 content was unhelpful (3 instances)	2 diabetic participants, 1-2 instances	• "I guess just to add on to that, it doesn't have to be like a learning thing, [3T1 can serve as] just a place where people can meet." (Diabetic participant, focus group)
3T1 generated positive emotions	T1D relief (21 instances)	7 participants, 1-5 instances	• "I'm looking forward to my husband being gone for a business trip - I get to focus on self-care for 6 days [smiling emoticon]" (Diabetic participant, week 6) • "What went well [this past week]: my kids have a great attitude about T1D and are great at sharing with their friends how they manage" (Caregiver participant, week 4) • "It's pretty profound how helpful it was just to be around other Type 1 diabetics like that alone, walking into a room and not feeling insecure about alarms going off and having to explain it or worrying about, you know, a high or a low and having to keep it secret and just seeing other people in real time also managing their diabetes or their kids is. It's such a simple thing, but it's so profound" (Caregiver participant, focus group)
	Empathy (4 instances)	3 diabetic participants, 1-2 instances	• "Knowing that we all have stress with our diabetes. We are all different yes, but we are all the same about the stress that type 1 causes with our life and not being the same as other people" (Diabetic participant, week 3)
	Giving grace (3 instances)	1 diabetic and 1 caregiver participant, 1-2 instances	• "I can maybe just like, relax a little bit about not having, you know, normal blood sugars, like somebody without diabetes because, you know, I have diabetes. So I have crazy numbers sometimes" (Diabetic participant, focus group).

	Participants identified personal strengths (1 instance)	1 diabetic participant, 1 instance	• "I think about it all the time but not in an overwhelming sense" (Diabetic participant, week 1)
Positive evaluations of 3T1	3T1 had value (15 instances)	3 diabetic and 2 caregiver participants, 1-5 instances	• "I did this specifically because I wanted to meet people in the community and, you know, definitely had success with that. And I think it was really great too, again, you know, having the psychologist perspective, being able to, you know, ask some questions that I had not thought of myself, bringing in that different perspective" (Diabetic participant, focus group) • "Community. Every bit of it was helpful. Thank you" (Diabetic participant, week 6) • "Hearing others' stories and helpful input. Very helpful and comforting. Very educational" (Caregiver participant, week 3) • "Hearing tips & tricks from other people with Type 1 has been neat. Like I didn't know you could refill Dexcoms [CGM devices] after only 23 days" (Diabetic participant, week 2)
	3T1 Psychology content was helpful (14 instances)	1 diabetic and 2 caregivers participants, 1-11 instances	• "Learning all the coping tools and hearing others' perspectives and thought and teachings surrounding T1D" (Caregiver participant, week 6)
	Combined group was beneficial (12 instances)	3 diabetic and 2 caregiver participants, 1-6 instances	• "I also really liked when we brought the two groups together" (Diabetic participant, focus group)
	SMART goals were helpful (10 instances)	(2 diabetic and 1 caregiver participants, 1-8 instances	• "I think it was really great having psychologists involved...it was nice to have a few, you know, interventions that we practiced it kind of just, you know, reframing some thoughts and specifically like writing SMART goals was really great" (Diabetic participant, focus group) • "Referring back to [SMART goals] in the following meetings, like continuously referring back to them. It's not just like, oh, we talk about it, we'll do one follow up and be done. But it was a continuous thing. So that was really great" (Diabetic participant, focus group)

	3T1 addressed unmet needs (6 instances)	3 diabetic and 1 caregiver participants, 1-2 instances	• "I think the big thing that's lacking is just that type 1 community" (Diabetic participant, focus group) • "I have learned a lot more recently about different strategies with dosing, so that has helped to make more informed choices" (Caregiver participant, week 6)
	Future orientation and planning / problem solving (6 instances)	1 diabetic and 1 caregiver participants, 2-4 instances	• "I really enjoyed the focus on it [a specific health target] and it really helped me like narrow down, be super specific about 1 area to work on" (Diabetic participant, focus group)
	Interventionists had expertise (5 instances)	1 caregiver participant, 5 instances	• "I think it was really great having psychologists involved so they could a, just ask some really like great questions and you know, kind of synthesize information really well" (Diabetic participant, week 3)
	Value of T1D education (5 instances)	2 diabetic and 2 caregiver participants, 1-2 instances	• "Tian has type 1 and is a researcher, so she's got a wealth of perspectives" (Diabetic participant, focus group) • "I regret that I missed part of [3T1] because I think it would have brought more to the plate and been more educational" (Diabetic participant, focus group)
	Big Wins (4 instances)	(2 diabetic and 2 caregiver participants, 1 instance per participant	• "I actually was able to let it [hypervigilance around BG regulation] go for about 6 hours" (Diabetic participant, focus group) • "Managing independently [which is atypical]" (Caregiver participant, week 2
	Small group was good (2 instances)	1 diabetic participant, 2 instances	• "One of the things that wasn't helpful was mixing caregivers and diabetics for a day, maybe I just think it wasn't helpful for me because my mother, but just think they thought, they knew what it's like to have diabetes, when they only know some parts" (Diabetic participant, week 6)
Interventionists			
Sub-theme	Code	Code distribution	Excerpt examples
Negative evaluations of 3T1	Interventionist uncertainty (26 instances)	2 diabetic and 2 caregiver	• "Honestly, it did sometimes feel like me and [Diabetes educator] were kind of like along for the ride" (Psychology interventionist, focus group)

		participants, 1-10 instances	• "I did have some trepidation about prolonging too much of my diabetes experience, in part because I was like, 'I don't know if I can model the same way'" (Psychology interventionist, focus group)
	Poor coordination between interventionists (20 instances)	2 diabetes educators and 2 psychology interventionists, 1-8 instances	• "We weren't really sure like who was driving, almost like we're throwing the steering wheel back and forth a little bit" (Diabetes educator, focus group) • "I think like a clearer relationship between the, the like psychotherapy interventions and the diabetes education components would have been helpful" (Diabetes educator, focus group) • "I definitely feel like there were a lot of moments where we were looking at each other like this, like kind of like 'you're gonna, you're gonna [say something]?' And I think also part of it was that we were throwing things that we were hoping somebody in the group would catch and they didn't" (Psychology interventionist, focus group)
	Non-generalizable study (12 instances)	2 diabetes educators and 2 psychology interventionists, 1-4 instances	• "[A] definite improvement would be in, in the, the size of the study group, just would offer a lot of different improvements" (Diabetes educator, focus group) • "I think small group sizes meant there was just less like less bouncing off of. And I really felt that when we had the full group, even though we lost some of the ability to really open up with the type 1s, I thought that like the, the feeling of that number of people was really powerful" (Diabetes educator, focus group) • "I feel like that was part of it [uncertainty between interventionists] as well was like small group sizes people like especially there was one [time] when I think we only had two people and like you could tell they were just sort of fatigued talking" (Psychology interventionist, focus group)
	3T1 content was unhelpful (4 instances)	1 diabetes educator and 1 psychology interventionist, 2 instances each	• "The DBT DEARMAN skill may not always work based on low or insufficient motivation from others to engage in critical conversations, i.e., hard for some participants to imagine using DEARMAN with their partners or healthcare providers" (Psychology interventionist, week 3)

3T1 generated positive emotions	Interventionist personal growth (24 instances)	2 diabetic and 2 caregiver participants, 3-9 instances	• "Hearing about other people's diabetes struggles makes me feel like we all have the power to do more if we share our information and stories with each other" (Diabetes educator, week 3) • I honestly feel like you two [diabetes educators] kind of got a little crash course in support group psychotherapy facilitation because like, I mean, Tian, it felt very much like it would have felt with a another like psychotherapist in the room of like just kind of the way that you were able to like bounce off experiences and empathize is like such a huge part of it (Psychology interventionist, focus group)
	Empathy (16 instances)	5 interventionists, 2-5 instances	• "Just hearing from other diabetics, different perspectives and insight" (Diabetes educator, week 2) • "[3T1] has opened my eyes to different views, hardships, successes, struggles of others" (Diabetes educator, week 5) • "I felt very empathetic towards the parents who I was just like, wow, you have it as bad as, you know, we do or as I did as a kid, but for different reasons. And, you know, it just made me feel a lot more empathetic towards them. And I felt like that was really powerful. Just for me, thinking as, like, this is, I'm an interventionist, but like, I'm also affected by this intervention" (Psychology interventionist, focus group)
	Participants identified personal strengths (4 instances)	1 diabetes educator and 1 psychology interventionist, 1-3 instances	• "Being in a room with other Type 1's builds resilience and emotional strength" (Diabetes educator, week 6) • "There has also been sharing of tips between participants, which seems very helpful" (Diabetes educator, week 3)
	T1D relief (3 instances)	3 psychology interventionists, each with 1 instance	• "It seems like parents of people with type 1 diabetes largely accept [having T1D after processing it] and [the] embrace of T1D increases independence from their children" (Psychology interventionist, week 3)
	Interventionist enjoyment (3 instances)	2 psychology interventionists, 1-2 instances	• "I think this has been a really beautiful project and everyone involved has brought a really important component" (Diabetes educator, focus group) • "Yeah, I'll echo that. I had so much fun doing this with y'all and thanks for letting me be your resident non-type 1 sneaking into the space. But I really enjoyed it and I've learned a lot" (Psychology interventionist, focus group)

	Giving grace (2 instances)	1 diabetes educator and 1 psychology interventionists, each with 1 instance	• "Currently, my closed loop [insulin delivery system] is turned off because the sensor I am wearing has proven to be unreliable and so I will give myself more grace in how I define 'good'" (Diabetes educator, intake form)
Positive evaluations of 3T1	Interventionists had expertise (27 instances)	1 diabetes educator and 2 psychology interventionists, 4-13 instances	• "Advice from interventionists included information about BG range and what good control actually is (e.g., perfectionism vs. 70% time in range)" (Psychology interventionist, week 5) • "You just have all this knowledge that you can then impart" (Psychology interventionist, focus group) • "I really can't tell you enough how incredible it was [to have you as an interventionist] not just as a diabetes educator, but in particular as your role as a pharmacist, given who we were working with. It felt so perfect...many of the things that you were able to speak to, particularly when someone was just like, 'my kid and, you know, his sister get insulin at different pharmacies or at different times and it's confusing'. And you're able to be like, 'Oh yeah, that pharmacy, here's what you got to do' was just incredible" (Psychology interventionist, focus group)
	Value of debriefs (20 instances)	2 diabetes educators and 2 psychology interventionists, 4-6 instances	• "Well, yes, like feels like a longer time commitment might also be helpful in like keeping our time as interventionists, like boundaried in that way. And I think it was really valuable having those chats as well." (Psychology interventionist, focus group)
	Combined group was beneficial (13 instances)	2 diabetes educators and 2 psychology interventionists, 4-6 instances	• "I also really liked when we brought the two groups together" (Diabetic participant, focus group) • "I really liked being in the full group tonight. I think a larger group is beneficial" (Diabetes educator, week 6)
	Nondiabetic interventionists helped (9 instances)	1 diabetes educator and 1 psychology	• "Like [diabetes educator] said, I think probably just makes you more of a human and less of like a scholar who's trying to do this big, you know, like like, sort of untouchable" (Psychology interventionist, focus group)

		interventionist, 2-7 instances	
	3T1 had value (8 instances)	2 diabetes educators and 2 psychology interventionists, 1-4 instances	• "Social interaction, hearing others' experiences, some of the stress management tools" (Diabetes educator, week 6) • "We had a fruitful conversation about stress this put on their bodies and careers, as well as their romantic relationships, and other carryover health effects" (Psychology interventionist, week 4) • "We are doing a good job of covering context that resonates with at least 1 person deeply" (Diabetes educator, week 5)
	3T1 addressed unmet needs (8 instances)	1 diabetes educator and 1 psychology interventionist, 1-7 instances	• "It also appeared beneficial for parents to develop goals like streamlined pharmacy organization (i.e., sitting down to coordinate diabetes supply delivery from a pharmacy for two children with T1D) and crafting more durable and suitable diabetes kits" (Psychology interventionist, week 4) • "But the, yeah, the perfectionism thing, again, also in the literature, it's huge problem with Type 1 because just like the nature of the way that they measure blood sugar, right? It's a percentage out of 100. It often reflects, it invokes a grade sensation, but the goal is 70%. So, like, you're, you know, there's just, there's a lot of tension. And then people typically have relationships with their doctors that are very evaluative, very blaming of the person when things aren't going well. And so, I think that it's a safe, like, place to start to assume that everyone's trying to achieve a higher goal than what's practical and what's good for their mental health" (Diabetes educator, focus group).
	3T1 Psychology content was helpful (7 instances)	3 psychology interventionists, 1-4 instances	• "Emphasis on making goals manageable and not striving for perfection" (Psychology interventionist, week 3)
	Future orientation and planning / problem solving (7 instances)	2 diabetes educators and 2 psychology interventionists, 1-3 instances	• "The most helpful was hearing from parents and doing real-time problem solving" (Psychology interventionist, week 3) • "Perhaps a goal for me would be to dedicate time to think about it [change]" (Diabetic educator, week 5)

	Transparent curriculum (7 instances)	1 diabetes educator and 1 psychology interventionist, 2-5 instances	• "Discussing our plans for the session seemed to improve the flow of the conversations" (Psychology interventionist, week 4)
	Value of T1D education (6 instances)	2 diabetes educators and 2 psychology interventionists, 1-3 instances	• "I was able to serve as a launching pad by responding to some of the interventionists' prompts: Tailoring the ideas more specifically to diabetes and then the group had a lot to say" (Diabetes educator, week 3)
	Interventionists redirected participants (6 instances)	1 diabetes educator and 2 psychology interventionists, 1-4 instances	• "I think MI was used effectively in the last 20 or so minutes of the intervention to have participants identify what worked and didn't for them with diabetes management" (Psychology interventionist, week 1) • "In support groups, like my typical like modus operandi is to just be really silent and let them fill the silence" (Psychology interventionist, focus group)
	Skills training was useful (5 instances)	1 diabetes educator and 2 psychology interventionists, 1-2 instances	• "Key benefits of the intervention highlighted by participants were that this was a dedicated time to consider diabetes problem solving" (Psychology interventionist, week 4) • "Learning new coping mechanisms" (Diabetes educator, week 5)
	Small group was good (4 instances)	2 diabetes educators and 1 psychology interventionist, 1-2 instances	• "I think just the small groups, like, I appreciate what you were saying, [Diabetes educator], that like maybe it facilitated some more openness and like communication" (Diabetes educator, focus group)
	Diabetic interventionists helped (4 instances)	2 psychology interventionists, 1-3 instances	• "I think the importance of understanding, like, the rollercoaster-ing of blood sugar and the relationship between how much investment you put in doesn't equal at all what you get out. And I think there's a lot of stigma, that can just, I see it in a lot of interventions that are designed by care providers that don't have Type 1. And I think that the beauty of this was that, like, it was just not there because we, like, as the designers, like, we're living it" (Diabetes educator, focus group)

	Strategizing T1D management (4 instances)	1 diabetes educator and 1 psychology interventionist received 2 instances each	• "This week I am thinking about how nuanced diabetes care needs to be. Diabetes constantly throws curve balls and handling them needs to be part of the plan rather than an unwanted pesky disturbance" (Diabetes educator, week 4) • "You had shared a story in Group about, you know, somebody very well versed in the biological side of diabetes, who said that he like advocates taking, like, a day, where you just know that you're going to, like, you know, eat a little extra sugar or whatever it is. And I feel, like, when you said that as the diabetes educator, like, the named person who is the expert in the room, I feel, like, there was like a, 'Oh my God, like, we can do that. It's OK to, like, to not adhere.' And I think that also was really powerful of like, yeah, 'It's OK to actually, like, you can slip and it's, you know, not necessarily the end of the world'. And even people very well versed in this agree with that. I think could be a very powerful thing to stick on next time" (Psychology interventionist, focus group)

Note: An "instance" refers to an occurrence of a code being applied to an excerpt. The range reflects the smallest to the largest number of instances per person.

Table 11

Participant descriptive statistics of psychosocial measures

	T_0 (Week 1)			T_1 (Week 6)			T_2 (Week 12)		
	n	Mean	SD	*n*	Mean	SD	*n*	Mean	SD
T1D Self-Efficacy	5	7.26	1.89	7	7.20	1.85	4	6.95	1.03
Neg Outcome Expectations	5	7.34	2.10	7	6.60	2.91	4	4.98	2.17
Pos Outcome Expectations	5	6.46	2.06	7	5.77	1.90	4	6.85	1.92
Total Outcome Expectations	5	6.88	1.64	7	6.17	1.35	4	5.93	1.39
PMCSMS	5	3.90	.98	7	3.64	1.10	4	3.18	.94
Total Diabetes Distress	5	2.90	.70	7	2.87	.53	4	2.85	.62
Diabetes Self-Management	5	2.24	.35	7	2.10	.30	4	2.13	.24
Total monthly PedsQL	6	60.63	18.76	7	54.86	18.43	3	55.32	27.70
Monthly Health-Related QL	6	60.42	19.26	7	55.48	17.79	3	52.09	29.03
Monthly Family Fx PedsQL	6	61.01	25.18	7	52.68	23.49	3	66.67	23.46
Total weekly PedsQL	4	70.83	14.88	7	59.33	21.62	3	62.96	34.18
Weekly Health-Related QL	4	70.54	12.22	7	59.06	19.92	3	60.12	36.43
Weekly Family Fx PedsQL	4	71.88	25.90	7	60.27	29.79	3	72.92	26.58

Note: The measures above have the following response ranges (higher values indicate higher levels of functioning): T1D Self-Efficacy (1-10); Outcome Expectations measures (1-10); Perceived Medical Condition Self-Management Scale (PMCSMS; 1-5); Diabetes Self-Management (0-3); PedsQL measures (0-100). The Total Diabetes Distress scores can range from 1-6, with higher values indicating greater distress and dysfunction and 2-2.9 indicating moderate distress.

Table 12

Participant descriptive statistics of biomarker data

	T_0 (week 1)			T_1 (week 6)			T_2 (week 12)		
	n	mean	SD	*n*	mean	SD	*n*	mean	SD
SBP, WNR < 120 mmHg	7	109.43	15.11	7	109	9	7	100	6
DBP, WNR < 80 mmHg	7	75.71	10.61	7	73	8	7	75	11
HR, WNR = 60-100 bpm	7	74	11	7	77	14	7	73	13
HDL, WNR > 55 mg/dL	7	69	17	7	59	11	7	60	11
LDL, WNR < 130 mg/dL	7	79	52	6	78	51	7	75	30
TG, WNR = 35-135 mg/dL	7	109	30	7	103	60	7	86	15
TC, WNR < 200 mg/dL	7	169	57	7	161	52	7	152	37
Hb, WNR = 12-16 g/dL	7	13	1	7	12	1	7	13	1
HbA1c, WNR = 4.0-5.9%	7	5.73	1.23	7	5.53	.94	7	5.66	.99
HbA1c, T1D, WNR <7%	4	6.33	1.35	4	6.10	.87	4	6.23	.90
CRP,WNR < 8.0mg/L	7	.634	.540	7	.784	.812	7	1.297	1.13
CRP CV, WNR<7%	7	1.77	1.81	7	1.78	2.99	7	5.12	10.10
HC, WNR = 17.7-153.2 pg/mg	6	8.91	4.783	6	7.88	3.33	6	9.75	4.36
HC CV, WNR<7%	6	8.65	6.67	6	12.73	8.48	6	12.51	14.23
HC CV at 450nm, WNR<7%	6	1.09	.644	6	1.39	.67	6	1.79	1.48
ALS, WNR < 4 out of 8	7	2.43	1.72	7	2.43	1.13	7	2.00	1.31
ALS, T1D, WNR < 4 out of 8	4	3.25	.50	4	2.75	.50	4	2.25	.96

Note: WNR = Within normal limits of adult women; SBP = Systolic blood pressure; DBP = Diastolic blood pressure; HR = Heart rate; HDL = High-density lipoprotein; LDL = Low-density lipoprotein; TG = Triglycerides; TC = Total cholesterol; Hb = Hemoglobin; HbA1c = Glycated hemoglobin; CRP = C-reactive protein; CV = Coefficient of variance; HC = Hair cortisol; ALS = Allostatic load score; T1D = Type 1 diabetic

Table 13

Two-tailed Wilcoxon signed-rank tests for participant implementation measures

	Week 1 Compared to Week 6 test-value	*p*	Week 6 Compared to Week 12 test-value	*p*	Week 1 Compared to Week 12 test-value	*p*
Acceptability	.00	1	-1.34	.18	-1.07	.29
Appropriateness	-.45	.66	-1.00	.32	-.45	.66
Feasibility	-1.34	.18	-1.41	.16	-.45	.66
Ease of participation	-1.34	.18	-	-	-	-
Appropriateness of Pacing	-.27	.79	-	-	-	-
Behavioral Outcomes	-1.63	.10	-	-	-	-
Composite 3T1 measure	-.184	.85	-	-	-	-

Table 14

Kendall's Coefficient of Concordance Tests of interventionist implementation measures

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Kendall's W statistic	Chi square	df	*p*	*n*
Acceptability	2.50	2.17	3.17	2.83	5.33	5.00	.631	9.47	5	.09	7
Appropriateness	2.33	3.00	3.00	2.67	5.00	5.00	.481	7.22	5	.21	7
Feasibility	3.17	3.17	1.83	3.83	3.83	5.17	.419	6.28	5	.28	7
Ease of participation	1.83	3.50	3.00	3.50	4.17	5.00	.400	6.60	5	.25	7
Pacing	3.00	3.17	4.00	3.33	4.00	3.50	.071	1.07	5	.96	7
Behavioral Outcomes	1.83	3.67	2.50	3.50	4.83	4.67	.421	6.31	5	.28	7

Table 15

Bivariate Pearson correlation matrix for participant psychosocial measures

Variable	*n*	1	2	3	4	5	6	7	8	9	10	11
1. T1D status	49	-										
2. DSES	25	-.20	-									
3. Neg DOES	25	-.06	.68‡	-								
4. Pos DOES	24	-.20	.43*	-.05	-							
5. DOES	25	-.14	.80†	.76†	.62†	-						
6. PMCSMS	25	-.29	.82†	.61†	.51*	.80†	-					
7. DDS	16	-.06	-.65†	-.29	-.69†	-.67†	-.61*	-				
8. DSMQ-R	16	-.09	.85‡	.51*	.60*	.78‡	.72†	-.53†	-			
9. Past month PedsQL	15	-.26	.90‡	.71†	.55*	.90‡	.87‡	-.72†	.77‡	-		
10. Past week PedsQL	13	-.22	.87‡	.69†	0.47	.83‡	.85‡	-.67*	.74†	.96‡	-	
11. HbA1c	16	.66†	.24	.35	-.05	.23	.25	-.44	.14	.31	.25	-

Note: Pearson values rounded up to the second decimal point.

T1D status = correlation with having T1D; DSES = Diabetes Self-Efficacy Scale; Neg DOES = Negative Diabetes Outcome Expectation Subscale; Pos DOES = Positive Diabetes Outcome Expectation Subscale; DOES = Diabetes Outcome Expectation Scale; PMCSMS = Perceived Medical Condition Self-Management Scale; DDS = Diabetes Distress Scale; DSMQ-R = Diabetes Self-Management Questionnaire-Revised; Past month PedsQL FIM = PedsQL Family Impact Measure related to experiences in the past month; Past week PedsQL FIM = PedsQL Family Impact Measure related to experiences in the past week; HbA1c = Glycated hemoglobin levels

'*' – Significant at the $p = .05$ level

'†' – Significant at the $p = .01$ level

'‡' – Significant at the $p = .001$ level

Table 16

Two-tailed Wilcoxon signed-rank tests for participant psychosocial measures

	Week 1 vs Week 6 test-value	*p*	Week 6 vs Week 12 test-value	*p*	Week 1 vs Week 12 test-value	*p*
Diabetes Self-Efficacy	-.67	.50	-.73	.465	-	-
Neg. Diabetes Outcome Expectations	-.73	.465	-1.60	.109	-1.60	.109
Pos. Diabetes Outcome Expectations	-1.48	.138	-1.83	.068	-1.63	.102
Diabetes Outcome Expectations	-1.75	.08	-1.60	.109	-	-
PMCSMS	-2.03	.042*	-.45	.655	-1.63	.102
Total Diabetes Distress	-.74	.461	-	-	-1.07	.285
Diabetes Self-Management	-1.30	.194	-	-	-.45	.655
Total monthly PedsQL	-2.20	.028*	0.00	1	-	-
Monthly Health-Related QoL	-1.83	.068	0.00	1	-1.07	.285
Monthly Family Functioning PedsQL	-1.80	.072	-1.34	.18	-.54	.593
Total weekly PedsQL	-1.10	.273	-1.60	.109	-	-
Weekly Health-Related QoL	-1.10	.273	0.00	1	-	-
Weekly Family Functioning PedsQL	-1.46	.144	-1.60	.109	-	-

Note: Wilcoxon test values rounded to two decimal places. PMCSMS = Perceived Medical Condition Self-Management Scale. * – Indicates significance at the $p = .05$ level.

Table 17

Two-tailed Wilcoxon signed-rank tests for participant biomarkers

	Week 1 Compared to Week 6 test-value	*p*	Week 6 Compared to Week 12 test-value	*p*	Week 1 Compared to Week 12 test-value	*p*
HbA1c	-.399	.735	-.509	.611	-	-
Hair cortisol	-1.363	.173	-1.782	.075	-1.897	.058
CRP	-1.153	.249	-1.183	.237	-1.690	.091
Composite ALS	0.00	1.00	-1.134	.257	-.828	.408

Note: HbA1c = Glycated hemoglobin; CRP = C-reactive protein; ALS = Allostatic load score; T1D = Type 1 diabetic

APPENDIX C - STUDY MATERIALS

IRB Protocol

Study Title: Tools for Tackling Type 1 (3T1): Improving diabetes management and mental health through a family self-efficacy intervention.

Protocol Number: 00001747

Principal Investigator: Christopher G. Capron, MS

A. Introduction and Background

Type 1 diabetes mellitus (T1D; formerly known as juvenile diabetes) is a chronic disease that requires 24/7 monitoring, has no cure, and affects every person slightly differently. There is no single diabetes management plan that works for everyone. Among families with children with diabetes, other family members, especially parents, are often recruited as caregivers to manage the treatment, social, and psychological stressors of the illness. The goal of this study is to ascertain how diabetes self-efficacy beliefs among both people with diabetes and their caregivers affect their psychological and metabolic well-being, as well as the feasibility of an intervention to affect these variables. We will provide six short-term intervention sessions designed to enhance diabetes management self-efficacy beliefs for diabetics and their family members. We will assess at pre-, post-, and follow-up timepoints participants' adherence to diabetes management, self-efficacy for management of diabetes, glycated hemoglobin levels (HbA1c) of diabetics, and psychological distress of both diabetics and caregivers. Participants will complete surveys and will be invited to participate in a focus group after completion of the 6- session intervention. We expect to find that the diabetes management adherence, and diabetes management self-efficacy of caregivers and diabetics will be inversely associated with diabetic HbA1c levels, and with psychological distress of diabetics and caregivers.

Type 1 diabetes is an autoimmune disorder that begins with the body attacking its own beta cells, which are responsible for producing the hormone insulin. Without insulin to allow glucose from food into the cells for energy, the body starves. A person with T1D takes synthetic insulin to replicate insulin production from a healthy pancreas. In addition to insulin, blood glucose levels are affected by food, exercise, stress, and illness among other variables. These factors must always be considered by people with diabetes in their daily lives and they must adhere to a treatment regimen that accounts for these factors. This includes glucose monitoring with regular blood glucose checks using finger stick checks with a glucometer or a continuous glucose monitor (CGM) inserted into subcutaneous tissue, calculating levels of carbohydrates in foods, and planning insulin dosing to account for stress, sickness, and physical activity. This regimen can be difficult to adhere to, and minors, particularly young children, often need caregivers to support them in adherence behaviors. The risks associated with poor diabetes treatment adherence include hypoglycemia in the short-term (which comes with risks of disorientation, impaired cognitive and motor function, tissue damage, and in rare cases, loss of consciousness, coma, and death) and hyperglycemia, especially in the long-term (which comes with risks of organ damage and death). As such, it is important that people with diabetes and those assisting with their care have adequate diabetes education and confidence in their ability to adhere to treatment regimens. Most families managing T1D adopt some system of diabetes management, but these methods are not always evidence-based and even when they are, they can be difficult to adhere to effectively. There are formal avenues to get diabetes treatment information, but often these avenues are only accessed at the time of diabetes diagnosis. Many people with type 1 diabetes resist attending “diabetes education” where they presumably go to learn about the disease that they live with and manage every day.

Decisions with T1D are complex and can have significant health consequences. The pressure to live a "normal" life and maintain health creates stress that greatly contributes to risks of anxiety, depression, and isolation in both people with diabetes and their caregivers. Given the risks of diabetes and complications, many families with diabetes never fully lose the fears of failing to adhere to an elusive "perfect" treatment regimen, particularly since perfect adherence is not generally compatible with other demands of modern life. Our aim is to better understand whether an intervention aiming to enhance diabetes management self-efficacy in people with diabetes and their caregivers can improve diabetic health and reduce stress as well as mood concerns in diabetic families. We hope to understand the acceptability, feasibility, and appropriateness of each of the sessions to participants to enhance the intervention.

B. Specific Aims/Study Objectives

Aim 1: To evaluate the associations among people with diabetes between measures of diabetes management self-efficacy, and each of the following outcome measures: HbA1c, psychosocial and physiological stress, and family trust and functioning .

Aim 2: To evaluate the associations among caregivers of people with diabetes between measures of diabetes management self-efficacy, and the following outcomes: psychosocial and physiological stress, and family trust and functioning .

Aim 3: To evaluate the changes in measures of diabetes management self-efficacy, HbA1c, psychosocial and physiological stress, and family trust and functioning among people with diabetes and their caregivers following a short-term intervention targeting diabetes DSMSE and diabetes education.

Aim 4: To evaluate the acceptability, feasibility, and appropriateness of each of the sessions to participants to enhance the intervention design and content for future iterations of the intervention.

Aim 5: To examine changes in allostatic load (an index of stress calculated using the biomarkers we will collect) among people with diabetes and caregivers.

Research Questions

1. How do diabetes treatment adherence behaviors and treatment adherence self-efficacy change after participating in a 6-week intervention focused on increasing Type 1 diabetes treatment adherence self-efficacy?

    a. What are participant (diabetic youth and caregivers) self-reported qualitative changes regarding thoughts, attitudes, and behaviors regarding T1D adherence following the intervention?

    b. What are participant (diabetic youth and caregivers) self-reported qualitative changes regarding thoughts, attitudes, and behaviors regarding general coping skills (e.g. emotion regulation skills) following the intervention?

2. How do measures of diabetics' HbA1c change after they and their caregivers are exposed to a 6-week intervention focused on increasing Type 1 diabetes treatment adherence self-efficacy?

3. How do measures of psychosocial well-being (i.e., stress, depression, anxiety, and family functioning) change after being exposed to a 6-week intervention focused on increasing Type 1 diabetes treatment adherence self-efficacy among both diabetics and caregivers of diabetics?

4. To what degree do changes in diabetes treatment self-efficacy predict changes in psychosocial distress, physiological stress, and HbA1c compared from initial measures to follow-up?

5. What is the association between changes in self-reported diabetes monitoring behaviors (like checking BG with finger sticks or continuous glucose monitors) and diabetes self-efficacy?

6. How does stress measured through allostatic load (AL) change throughout the time of the intervention from pre to post?

7. Is there a correlation between lowering of AL and amount of percent change in HbA1c?

8. What are the perceptions of the implementation, feasibility, appropriateness, and acceptability of research participants and the research team on the intervention (i.e., how well it seems to be doing what it is purported to do)?

C. Methods, Materials and Analysis Components of Study:

Upon completing consent (and assent, as appropriate) forms to participate in the research, all participants (both caregivers and diabetics) will be asked to complete an intake and demographics questionnaire at the beginning of the first intervention session. The questionnaire will be administered using a Qualtrics link available as a QR code or paper form for participants [see attached "3T1 Intake and demographics questionnaire (before session 1)" document]. Participants (both caregivers and diabetics) will be asked to participate in biomarker collection, as well as to complete initial psychological measures. Participants have the option to refuse to participate in part or all the biomarker collection and still complete the research study, with the understanding that they will not be able to learn about any changes in their biomarkers should they refuse to participate in collection.

The study will consist of the following parts:

Recruitment (~ 3 weeks)

Meeting 1:

Verbal and written consent Full questionnaires (see measures in the "Online Survey" section below, as well as PedsQL measure) (attached under the name "3T1 Caregiver questionnaires for each session" and "3T1 Diabetic questionnaires for each session")

Biomarker collection #1

Intervention session content (see attached "3T1 Session Descriptions" document)

Post meeting questionnaire for interventionists and participants (attached under the name "3T1 Interventionist questionnaires for each session")

Meeting 2:

Verbal Consent

Half of questionnaires (listed below as numbers #1, #2, and #3)

Intervention session content

Post meeting questionnaire for interventionists and participants

Meeting 3:

Verbal Consent Half of questionnaires (listed below as numbers #4 and #5)

Intervention session content Post meeting questionnaire for interventionists and participants

Meeting 4:

Verbal Consent Half of questionnaires (listed below as numbers #1, #2, and #3)

Intervention session content

Post meeting questionnaire for interventionists and participants

Meeting 5:

Verbal Consent

Half of questionnaires (listed below as numbers #4 and #5)

Intervention session content

Post meeting questionnaire for interventionists and participants

Meeting 6:

Verbal consent Full questionnaires (listed below as numbers #1-#6, as well as PedsQL measure)

Review of the intervention content

Biomarker collection #2

Focus group:

All interventionists and subset of participants invited, to be conducted within two weeks of the completion of the intervention

Biomarker collection #3

After 3 months from the start of the intervention

3-month follow-up questionnaire (all questionnaires)

Biomarker Samples

All consenting participants (caregivers and youth) will have biomarker samples gathered at the first and last intervention session. We will conduct finger-stick blood tests to assess biomarkers for allostatic load (AL) and overall health. Finger sticks will be administered by a member of the research team using a disposable lancet. Even though people with diabetes are accustomed to administering their own finger pokes for blood sugar tests, a research team member will administer the poke to ensure the ideal angel of the lancet and the proper amount of pressure. The hair will be collected by a trained member of the research team following protocols (see Local Site Documents). From the finger stick we will collect 8 drops of blood, 4 of which will be deposited on filter paper for drying and later laboratory analysis of C-reactive protein, and 4 of which will go directly into point-of-care instruments to assess blood glucose, glycated

hemoglobin, lipid panel, and iron deficiency anemia instantaneously. Our finger stick and blood spot collection procedures will follow the Global Health Biomarker Laboratory's dried blood spot collection procedures (appended to this instance; please note that these documents contain some comments but that they are identical to the final versions, with the one exception that we will use non-latex gloves to avoid latex allergies) and the WHO's World Health Survey + procedures for point of care testing (also appended here; also contains some comments but is a final draft). These procedures adhere rigorously to medical standards for sanitation, handling, and disposal of biological material.

We will also collect a hair sample for laboratory analysis of hair cortisol, to take place offsite at the Global Health Biomarker Laboratory. A 0.5-cm wide bunch of hair will be isolated on the back midpoint (posterior vertex) of each participant's head, tied off with cotton string, cut, and stored in foil for later laboratory analysis of cortisol. We will take care to collect only in a non-visible location and will use texture-specific procedures for those with densely textured hair. The hair collection protocol is also attached here.

None of the hair or blood samples collected in this research will be used for whole genome sequencing or any other kind of genetic sequencing. There is no chance that the samples could be used for commercial profit, since they will be destroyed directly after analysis.

We will also measure each participant's blood pressure and heart rate using an Omron 3 automated blood pressure device (Hoffman Estates, IL), which wraps around the upper arm and auto-inflates to produce a blood pressure reading. We will measure each person's blood pressure and heart rate three times consecutively (spaced out across 1-3 minutes) (if possible, it is best if we can spread these out a little) and calculate an average across the three measures.

Return of biomarker results: Blood pressure, heart rate, blood glucose, glycated hemoglobin, lipid panel, and iron-deficiency anemia measures will be recorded and provided to research participants at the end of their biomarker collection procedure, along with information about normal range values and the purpose of each test.

These biomarkers will also be gathered at the end of the study, approximately 3 months from the date of first sample gathering, or 6 weeks from the end of the study. This final biospecimen collection may occur at the Global Health Biomarker Laboratory, at the offices of DCCT, or a place of the participant's choosing (e.g., at their home, with their consent). These samples will serve as pre-,post-, and follow-up intervention measures to evaluate the effects of the intervention.

2. Online surveys – The following self-report measures will be administered electronically using a Qualtrics form (while also being available in paper form) and gathered before the beginning of each of 6 sessions. Participants will complete all numbered measures (see below) at the first intervention session and then complete half of the measures on alternating weeks at the start of intervention sessions (i.e., Sessions #2, 4, 6 will have participants complete measures (1), (2), and (3), while Sessions #3, 5, 6 will have participants complete measures (4) and (5)). Alternating weeks of data collection is intended to make the measures easier and quicker to complete for participants. All measures will be administered electronically at follow-up as well (3 months from the start of the intervention). These measures will be gathered multiple times in order to identify changes over time in self-report measures within participants. All materials will be available to complete digitally but paper copies will also be made available for the in-person sessions.

The survey will be a combination of investigator-modified scales and validated scales and will take 8-15 minutes to complete. They will be administered at the beginning of each intervention session in order to ensure completion. Scales will include:

1. Diabetes Self-Efficacy Scale (Iannotti et al., 2006) is a 10-item measure with 10-point Likert-type response choices ranging from 1 (“Not sure at all”) to 10 (“Completely sure”) for diabetics, modified to also apply to caregivers, that asks about beliefs about managing diabetes.
2. Diabetes Outcome Expectations Scale (Iannotti et al., 2006) is a 24-item measure (made up of 12 Negative Outcome Expectation and 12 Positive Outcome Expectation subscales, with 10-point Likert-type response choices ranging from 1 (“Not at all”) to 10 (“A lot”) for diabetics, modified to also apply to caregivers, that asks about beliefs about managing diabetes.
3. Perceived Medical Condition Self-Management Scale (PMCSMS; Wild et al., 2018) will also be used to measure diabetes self-efficacy. The PMCSMS is an 8-item measure with 4-point Likert-type response choices ranging from 1 (“Strongly Disagree”) to 5 (“Strongly Agree”) for all items. It has been modified for use by caregivers as well.
4. Diabetes Distress Scale (DDS; Polonsky et al., 2005) is a 17-item scale , with 6-point Likert-type response choices ranging from 0 (“No problem”) to 6 (“Serious problem”) comprised of 4 subscales that address emotional burden, physician-related distress, regimen-related distress, and interpersonal distress. This last scale measures a form of diabetes-specific depression that can lead to what is known as “diabetes burnout” where the tasks involved in management become so overwhelming that a person gives up on their care.
5. The Diabetes Self-Management Questionnaire-Revised (DSMQ-R; Schmitt et al., 2022) is a 27-item scale with 4-point Likert type response choices ranging from 0 (“Does not apply to me / my child”) to 3 (“Applies to me / my child very much”) that asks people with diabetes about

their diabetes self-care behaviors and is strongly associated with measures of diabetes health. It has been modified for use by caregivers as well.

Additional measures

• The PedsQL Family Impact Module (Varni et al., 2004) will be used at the beginning (Session #1) and end of the intervention (Session #6) and at follow up (6-weeks from the end of the intervention). It is a 36- item measure and is attached separately. As a copyrighted instrument with conditional use, it will be presented to participants with all information displayed as is on the attached PDF (see Local Site Documents), rather than being modified for use by diabetics. Diabetics will be instructed prior to completing the PedsQL to complete the measure as though it was asking about their own experiences, rather than asking them to take the perspective of their caregivers. The measure will be available to complete in Qualtrics or on paper.

At the end of every session, all participants and the 4 interventionists and up to 4 DCCT staff/volunteers will be asked to complete the Acceptability of Intervention Measure (AIM), Intervention Appropriateness Measure (IAM), and Feasibility of Intervention Measure (FIM) scales (Weiner et al., 2017). These are each 4-item scale with 5-point Likert-type response choices which range from 1 (“Completely disagree”) to 5 (“Completely agree”). Participants and interventionists will also be asked to write out answers to 3 investigator-created questions, also at the end of every session:

o “What gets in the way of diabetes adherence?”

o “What about diabetes management is going well this week?”

o “What has been the most helpful aspect of this intervention so far? The least helpful?”

Focus group Participants and staff will be asked if they are willing to participate in an additional remote group interview shortly after the completion of the final intervention session. This will be a semi-structured interview with open-ended questions about experiences of diabetes management behaviors, diabetes management self-efficacy, and experiences with and impressions of this intervention. Approximately 24 participants will be recruited (10 diabetics, 10 caregivers, and 4 interventionists) for this virtual focus group. The interventionist and DCCT volunteer/staff focus group will be conducted separately in order to reduce the chance of biased or self-censored responses from other participants. The interview will take place remotely via Zoom and will last between 45 to 90 minutes. Interviews will be audio recorded and saved to a secure server by an external interviewer who was not involved in the intervention. The interviews will be transcribed and coded for thematic analysis. Any direct quotes drawn from these interviews will be anonymized in any publications resulting from this research. The focus group guide is attached in the Local Site Documents tab.

Follow up

Participants will all be invited to take part in follow up data collection procedures approximately 3 months from the start of the intervention, which will involve inviting participants to return to the DCCT offices for an in-person biomarker sample collection and to complete all questionnaires listed above.

Session descriptions

Intervention sessions will involve a group intervention format and will all involve opportunities for participants to practice adherence, either in-session or by making a concrete plan to engage in

treatment adherent behavior between sessions. The execution of those plans will be reviewed at the start of Sessions #2-6 by facilitators. Participants will be split into two groups, one for people with T1D, and another for caregivers of people with T1D. The groups will take place simultaneously at the offices of DCCT and take approximately 90 minutes to complete. Each group will be facilitated by a trained diabetes educator who will have a Diabetes Community Care Coordinator Certificate or higher-level certification from the Association of Diabetes Care & Education Specialists (ADCES), and a master's level or higher psychotherapist. A full description of the sessions can be found as an attached Word doc in the Local Site Documents section of the IRB submission (labeled "3T1 Session Descriptions").

Completion Reminders

Participants who do not complete measures in session will receive two emails 3 days apart to the address on file, reminding them that they need to complete all measures to be eligible for the bonus for participating in all sessions. If participants do not respond to the email, they will be asked at the next in-person, when applicable, to complete the measures, but otherwise will not receive additional follow-up.

Excess participants

Up to 50 additional individuals who wish to participate in this intervention (e.g., 25 additional caregiver-diabetic dyads or 50 individuals (caretakers or diabetic youth) beyond what it required for this study), will be offered the opportunity to give their permission to be contacted in the future if another iteration of this intervention takes place. Should the interest exceed 50 individuals, they will be informed that the list to be contacted in the future is full and invited to

check back in at their own discretion with the PI. The purpose of this is to allow future iterations of this research to occur with less time and energy spent on recruitment to expedite future research. This group will not be a waitlist control group, as they will not be asked to complete any other measures due to difficulty with scheduling follow-up and collecting data, but will instead be considered for any future related to this study's future iterations.

D. Research Population & Recruitment Methods Study population:

The study will begin with an online screener (linked HERE). This screener will collect age, diabetes status, and an email address, with an option to also submit a phone number. The screener will only be used for purposes of screening, recruiting, and/or determining eligibility (i.e., data gathered will not be analyzed as part of this research). Those deemed ineligible for the study will have their data removed from the screener response dataset upon completion of the intervention unless they have provided permission for us to retain their information to be contacted about for future research opportunities. Excess/ineligible participants will be emailed (see "Email to excess participants for 3T1" in Recruitment documents) to inquire about their willingness to be contacted for future research. If we do not hear back from participants within 2 weeks, we will assume they are not interested and will delete information from the screener. The screener will request that the only contact information given to follow up and determine eligibility is that of a caregiver or legal guardian. Upon reaching out to follow up from the screener, participants will be asked to confirm that they are adults to participate in the study and informed that minors without caregiver consent will not be allowed to participate in this research.

This screener will be made available as a QR code in a PDF sent to local affinity groups (e.g., UO Ducks with Diabetes Club), Facebook groups (e.g., advocacy group, "Mama I'm Low"), and posted on Diabetes Community Care Team (DCCT) social media pages. Social media posts will have comments turned off and will indicate that all inquiries about the study should be directed to the PI. The posts will not solicit health status or other sensitive information. Physical flyers will be hung at the University of Oregon student health center and local endocrinology offices. With permission we will post the flyer at a local PeaceHealth hospital as well. We may extend recruitment to include doctors' offices and diabetes centers outside of Eugene. Emails with PDFs of the recruitment flyers and recruitment invitations will also be sent to school nurses' offices in the Eugene 4J and Bethel School District within 10 miles of the DCCT offices.

We will reach out to school nurses that are a part of DCCT's network to request that they share the study information with families that might be interested.

The maximum number of participants who may included in this research is 50 (20-25 diabetics, and 25-30 adult caregivers). Approximately 200 individuals are expected to be reached through the proposed outreach with an expected 25% response rate.

All communication with prospective and enrolled participants will take place via email, which will have to be associated with an adult caregiver for minors with T1D. Phone calls will be limited to answering queries from participants via phone.

Participants will also be asked in their consent to allow for text message and email reminders of upcoming study sessions that they may opt out of at any time. Participants will be eligible to participate if: (1) they are Type 1 diabetics ages 12 and up who assent to participate and have parent/guardian consent OR are age 18 or older (i.e., Type 1 diabetics ages 12 and up can participate in this research); (2) if they report they are caregivers for Type 1 diabetics of any age;

(3) report they are willing to participate in 6 consecutive weekly in-person research/intervention sessions in Eugene, Oregon at the offices of Diabetes Community Care team (207 E 5th Ave Suite 220, Eugene, OR 97401); and (4) speak English, as the study and group intervention will be conducted in English and non-English speakers will not be able to fully participate in or benefit as anticipated from this study. Only families with at least one member with T1D will be eligible to participate in this evaluation, as opposed to other forms of diabetes. Participants in caregiver-diabetic dyads will be prioritized for recruitment, such that enrollment in the study will not be made on a first-come, first-served basis, but with preferential enrollment for dyads. However, participants not in dyads (including minors with parental/legal guardian consent who choose not to participate in the study themselves) will be eligible to participate in this research. Participants deemed eligible to participate will be invited via email to review an informed consent/assent form. Participants will review the consent and assent forms in-person with a study interventionist, and minors will be told they can only participate if a parent/guardian consents. Participants will be screened and invited to participate until approximately 25-30 families (i.e., caregiver-diabetic dyads) have been enrolled in the study. Ineligible or excess participants will be offered by email the chance to stay on a waitlist to participate in potential future research. We will submit a modification or new study for IRB review and approval prior to implementing any future research. If after 3 weeks the target 45 families have not been met, then the project will proceed with the enrolled participants.

In addition to participants with T1D and their caregivers, approximately 4 (with a maximum of 8) DCCT personnel/volunteers and interventionists involved in the dissemination and facilitation of the intervention will also be consented to join the study at the beginning of the first intervention session using paper forms and be invited to complete implementation questionnaires

at the end of all intervention sessions and be interviewed separately from other study participants. These team members have already been identified, and only preapproved team members will be invited to participate. They will receive an email 2 weeks prior to the study consisting of the following language:

> "Thank you for taking part in the 3T1 project to support families with Type 1 diabetes, I appreciate having you on our team! This is a reminder that we hope to get data from you as well to get your perspective about what it is like to implement the intervention. If you are willing to complete some questionnaires and participate in a focus group, please complete the study consent form. You will be invited to complete surveys at the end of all sessions, as well as to participate in a focus group at the end of the intervention. Your willingness to participate in this research has no bearing on your eligibility to work as an interventionist or support staff for this study: this is an optional and voluntary activity for which you will receive no additional compensation besides the hourly rate you are being offered as you complete any research measures. Thank you very much, please let me know if you have any questions!"

Compensation:

Staff members/interventionists will be offered compensation in the form of a personal check or Amazon gift card written out from the PI, made on a bi-weekly basis, from a research fund set aside for this purpose. Research team members will be compensated for their time and expertise and will receive compensation if they show up as agreed upon to participate as fully as possible in the sessions at which their attendance is expected.

Both diabetic and caregiver participants will each be offered monetary compensation for participating in the study, payable as electronic Amazon gift-cards. These will be made payable to caregivers. Minors will not be offered payment directly and in the event a diabetic minor opts to receive compensation, their compensation will be given to a legal guardian or caregiver. This compensation will be offered with the stated intended purpose that they be for the diabetic's use to thank them for participating in this research.

Participants will be offered monetary compensation for participating in the study, payable as electronic Amazon gift-cards. They will be offered $10 within 48-hours of attending an intervention, $25 as a bonus for completing all 6 sessions, and an additional $25 for participating in a focus group after the intervention sessions are over. Additionally, each participant will be offered $10 for participating in each biomarker data collection session (intake, post-intervention, and follow-up at 3 months from intervention start). The total possible compensation for completing all 6 sessions, 1 focus group, and 3 biomarker collections will be $140, paid over the course of approximately 3 months. Research team members will not be given additional compensation for completing surveys and/or participating in a focus group, beyond the hourly rate they receive for their activities in 3T1 (i.e., they will be paid for their time, not for participating in these data collection activities).

E. Informed Consent Process

The full consent form (for adults) and consent and assent forms (for minors) will be emailed to participants if they qualify for the study for their review. Physical copies of the consent and assent will need to be signed at the first intervention session. At the first session, participating youth will need to have their caregiver(s) or legal guardian(s) sign a physical copy of their

consent form to ensure that we have consent of a legal guardian. All consent forms, but not screener forms, will include a signature line and name for participants to print their signatures, but this is one of the only times where their names will be recorded. Both adults and minors will have at least one study interventionist or staff member go through the consent forms verbally with participants, going line by line with a readable copy on hand of the consent to ensure the procedures, potential benefits and risks, and compensation are clear to participants. In the event a participant turns 18 during their study, they will be asked to re-consent as an adult in order to proceed and participate as before.

As mentioned above, interventionists and staff will also be asked to complete the consent process and be asked to participate in this research, and they will be informed that their participation or lack thereof will have no effect on their participation as interventionists in the study. They will be required to sign a physical copy of the consent form at the first intervention session.

The research presents minimal risk because we are asking people to have discussions about and answer questions about diabetes management that is a prominent part of their life. Most of the questions that we ask are on subjects that a person with diabetes thinks about regularly. A few of the questions regarding mental health may cause someone to reflect on something they otherwise wouldn't, but the risk of such questions stirring up unpleasant emotions is low.

The process of filling out the survey including length and question styles will be explained. We will point out that participants may choose not to answer any question and may choose to stop filling out the survey at any point. They will be informed about the details of how we will store data and maintain practices that keep their information secure.

Additional verbal consent will be done at the time of each of the in-person intervention sessions and remote interviews for those who opt in and are chosen for the focus-group interview. This

will be a verbal refresher of participants' right to refrain from answering any of the questions and stop participating at any time. Participants will be asked to verbally consent to an audio recording of the focus group for transcription purposes. Participants who do not agree to be recorded will not participate in this portion of the study. PI Capron will keep a master document and initial to indicate whether consent for the interview is granted and whether consent for the audio recording is granted. If consent for the interview is not granted, the interview will not proceed. If consent for the audio recording is not granted, then the interviewer will take detailed notes during the interview.

F. Provisions for Participant Privacy and Data Confidentiality

A. All survey data will be stored in University of Oregon OneDrive and backed up on PI Capron's secure University of Oregon Dropbox drive and will be password protected. Hardware will be a personal computer that adheres to the UO personal device guidance, including device password, anti- virus, up-to-date patches, and encryption features. Biomarker data will be uploaded to Qualtrics and then stored in a password protected file on OneDrive. Interview recordings will be stored on PI Capron's password protected laptop as well as a password-protected folder in Dropbox and deleted once they are transcribed. All information for the study will be stored in password protected worksheets on password protected computers. Biomarker samples will be destroyed after they are analyzed and biomarker data will be kept as entries in a CSV file kept on a secure and password protected OneDrive server of either the PI Christopher Capron or Co-PI Tian Walker. The anonymized biomarker data may be associated with demographic information (e.g., age, diabetes status), excluding personally identifiable

characteristics (e.g., name, contact information) and reported out as aggregated data for future research projects.

Participants (diabetic adults and caregivers to minors with diabetes) will provide their email addresses in the screener, and this will be the only time they provide an email address. Participants will be told their emails have to be associated with an adult/guardian, and emails will be confirmed verbally at the time of consent. Their email address and name will be added to an Excel list kept on a secure UO server (e.g., Dropbox) and associated with a unique identifier (e.g., a combination of the date of their birth, the last two letters of their first name, the last two numbers of their birth year, the first two letters of their mother's maiden name, and the last two numbers associated with their home phone number). This unique identifier will be the only identifier associated with any subsequent measures and qualitative data, which will be kept in a separate, secure UO server (e.g., OneDrive).

The only identifier that will be looked at or seen by researchers will be participants' email address, which will not be associated with any data. The file with participant's email information will be stored as a password protected document on a password protected computer hard drive. Data for ineligible/excess participants who opt to have us retain their contact information from the screener questionnaire will have their responses to the screener kept in a separate file on a secure UO server (e.g., OneDrive) accessible only to the PI or Co-PI.

Participants may choose to share their name during the focus group, but it will not be asked for and will be anonymized in transcription. Participants may also make references during the interview to specific people and places and these will be de-identified during transcription (for example if someone were to name their place of work, the transcript would read 'participant's

place of work'). Any specific identifying information will be manually removed from the interview transcript.

The only people that will have access to the research records are PIs Capron and Walker and project advisor, Dr. Ellen McWhirter. Research records will include digital or physical copies of data from self-report measures, biomarker data that will be stored as digital data, notes taken during the course of interactions during the meeting (void of any personally identifiable data), and audio transcripts. These records may be handled by interventionists who will turn them over to PI Capron before any intervention session is completed.

All study records—including self-report questionnaire data, biomarker data, and lab samples—will be labeled only with a participant number or pseudonym. After transcription, original voice recordings of the focus group retained for a period of 5 years before being deleted. Likewise, laboratory samples will be de-identified and labeled only with a participant number before being stored in the Global Health Biomarker Lab. A laboratory technician will complete the lab analyses but will not have access to participant identifying information. After analysis, laboratory samples of hair and blood will be incinerated to prevent their use outside the specific study purposes. The code key document will be retained in password protected files and machines for the subsequent 10 years in case there is a need to follow up with participants, or in case the research team receives additional funding that allows the study to continue past the current planned 3 months, to avoid resampling the same individuals. As a result of those practices, people who look at the results of this study will not be able to identify participants personally. Participant name and other facts that may identify them will not appear when we present this study or publish its results; pseudonyms will be used.

G. Potential Research Risks or Discomforts to Participants

It is possible that sharing about diabetes and learning about mental health and diabetes, both through self-report questionnaires and participation in group interventions and a focus group may be uncomfortable or emotional for some individuals. Answering questions about blood sugar and diabetes knowledge can bring up negative emotions for people living with type 1 diabetes and their caregivers. We have designed our questions to reflect supportive, non-judgmental language in order to mitigate this risk. Other risks include participating in a novel diabetes intervention that may not result in improvements in blood glucose management and could result in psychological distress or even reduced diabetic health, though it is anticipated that this is unlikely as the diabetes management information will be evidenced-based, as will the implementation of a group psychosocial intervention. The intervention is novel insofar as this particular format has not been evaluated before (i.e., two concurrent group psychoeducational interventions), however the information being provided in each group is drawn from best practices and information related to diabetes education and group interventions. Some of the best practices will be drawn from the Association of Diabetes Care & Education Specialists and the Diabetes Self-Management Education and Support and the ADCES7 Self-Care Behaviors, specifically using the ADCES 2024 curriculum book (ADCES, 2024). Information in ADCES7 includes modules related to Healthy Coping, Healthy Eating, Being Active, Taking Medication, Monitoring, Reducing Risks, and Problem Solving. For example, content around diabetes education provided about monitoring will include how to track food intake, physical activity, blood glucose, stress, and insulin.

Psychological distress and diabetes health risks could arise in the event that being asked to participate in or listening to conversations about diabetes health challenges can be stressful and

can increase feelings of anxiety and hopelessness. In extreme cases, these could result in symptoms associated with mood disorders like anxiety and depression. These are extremely unlikely to occur because the main focus of the psychological portion of the intervention is to identify beliefs that increase feelings of hopelessness and dread and then to change those beliefs and associated behaviors in order to increase self-efficacy. As such, these potential psychological risks will be actively discussed and monitored both during intervention sessions and in self-report measures gathered each week.

Diabetes health risks could include deliberately not engaging in diabetes management behaviors (e.g., checking blood glucose levels and administering insulin), but this is unlikely because participants will receive information about best practices related to these behaviors. Additionally, it is anticipated that participants who take part in this kind of research program have an interest in diabetes health and are more likely to already be receptive to the idea that they can engage in health-promoting behaviors.

In the event that participants report that they are experiencing excessive or unusual symptoms associated with the intervention (e.g., severe blood glucose dysregulation), they will be given referrals for medical care and additional diabetes education. If participants endorse that they are engaging in life-threatening behaviors (e.g., not regulating blood glucose levels at all or planning and intending to kill themselves), they will be given additional medical or mental health referrals and a trained psychotherapist team member will work with them outside of normal session hours to complete a safety plan and inform them that participating in the study should be paused given more immediate concerns. If a minor is involved and their safety is at risk, their parent or legal guardian will be informed of the minor's concerns as well as any intervention to safeguard them

(e.g., the development of a safety plan for participants actively planning to kill themselves). We do not anticipate anything of this nature occurring, but we will be prepared for it.

There will not be any stopping rules for participants who may experience excessive or unusual aversive symptoms because it will not be possible to determine whether a decline in health or serious health episode (e.g., diabetic ketoacidosis or loss of consciousness), can be attributable to participating in 3T1. Adverse health consequences can occur at any time for diabetics, even when the disease is well-controlled most of the time. In the event that participants express concern about their health being negatively affected by participation in the study, they will be informed that they may withdraw without penalty at any time.

Additionally, some people may wish to keep their diagnosis of type 1 diabetes a secret and participating in this study means that other participants will be aware of the diagnosis. A breach of the data also poses the risk of a loss of confidentiality. In the group interventions and focus group, participants will be told that they are expected to maintain confidentiality and respect the privacy of others (i.e., participants can take lessons from other participants but not share in the future who said those things). Participants will be informed that confidentiality cannot be guaranteed, and that breaches of confidentiality are possible. As such, participants will be asked to be aware that they may want to limit some of the information they share in a group setting if they could not bear to have that information possibly be shared outside of the group. If a group member discloses that they knowingly and intentionally disclosed, they will be asked to apologize and, at the discretion of the interventionist team, may be asked to leave the group (e.g., a participant might be able to stay if they mentioned that another diabetic at a specific school said something, but a participant may be asked to leave the study if they were found out to have

deliberately spread falsehoods or private information disclosed in a group intervention or focus group session).

Other potential risks include physical discomfort, pain, tenderness, bruising, and infection from having a finger stick procedure to draw approximately 8 drops of blood, as well as the fact that they may feel uncomfortable if hair collected from their scalp is noticeable by others, though efforts will be made to prevent this occurrence by carefully identifying where to collect hair so it is as unnoticeable as possible per collection protocol. There is minimal risk that the biomarker samples will be lost and no risk that they would be associated with personally identifiable information at or in transit to the UO Global Health Biomarker Lab. There is a risk that other participants could overhear a discussion about biomarkers that are analyzed on the spot (including assay results like blood glucose, glycated hemoglobin, lipid panel, and iron deficiency anemia, the measures of which will be generated on site at the time of biomarker collection), however results will be shared as confidentially as possible and participants not having samples collected will be asked to step away from the collection area.

There will be multiple confidentiality measures in place. Type 1 diabetes is covered under the Americans with Disabilities Act and thus legal protections exist for people living with type 1 diabetes, and they are not expected to face any kind of legal, professional, educational, or other recriminations for participating in this study.

H. Potential Benefits of the Research

Expanding knowledge about health outcomes, diabetes management self-efficacy, and attitudes and beliefs about participating in an intervention among people with type 1 diabetes and their caregivers has the potential to improve the daily experiences and long-term health of the

participants, and this knowledge could benefit people living with type 1 diabetes and improve family relationships by informing future interventions and best practices/resources to recommend among medical providers. Previous studies have found that receiving diabetes education in groups is beneficial to people with T1D (Odgers-Jewell et al., 2017; Rickheim et al., 2002) and we anticipate our participants will experience similar benefits.

This research will be the subject of my dissertation which I intend to publish and disseminate to diabetes organizations (like our partner organization, DCCT) and develop a guide for how to successfully conduct such interventions at other sites.

I. Investigator Experience

The principal investigators both have a Diabetes Community Care Coordinator Certificate (indicating training about best practices related to diabetes management). PI Capron has spent hundreds of hours providing diabetes education and support to families with diabetes in the USA, Ecuador, and the Dominican Republic, and has experience researching barriers to diabetes treatment abroad. He is also a Qualified Mental Health Professional with 4 years of experience providing psychotherapy to adults and children in individual and group settings. The principal investigator also has experience conducting semi-structured interviews and analyzing survey and qualitative data through the work on a variety of projects. He is also supported by his advisor and Dissertation Committee Chair, Dr. Ellen McWhirter, who has experience working with doctoral candidates in developing and implementing community-based interventions in the past.

Co-PI Walker is an experienced diabetes researcher and doctoral student at the University of Oregon in the Anthropology department, and is affiliated with the UO Global Health Biomarker Lab. She is also certified as a paraprofessional diabetes educator, completed over 30 hours in

diabetes care education through the Association of Diabetes Care and Education Specialists, and managed diabetes education programs at DCCT for two years.

All other research team members are affiliated with UO and are listed in the Local Study Team Members section.

Study Recruitment Materials

Study Flyer



Recruitment and study email

Tools for Tackling Type 1 (3T1) Participant screener

Thank you for your interest in our study on Type 1 diabetes, families, and stress! This form is intended to determine your eligibility to participate in a research program examining the efficacy and feasibility of a 6-week family diabetes intervention. Participants will receive a no-cost intervention and be compensated up to $195 for their participation.

Participants will be eligible to participate if they have Type 1 diabetes and are ages 12 and up, while caregivers may participate if they care for Type 1 diabetics of any age. Participants commit to attending 6 consecutive weekly 90-minute group sessions focused on living with diabetes and reducing personal and family stress, as well as completing several questionnaires and completing a no-cost finger stick test to evaluate HbA1c and other health biomarkers. At this time, only families with members who have Type 1 diabetes will be eligible to participate in this evaluation at this time. Please answer the following questions to be considered for the program:

- What is your age in years? ____
- Do you have Type 1 diabetes? (Y/N)
- Are you a primary caregiver for someone with Type 1 diabetes? (Y/N)
- If so, how old are they?
- Can you commit to a paid 6-week in-person group intervention program sponsored by Eugene-based Diabetes Community Care Team, located at 207 E 5th Ave Suite 220, Eugene, OR 97401 (program dates TBD)? (Probably/Y/N)
- What is a good way to get in touch with you? By responding, you give your permission for follow up contact about participation in this research study. If you are a minor, please

provide the number or email of a parent, caregiver, or legal guardian. If you do not wish to be contacted at this time, please exit this survey.

Email address: _____

Phone number (optional): _____

Thank you for your interest in our study, we look forward to being in touch!

Self-report measures

1. Diabetes Self-Efficacy Scale (Iannotti et al., 2006)

CAREGIVER VERSION
How Sure Are You That You Can Do Each of the Following, Almost All the Time, for the person whom you care for with diabetes? (On a 1-10 scale, with 1 being ‘‘not sure at all’’ and 10 being ‘‘completely sure”)

1. Adjust insulin correctly when eating more or less than usual.
2. Choose healthful foods when going out to eat.
3. Exercise even when not really feeling like it.
4. Adjust insulin or food accurately based on amount of exercise.
5. Talk to a doctor or nurse about any problems the person with diabetes you’re caring for is having with taking care of diabetes.
6. Do blood sugar checks even when really busy.
7. Manage diabetes the way the health care team wants.
8. Manage diabetes even when feeling overwhelmed.
9. Find ways to deal with feeling frustrated about diabetes.
10. Identify things that could get in the way of managing diabetes.

DIABETIC VERSION
How Sure Are You That You Can Do Each of the Following, Almost All the Time, for the person whom you care for with diabetes? (On a 1-10 scale, with 1 being ‘‘not sure at all’’ and 10 being ‘‘completely sure”)

1. Adjust insulin correctly when eating more or less than usual.
2. Choose healthful foods when going out to eat.
3. Exercise even when not really feeling like it.
4. Adjust insulin or food accurately based on amount of exercise.
5. Talk to a doctor or nurse about any problems I am having with taking care of diabetes.
6. Do blood sugar checks even when really busy.
7. Manage diabetes the way the health care team wants.
8. Manage diabetes even when feeling overwhelmed.
9. Find ways to deal with feeling frustrated about diabetes.
10. Identify things that could get in the way of managing diabetes.

2. Diabetes Outcome Expectations Scale (Iannotti et al., 2006)

CAREGIVER VERSION
‘‘If I Do Everything I’m Supposed to Do to Take Care of Diabetes For The Diabetic I am Caring For, It Would...’’ (On a 1-10 scale, with 1 being ‘‘not at all’’ and 10 being ‘‘a lot’’).

Expected negative outcomes (reverse scored)
1. Be too much to think about.
2. Keep them from doing things with their friends.

3. Keep them from living life the way they want to.
4. Take too much time.
5. Cost too much.
6. Be too much work.
7. Keep them from having fun at parties or on holidays.
8. Be too strict of a schedule.
9. Give them too many marks on their skin from checking their blood.
10. Be too much responsibility.
11. Keep them from eating what they want.
12. Make them gain weight.

Expected positive outcomes
1. Make them have fewer high blood sugars.
2. Make them be admired by their friends.
3. Save money now.
4. Keep them from missing too much school.
5. Save money in the future.
6. Help them avoid fighting with me (or their parents/guardians).
7. Keep their diabetes in better control.
8. Make them feel good about themselves.
9. Help them do better in their schoolwork.
10. Keep them healthy.
11. Make them better in sports.
12. Give them more energy.

DIABETIC VERSION

''If I Do Everything I'm Supposed to Do to Take Care of Diabetes It Would...'' (On a 1-10 scale, with 1 being ''not at all'' and 10 being ''a lot'').

Expected negative outcomes (reverse scored)
1. Be too much to think about.
2. Keep me from doing things with my friends.
3. Keep me from living life the way I want to.
4. Take too much time.
5. Cost too much.
6. Be too much work.
7. Keep me from having fun at parties or on holidays.
8. Be too strict of a schedule.
9. Give me too many marks on my skin from checking my blood.
10. Be too much responsibility.
11. Keep me from eating what I want.
12. Make me gain weight.

Expected positive outcomes
1. Make me have fewer high blood sugars.
2. Make me be admired by my friends.

3. Save money now.
4. Keep me from missing too much school.
5. Save money in the future.
6. Help me avoid fighting with my parents/guardians.
7. Keep my diabetes in better control.
8. Make me feel good about myself.
9. Help me do better in my schoolwork.
10. Keep me healthy.
11. Make me better in sports.
12. Give me more energy.

3. Perceived Medical Condition Self-Management Scale (PMCSMS; Wild et al., 2018)

CAREGIVER VERSION
Please answer the following questions by picking between 1 (Strongly Disagree) and 5 (Strongly Agree) for all items:

1. It is difficult for me to find effective solutions for problems that occur with managing my child's medical condition
2. I find efforts to change things I don't like about my child's medical condition are ineffective
3. I handle myself well with respect to my child's medical condition
4. I am able to manage things related to my child's medical condition as well as most other people
5. I succeed in the projects I undertake to manage my child's medical condition
6. Typically, my plans for managing my child's medical condition don't work out well
7. No matter how hard I try, managing my child's medical condition doesn't turn out the way I would like
8. I'm generally able to accomplish my child's goals with respect to managing my medical condition

DIABETIC VERSION
Please answer the following questions by picking between 1 (Strongly Disagree) and 5 (Strongly Agree) for all items:

1. It is difficult for me to find effective solutions for problems that occur with managing my medical condition
2. I find efforts to change things I don't like about my medical condition are ineffective
3. I handle myself well with respect to my medical condition
4. I am able to manage things related to my medical condition as well as most other people
5. I succeed in the projects I undertake to manage my medical condition
6. Typically, my plans for managing my medical condition don't work out well
7. No matter how hard I try, managing my medical condition doesn't turn out the way I would like
8. I'm generally able to accomplish my goals with respect to managing my medical condition

4. Diabetes Distress Scale (Polonsky et al., 2005)

CAREGIVER VERSION
Please answer the following questions by picking between 1 (Not a problem) to 6 (Serious problem) for all items:

1. Feeling that my child's diabetes is taking up too much of my mental and physical energy every day.
2. Feeling that my child's doctor doesn't know enough about diabetes and diabetes care.
3. Feeling angry, scared, and/or depressed when I think about my child living with diabetes.
4. Feeling that my child's doctor doesn't give me clear enough directions on how to manage my child's diabetes.
5. Feeling that I am not testing my child's blood sugars frequently enough.
6. Feeling that I am often failing with my child's diabetes regimen.
7. Feeling that friends or family are not supportive enough of my child's selfcare efforts (e.g., planning activities that conflict with my child's schedule, encouraging my child to eat the "wrong" foods).
8. Feeling that diabetes controls my life.
9. Feeling that my child's doctor doesn't take my concerns seriously enough.
10. Not feeling confident in my child's day-to-day ability to manage diabetes.
11. Feeling that I/my child will end up with serious long-term complications, no matter what I do.
12. Feeling that I am/my child is not sticking closely enough to a good meal plan.
13. Feeling that friends or family don't appreciate how difficult living with diabetes can be.
14. Feeling overwhelmed by the demands of living with diabetes.
15. Feeling that I don't/my child doesn't have a doctor who my child can see regularly about my child's diabetes.
16. Not feeling motivated to keep up my child's diabetes self-management.
17. Feeling that friends or family don't give me/my child the emotional support that I would like.

DIABETIC VERSION
Please answer the following questions by picking between 1 (Not a problem) to 6 (Serious problem) for all items:
1. Feeling that my diabetes is taking up too much of my mental and physical energy every day.
2. Feeling that my doctor doesn't know enough about diabetes and diabetes care.
3. Feeling angry, scared, and/or depressed when I think about living with diabetes.
4. Feeling that my doctor doesn't give me clear enough directions on how to manage my diabetes.
5. Feeling that I am not testing my blood sugars frequently enough.
6.Feeling that I am often failing with my diabetes regimen.
7. Feeling that friends or family are not supportive enough of my selfcare efforts (e.g., planning activities that conflict with my schedule, encouraging me to eat the "wrong" foods).
8. Feeling that diabetes controls my life.
9. Feeling that my doctor doesn't take my concerns seriously enough.
10. Not feeling confident in my day-to-day ability to manage diabetes.
11. Feeling that I/will end up with serious long-term complications, no matter what I do.

12. Feeling that I am is not sticking closely enough to a good meal plan.
13. Feeling that friends or family don't appreciate how difficult living with diabetes can be.
14. Feeling overwhelmed by the demands of living with diabetes.
15. Feeling that I don't have a doctor who I can see regularly about my diabetes.
16. Not feeling motivated to keep up my diabetes self-management.
17. Feeling that friends or family don't give me the emotional support that I would like.

5. The Diabetes Self-Management Questionnaire-Revised (DSMQ-R; Schmitt et al., 2022)

CAREGIVER VERSION

The following statements describe self-care activities related to your management of diabetes of the person for whom you care. Thinking about diabetes care over the last 4 weeks, please specify the extent to which each statement applies to you: 3 – Applies to me / my child very much; 2 – Applies to me / my child to a considerable degree; 1 – Applies to me / my child to some degree; 0 – does not apply to me / my child

1. My child/person with diabetes checks glucose levels with care and attention.
2. The foods my child/person with diabetes chooses to eat make it easy for them to achieve good glucose levels.
3. My child/person with diabetes regularly sees the doctor (/diabetes specialist) regarding diabetes.
4. My child/person with diabetes takes diabetes medication (e.g., insulin consistently and reliably.
5. My child/person with diabetes occasionally eats large amounts of sweets or other foods rich in carbohydrates.
6. My child/person with diabetes keeps a diary/log of glucose levels to inform and improve diabetes management.
7. My child/person with diabetes tends to avoid seeing the doctor (/diabetes specialist) regarding diabetes.
8. My child/person with diabetes is regularly physically active to improve diabetes and health.
9. My child/person with diabetes follows the current dietary recommendations for people with diabetes (e.g. given to them by their doctor or diabetes specialist).
10. My child/person with diabetes does not check glucose levels frequently enough for achieving good blood glucose control.
11. My child/person with diabetes avoids physical activity although it would be good for diabetes.
12. My child/person with diabetes tends to forget or skip taking diabetes medication (e.g. insulin).
13. Sometimes my child/person with diabetes has real 'food binges' (not triggered by hypoglycemia).
14. Regarding my child/person with diabetes' diabetes, they should see their doctor (/diabetes specialist) more often.
15. My child/person with diabetes is less physically active than would be good for diabetes.
16. My child/person with diabetes could improve diabetes self-care considerably.
17. My child/person with diabetes estimates the carbohydrate content of meals/foods (to improve diabetes control).

18. My child/person with diabetes eats without regard to diabetes.
19. My child/person with diabetes checks and discusses diabetes treatment with the doctor (or diabetes specialist) regularly.
20. My child/person with diabetes' diabetes self-care is poor.
21. My child/person with diabetes checks glucose levels before each meal.
22. My child/person with diabetes adjusts insulin doses to the carbohydrate content of meals.
23. My child/person with diabetes adjusts the timing of insulin injections to the start of meals.
24. My child/person with diabetes adjusts insulin doses according to the current glucose levels and preceding or planned activities.
25. My child/person with diabetes corrects elevated glucose levels consistently whenever necessary.
26. My child/person with diabetes carries fast carbohydrates to enable quick treatment of low blood glucose.
27. In case of low blood glucose, my child/person with diabetes takes appropriate amounts of carbohydrates to avoid causing high blood glucose.

DIABETIC VERSION

The following statements describe self-care activities related to your management of diabetes of the person for whom you care. Thinking about diabetes care over the last 4 weeks, please specify the extent to which each statement applies to you: 3 – Applies to me / my child very much; 2 – Applies to me / my child to a considerable degree; 1 – Applies to me / my child to some degree; 0 – does not apply to me / my child

1. I check my glucose levels with care and attention.
2. The foods I choose to eat make it easy for me to achieve good glucose levels.
3. I regularly see the doctor (/diabetes specialist) regarding my diabetes.
4. I take my diabetes medication (e.g. insulin, tablets) consistently and reliably.
5. I occasionally eat large amounts of sweets or other foods rich in carbohydrates.
6. I keep a diary/log of my glucose levels to inform and improve my diabetes management.
7. I tend to avoid seeing the doctor (/diabetes specialist) regarding my diabetes.
8. I am regularly physically active to improve my diabetes and health.
9. I follow the current dietary recommendations for people with diabetes (e.g. given to me by my doctor or diabetes specialist).
10. I do not check my glucose levels frequently enough for achieving good blood glucose control.
11. I avoid physical activity although it would be good for my diabetes.
12. I tend to forget or skip taking my diabetes medication (e.g. insulin, tablets).
13. Sometimes I have real 'food binges' (not triggered by hypoglycemia).
14. Regarding my diabetes, I should see my doctor (/diabetes specialist) more often.
15. I am less physically active than would be good for my diabetes.
16. I could improve my diabetes self-care considerably.
17. I estimate the carbohydrate content of my meals/foods (to improve my diabetes control).
18. I eat without regard to my diabetes.
19. I check and discuss my diabetes treatment with the doctor (/diabetes specialist) regularly.
20. My diabetes self-care is poor.
21. I check my glucose levels before each meal.

22. I adjust my insulin doses to the carbohydrate content of my meals.
23. I adjust the timing of my insulin injections to the start of my meals.
24. I adjust my insulin doses according to the current glucose levels and preceding or planned activities.
25. I correct elevated glucose levels consistently whenever necessary.
26. I carry fast carbohydrates to enable quick treatment of low blood glucose.
27. In case of low blood glucose, I take appropriate amounts of carbohydrates to avoid causing high blood glucose.

6. PedsQL Family Impact Module (Varni et al., 2004) could not be shared below due to copyright restrictions. More information about 36-item measure about family functioning over the past week and past month can be found at https://eprovide.mapi-trust.org/instruments/pediatric-quality-of-life-inventory-family-impact-module. All participants were instructed to answer all items as though they applied to them, though some are phrased for caregivers.

7. Acceptability of Intervention Measure (AIM; Weiner et al. (2017)
Please respond to the following questions with a response from 1 (Completely disagree) to 5 (Completely agree):
1. Tools for Tackling Type 1 meets my approval.
2. Tools for Tackling Type 1 is appealing to me.
3. I like Tools for Tackling Type 1.
4. I welcome Tools for Tackling Type 1.

8. Intervention Appropriateness Measure (IAM; Weiner et al. (2017)
Please respond to the following questions with a response from 1 (Completely disagree) to 5 (Completely agree):
1. Tools for Tackling Type 1 seems fitting.
2. Tools for Tackling Type 1 seems suitable.
3. Tools for Tackling Type 1 seems applicable.
4. Tools for Tackling Type 1 seems like a good match.

9. Feasibility of Intervention Measure (FIM; Weiner et al. (2017)
Please respond to the following questions with a response from 1 (Completely disagree) to 5 (Completely agree):
1. Tools for Tackling Type 1 seems implementable.
2. Tools for Tackling Type 1 seems possible.
3. Tools for Tackling Type 1 seems doable.
4. Tools for Tackling Type 1 seems easy to use.

10. Study specific measures
Please respond to the following questions with a response from 1 (Completely disagree) to 5 (Completely agree):
1. This week's content was easy to understand.
2. This week's content used vocabulary and language that was appropriate for me.
3. In this week's content the facilitator was easy to understand.

4. This week's content was delivered at a slow and inappropriate pace.
5. This week's content was delivered at a fast and inappropriate pace.
6. I have a plan to incorporate this week's content into my daily diabetes management.
7. I feel confident in my ability to incorporate this week's content into my daily diabetes management.

11. Open-ended questions

PARTICIPANT QUESTIONS
Write as much as you want to answer the following prompts:

- "What gets in the way of diabetes adherence?"
- What about diabetes management is going well this week?
- "What has been the most helpful aspect of this intervention so far? The least helpful?"

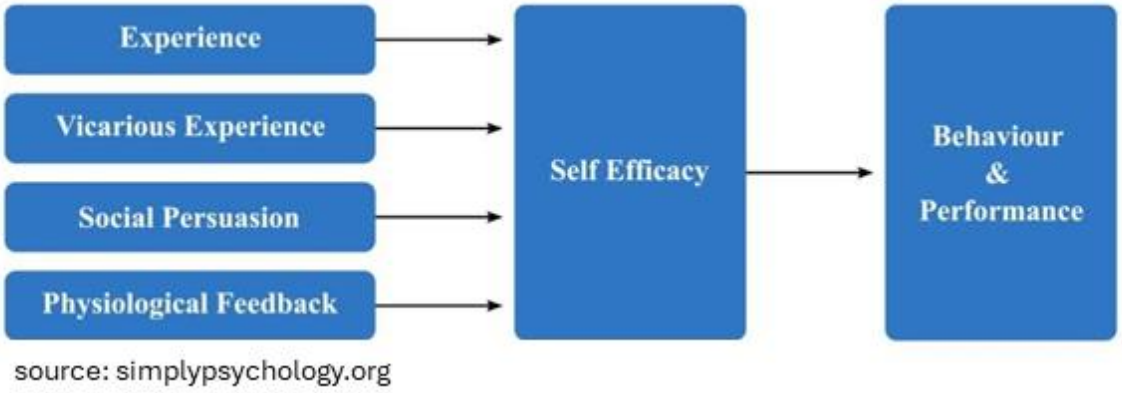
INTERVENTIONIST QUESTIONS
Write as much as you want to answer the following prompts:

- "What gets in the way of diabetes adherence?"
- "How do you feel about managing diabetes?"
- "What has been the most helpful aspect of this intervention so far? The least helpful?"

SESSION GUIDE FOR INTERVENTIONISTS: TOOLS FOR TACKLING TYPE 1 (3T1)

Sessions will all involve opportunities for participants to practice adherence to diabetes treatment and management behaviors , either in session or by making a concrete plan to engage in treatment adherent behavior between sessions. The execution of those plans will be reviewed at the start of sessions 2-5 by facilitators. Participants will be split into two groups, one for people with T1D, and another for caregivers of people with T1D. The groups take place simultaneously and take approximately 90 minutes to complete. Each group will be facilitated by a trained diabetes educator who will have a Diabetes Community Care Coordinator Certificate or higher-level certification from the Association of Diabetes Care & Education Specialists (ADCES), and a master's level psychotherapist.

The theory behind this intervention is Social Cognitive Theory (Bandura, 1977) and self-efficacy. As belief in the ability to adhere to diabetes treatment increases (diabetes management self-efficacy), we would expect adherence behaviors to increase. As noted by Simply Psychology (https://www.simplypsychology.org/self-efficacy.html) people with strong self-efficacy tend to: embrace difficult tasks as opportunities to learn; recover quickly from setbacks ; attribute failure to insufficient effort or poor strategy (things they can change); and have lower stress and are less likely to develop depression.



Group interventions offer all these experiences, perhaps excepting "physiological feedback", though that can also be modeled and practiced when possible in session. The "experience" (or "mastery") just refers to learning by doing, 'practice making perfect'. "Vicarious experience" just means learning by watching, learning from, and imitating others, and "social persuasion" can be thought of as instruction, direction, or coaching, which WE will definitely be providing, but so too will other group members (e.g., tips and tricks from other group members on how to do certain things).

Each session will follow a similar structure:

- 10 minutes at the beginning of the session to focus on completing all measures, checking blood sugar, and settling into groups.
- 5-10 minutes of review of content and between session activities from the previous week, led by the psychotherapist.
- 25-30 minutes of review of the materials and lessons for the day, led by the psychotherapist and diabetes interventionist.

- 5-10 minutes of break to check blood glucose levels and treat any dysregulated blood glucose levels, supervised by a diabetes educator.
- 15-20 minutes of review and discussion in small groups and with the larger group to discuss how to overcome barriers and to answer questions about diabetes management, led by the diabetes educator and psychotherapist, as necessary.
- 5 minutes to complete plan of action for the following week, facilitated by psychotherapist
- 5 minutes to complete remaining survey measures and prepare to leave
- Total time: 70-90 minutes

Each session will have a unique primary focus, see below.

(Session 1)

6:00pm – 3T1 team shows up, reviews materials and agenda, troubleshoot, answer questions.

CHOOSE TIMEKEEPERS.

6:30pm-6:45pm – Do biomarker data collection from participants, complete consent forms

-Tian and Chris collect biomarker data

-LP and Molly will consent participants: Consent forms

-Participants will be asked to complete survey measures after consenting

6:50pm-7:00pm – Introductions and Program Overview

-All interventionists and participants will introduce themselves with:

-Name

-What they hope to get out of the group

-Experience with groups

-Years with diabetes

-Qualifications and scopes of practice (interventionists only)

-LP and Tian / Chris and Molly will present to their respective groups (diabetics and caregivers of diabetics) to talk about the structure of the intervention going over:

-Duration (6 weeks)

-Rules about privacy and confidentiality within group (establish with each group)

-Reminders about contents members share, including reporting requirements and limits to confidentiality

-Reminder that any contact between group members outside of group is welcome but needs to be done thoughtfully and in such a way that it does not disrupt group later.

-Reminder about need for feedback and thoroughness when completing measures

7:00pm-7:20pm – Setting goals (7:00-7:10pm) and ADCES-7 Behaviors (7:10-7:20pm)

-Psych interventionists will have group members articulate challenges with diabetes

-Focus is to not linger on hardship but just to capture an array of challenges. Expected concerns include: unpredictability; diabetes burnout; shame and awkwardness; isolation

-Psych interventionists will talk about self-efficacy, building confidence and trust in ourselves and the diabetics in our lives, value of focusing on the good and on wins, not just deficits

-Diabetes interventionists will introduce the Association of Diabetes Care and Education Specialists (ADCES) 7 Self-Care Behaviors (ADCES7): https://www.adces.org/diabetes-education-dsmes/adces7-self-care-behaviors

-Ask participants what behaviors go into glycemic control in their lives

-Introduce and briefly describe the ADCES7 components: Healthy Coping; Healthy Eating; Being Active; Taking Medication; Monitoring; Reducing Risks; Problem Solving;

7:20pm-7:30pm – Blood sugar checks and snacks; groups can co-mingle

7:30pm-7:50pm – Make the first behavioral intervention plan

-Both interventionists will introduce value of tracking behaviors and mindfulness

-Participants will be invited to imagine they have a very high degree of self-efficacy and mastery over diabetes management and share out to the group what that life would be like.

-Participants will be asked to write down how important (scale of 1-10, with 10 being the most important) this is to them and why the rating is not lower, as well as what could make the rating higher.

-Review change maintenance plans (e.g. Change Maintenance Plan.pdf)

-Introduce mindfulness principles, doing check-ins with self throughout the day to review goals

-Share that more mindfulness tools will be taught at next session.

-Have participants write out 2 behaviors related to ADCES7 they do well already and 2 they want to work on.

-Both interventionists will introduce and review SMART goals

-Participants will be asked to make goals for behaviors (can be physical or mental behaviors) written as SMART goals (i.e., specific, measurable, attainable, relevant, and time-bound).

-Participants will be asked to write about when and how they will engage in all 4 behaviors they identified above, and what to do when something gets in their way.

-Example SMART goals could be things like:

-Checking blood glucose levels and administering insulin at least 20 minutes before a scheduled meal

-Monitoring unpleasant emotions and tracking their effects on behavior (e.g., journaling about how feelings of loneliness are associated with eating without counting carbohydrates or eating foods associated with dysregulated blood glucose levels).

7:50pm-8:00pm – Complete session, complete final self-report measures

-Make sure participants have needed snacks and correct any dysregulated blood glucose (BG)

-Have participants complete final written measures

-Ensure participants return all paper measures and that interventions have a means of getting in contact with them so that we can compensate them for biomarker collection and for attending session 1 ($25+$10 in Amazon gift cards).

(Session 2)

6:00pm – 3T1 team shows up, reviews materials and agenda, troubleshoot, answer questions. CHOOSE TIMEKEEPERS.

6:30pm-6:40pm –participants complete consent forms (if new), session measures again

-LP and Molly will consent participants: Consent forms

-Chris and Tian will get groups set up.

-Participants will be asked to complete survey measures after consenting

6:40pm-6:45pm – Introductions and Program Overview

-All interventionists and participants will introduce themselves with:

-Name

-What they hope to get out of the group

-Experience with groups

-Years with diabetes

-Qualifications and scopes of practice (interventionists only)

-LP and Tian / Chris and Molly will present to their respective groups (diabetics and caregivers of diabetics) to talk about the structure of the intervention going over:

-Duration (5 weeks)

-Rules about privacy and confidentiality within group (establish with each group)

-Reminders about contents members share, including reporting requirements and limits to confidentiality

-Reminder that any contact between group members outside of group is welcome but needs to be done thoughtfully and in such a way that it does not disrupt group later.

-Reminder about need for feedback and thoroughness when completing measures

6:45-7:20pm – Setting goals (6:45-7:00pm), Self-efficacy (7:00-7:10pm), and ADCES-7 Behaviors (7:10-7:20pm)

-Psych interventionists will have group members articulate challenges with diabetes

-Focus is to not linger on hardship but just to capture array of challenges. Expected concerns include: unpredictability; diabetes burnout; shame and awkwardness; isolation

-Psych interventionists will talk about self-efficacy, building confidence and trust in ourselves and the diabetics in our lives, value of focusing on the good and on wins, not just deficits

-All interventionists will ask about beliefs about diabetes management and about confidence levels to manage diabetes when not stressed, mildly, moderately, and intensely stressed. If there is time, we can ask what ways other group members have to reduce stress.

-Diabetes interventionists will introduce the Association of Diabetes Care and Education Specialists (ADCES) 7 Self-Care Behaviors (ADCES7): https://www.adces.org/diabetes-education-dsmes/adces7-self-care-behaviors

-Ask participants what behaviors go into glycemic control in their lives

-Introduce and briefly describe the ADCES7 components: Healthy Coping; Healthy Eating; Being Active; Taking Medication; Monitoring; Reducing Risks; Problem Solving;

-Share information about blood glucose monitoring best practices (how often to check, how to analyze data and trends on one's own, etc.).

7:20pm-7:30pm – Blood sugar checks and snacks; groups can co-mingle, chat as needed, review any session worksheets

7:30pm-7:50pm – Review and revise behavioral intervention plan

-Both interventionists will review value of tracking behaviors and mindfulness

-Participants will be invited to imagine they have a very high degree of self-efficacy and mastery over diabetes management and share out to the group what that life would be like.

-Participants will be asked to write down how important (scale of 1-10, with 10 being the most important) this is to them and why the rating is not lower, as well as what could make the rating higher.

-Review change maintenance plans (e.g. Change Maintenance Plan.pdf or SMART-Goals-Worksheet-1.pdf)

-Introduce mindfulness principles, doing check-ins with self throughout the day to review goals

-Share that more mindfulness tools will be taught at next session.

-Have participants write out 2 behaviors related to ADCES7 they do well already and 2 they want to work on.

-Both interventionists will introduce and revisit SMART goals

-Participants will be asked to make goals for behaviors (can be physical or mental behaviors) written as SMART goals (i.e., specific, measurable, attainable, relevant, and time-bound).

-Participants will be asked to write about when and how they will engage in all 4 behaviors they identified above, and what to do when something gets in their way.

-Example SMART goals could be things like:

-Checking blood glucose levels and administering insulin at least 20 minutes before a scheduled meal

-Monitoring unpleasant emotions and tracking their effects on behavior (e.g., journaling about how feelings of loneliness are associated with eating without counting carbohydrates or eating foods associated with dysregulated blood glucose levels).

7:50pm-8:00pm – Complete session, complete final self-report measures

-Make sure participants have needed snacks and correct any dysregulated blood glucose (BG)

-Have participants complete final written measures

-Ensure participants return all paper measures and that all have a means of getting in contact with them so that we can compensate them for biomarker collection and for attending session 1 ($25+$10 in Amazon gift cards).

8:00-onwards – Do biomarker data collection from new participants

-Tian and Chris collect biomarker data

-Participants will be asked to complete survey measures if they haven't already

(Session 3)

6:00pm – 3T1 team shows up, reviews materials and agenda, troubleshoot, answer questions. CHOOSE TIMEKEEPERS.

6:30pm-6:40pm –participants complete consent forms (if new), session measures again

-Chris and Tian will get groups set up.

-Participants will be asked to complete survey measures after arriving

6:40pm-6:45pm – Introductions and Program Overview

Reminders:

-Rules about privacy and confidentiality within group (establish with each group)

-Reminders about contents members share, including reporting requirements and limits to confidentiality

-Reminder that any contact between group members outside of group is welcome but needs to be done thoughtfully and in such a way that it does not disrupt group later.

-Reminder about need for feedback and thoroughness when completing measures

-Check in, chatting

6:45-7:20pm – Mindfulness (6:45-7:00pm), Communication and Getting what we want

-Psych interventionists will have group members articulate any challenges with diabetes and mindfulness

-Psych interventionists will talk about mindfulness, including mindful presence and DBT Wise Mind tools, as appropriate (https://dbt.tools/mindfulness/wise-mind.php)

-All interventionists will ask about beliefs about diabetes management and about confidence levels to manage diabetes when not stressed, mildly, moderately, and intensely stressed. If time, can ask what are ways other group members have to reduce stress.

-Effective communication about : https://dbt.tools/interpersonal_effectiveness/dear-man.php

-Ask participants what needs to be communicated about diabetes and to whom (e.g., schools, employers, caretakers, doctors, etc.)

-Introduce and briefly describe the DBT DEARMAN skill to ask for things effectively (Describe, Express, Assert, and Reinforce while being Mindful, Appearing confident, and being willing to Negotiate)

-Discuss how these kinds of communication tools can be applied, strategize as groups about ways to make effective communication scripts, as appropriate.

-Other topics could include how to request workplace or school accommodations (https://diabetes.org/advocacy/know-your-rights/common-reasonable-accommodations#:~:text=Breaks%20to%20check%20blood%20glucose,to%20perform%20essential%20job%20functions.)

7:20pm-7:30pm – Blood sugar checks and snacks; groups can co-mingle, chat as needed, review any session worksheets

7:30pm-7:50pm – Review and revise behavioral intervention plan

-Both interventionists will review value of tracking behaviors and mindfulness

-Discuss whatever other behaviors need tracking and revisions

-Review change maintenance plans (e.g. Change Maintenance Plan.pdf or SMART-Goals-Worksheet-1.pdf)

-Introduce mindfulness principles, doing check-ins with self throughout the day to review goals

-Both interventionists will revisit SMART goals

-Participants will be asked to review or revise goals for behaviors (can be physical or mental behaviors) written as SMART goals (i.e., specific, measurable, attainable, relevant, and time-bound).

-Participants will be asked to reflect on their SMART goals and what to do when something gets in their way of achieving them

-Example SMART goals could be things like:

-Checking blood glucose levels and administering insulin at least 20 minutes before a scheduled meal

-Monitoring unpleasant emotions and tracking their effects on behavior (e.g., journaling about how feelings of loneliness are associated with eating without counting carbohydrates or eating foods associated with dysregulated blood glucose levels).

7:50pm-8:00pm – Complete session, complete final self-report measures

-Make sure participants have needed snacks and correct any dysregulated blood glucose (BG)

-Have participants complete final written measures

-Ensure participants return all paper measures and that all have a means of getting in contact with them so that we can compensate them for biomarker collection and for attending session 1 ($25+$10 in Amazon gift cards).

(Session 4)

6:00pm – 3T1 team shows up, reviews materials and agenda, troubleshoot, answer questions. CHOOSE TIMEKEEPERS.

6:30pm-6:40pm –participants complete consent forms (if new), session measures again

-Chris and Tian will get groups set up.

-Participants will be asked to complete survey measures after arriving

6:40pm-6:45pm – Introductions and Program Overview

Reminders:

-Rules about privacy and confidentiality within group (establish with each group)

-Reminders about contents members share, including reporting requirements and limits to confidentiality

-Reminder that any contact between group members outside of group is welcome but needs to be done thoughtfully and in such a way that it does not disrupt group later.

-Reminder about need for feedback and thoroughness when completing measures

-Check in, chatting

Other topics include: communication skills, diabetes pride, review behavioral activation, behavioral experiments, and family dynamics.

6:45-7:20pm – Exploring burnout (as appropriate)

-This session can focus more on community building, eliciting stories of struggle and common strategies to manage them.

-Psych interventionists will have group members articulate any challenges with diabetes burnout

-All interventionists will ask about beliefs about diabetes management and about confidence levels to manage diabetes when not stressed, mildly, moderately, and intensely stressed. If time, we can ask what ways other group members have to reduce stress

7:20pm-7:50pm – Building resilience and mindfulness tools

-Both interventionists will review value of tracking behaviors and mindfulness

-Discuss whatever other behaviors need tracking and revisions

-Review change maintenance plans (e.g. Change Maintenance Plan.pdf or SMART-Goals-Worksheet-1.pdf)

-Introduce mindfulness principles, doing check-ins with self throughout the day to review goals, as well as tools to re-regulate body (e.g., breathing techniques, self-compassion, grounding, movement, sharing tools the group uses to find mindfulness).

-E.g., DBT Wise Mind tools, as appropriate (https://dbt.tools/mindfulness/wise-mind.php), support groups and community

-Diabetes educators can provide tools for managing diabetes, as needed, and talk about how diabetes management changes over time, across the lifespan.

-Both interventionists will revisit SMART goals

-Participants will be asked to review or revise goals for behaviors (can be physical or mental behaviors) written as SMART goals (i.e., specific, measurable, attainable, relevant, and time-bound).

-Participants will be asked to reflect on their SMART goals and what to do when something gets in their way of achieving them

-Example SMART goals could be things like:

-Checking blood glucose levels and administering insulin at least 20 minutes before a scheduled meal

-Monitoring unpleasant emotions and tracking their effects on behavior (e.g., journaling about how feelings of loneliness are associated with

eating without counting carbohydrates or eating foods associated with dysregulated blood glucose levels).

7:50pm-8:00pm – Complete session, complete final self-report measures

-Make sure participants have needed snacks for dysregulated blood glucose (BG)

-Have participants complete final written measures

-Ensure participants return all paper measures and that all have a means of us getting in contact with them so that we can compensate them for attending session 4 ($10 in Amazon gift cards).

(Session 5)

6:00pm – 3T1 team shows up, reviews materials and agenda, troubleshoot, answer questions.

CHOOSE TIMEKEEPERS.

6:30pm-6:40pm –participants complete consent forms (if new), session measures again

-Chris and Tian will get groups set up.

-Participants will be asked to complete survey measures after arriving

6:40pm-6:45pm – Introductions and Program Overview

Reminders:

-Rules about privacy and confidentiality within group (establish with each group)

-Reminders about contents members share, including reporting requirements and limits to confidentiality

-Reminder that any contact between group members outside of group is welcome but needs to be done thoughtfully and in such a way that it does not disrupt group later.

-Reminder about need for feedback and thoroughness when completing measures

-Check in, chatting

Other topics include: communication skills, diabetes pride, review behavioral activation, behavioral experiments, and family dynamics.

6:45-7:20pm – Resilience, diabetes pride, and living best lives

-Psych interventionists will have group members discuss sources of pride and resilience. Diabetes educators can reinforce the "70% time in range" goals for BG management.

-All interventionists will ask about beliefs about diabetes management and about confidence levels to manage diabetes when not stressed, mildly, moderately, and intensely stressed. If time, we can ask what ways other group members have to reduce stress

7:20pm-7:50pm – Mindfulness and support

-Both interventionists will review value of tracking behaviors and mindfulness

-Discuss whatever other behaviors need tracking and revisions

-Review change maintenance plans (e.g. Change Maintenance Plan.pdf or SMART-Goals-Worksheet-1.pdf)

-Introduce mindfulness principles, doing check-ins with self throughout the day to review goals, as well as tools to re-regulate body (e.g., breathing techniques, self-compassion, grounding, movement, sharing tools the group uses to find mindfulness).

-E.g., DBT Wise Mind tools, as appropriate (https://dbt.tools/mindfulness/wise-mind.php), support groups and community

-Diabetes educators can provide tools for managing diabetes, as needed, and talk about how diabetes management changes over time, across the lifespan.

-Both interventionists will revisit SMART goals

-Participants will be asked to review or revise goals for behaviors (can be physical or mental behaviors) written as SMART goals (i.e., specific, measurable, attainable, relevant, and time-bound).

-Participants will be asked to reflect on their SMART goals and what to do when something gets in their way of achieving them

-Example SMART goals could be things like:

-Checking blood glucose levels and administering insulin at least 20 minutes before a scheduled meal

-Monitoring unpleasant emotions and tracking their effects on behavior (e.g., journaling about how feelings of loneliness are associated with eating without counting carbohydrates or eating foods associated with dysregulated blood glucose levels).

7:50pm-8:00pm – Complete session, complete final self-report measures

-Make sure participants have needed snacks for dysregulated blood glucose (BG)

-Have participants complete final written measures

-Ensure participants return all paper measures and that all have a means of us getting in contact with them so that we can compensate them for attending session 4 ($10 in Amazon gift cards).

(Session 6)

6:00pm – 3T1 team shows up, reviews materials and agenda, troubleshoot, answer questions.

6:30pm-7:00 pm – Do biomarker data collection from participants,

-Tian and Chris collect biomarker data

-LP and Molly will consent participants: Consent forms

-Participants will be asked to complete survey measures after consenting

7:00pm-7:30pm – Reviewing goals and tools

-Check in with group members about their goals, do not need to share all around

-Share out as a group what helps them to achieve goals of :

- living with diabetes and healthy coping

-strategies used to improve the situation and diabetes management

-list of accomplishments of participants and moments of joy

7:30pm-7:50pm – Discuss what it was like to have behavioral intervention plan and what it was like to do group

-Both interventionists will introduce value of tracking behaviors and mindfulness

-Review change maintenance plans (e.g. Change Maintenance Plan.pdf)

-Final review of mindfulness principles, doing check-ins with self throughout the day to review goals

7:50pm-8:00pm – Complete session, complete final self-report measures

-Make sure participants have needed snacks and correct any dysregulated blood glucose (BG)

-Have participants complete final written measures

-Ensure participants return all paper measures and that all have a means of us getting in contact with them so that we can compensate them for biomarker collection and for attending session 1 ($25+$10 in Amazon gift cards).

Focus group outlines for facilitators

3T1 Focus group guide

This guide is intended to outline questions to be used in the post-intervention focus group, with the recognition that the interviewers will have the discretion to ask follow-up questions related to learning about what the experience was like for participants and interventionists.

Comments to preface and introduce the focus group:

- Welcome to the focus group! This is intended to be a place for us to debrief about the experiences of participating in the Tools for Tackling Type 1 (3T1) study. As you know, this was a pilot study and we want to understand your experiences of this study. We expect this focus group will last approximately 75 (between 60 to 90) minutes.
- Please keep in mind that we will be recording this study to understand your experiences and perspectives; however, no identifiable information will be connected with any one of your comments.
- If you do not want to be recorded, we will ask that you leave the Zoom room now and appreciate your taking part in the study.
- For those who choose to stay, please silence all electronic devices and close other tabs and instances on your devices. We appreciate your undivided attention as we conduct this focus group. We also ask that participants mute themselves and stay on camera for the duration of the focus group, as much as possible. Please feel free to leave and come back if your attention is needed elsewhere.
- [Omar]
- Additionally, please raise your hand and wait to be called on when we ask questions [MAY NOT BE NECESSARY]. We will be keeping track of who has raised their hands,

but please feel free to put something in the chat if we do not get to you. We realize that not everyone will be able to answer all questions and that's okay. If there is additional feedback you have for the study team, please feel free to make a note of it and send it to us at our email addresses (see the chat).

- We want to learn more about what we did well and what we could have done differently in this study. We are hoping to do this intervention again in the future and your feedback is invaluable to understand how we can improve. With that said, please refrain from making remarks about other people's experiences and remember that this is also a confidential space, just like the 3T1 groups.
- Are there any questions? (Pause for 10 seconds or answer questions).
- Let's begin! **START RECORDING TO A LOCAL OR CLOUD DRIVE**

General questions for all participants (all do not need to be asked):

- What was it like to participate in a group intervention?
- What support systems and people in your life do you have to talk about diabetes with?
- Based on your experiences in this study, what have you learned about or how do you think about diabetes adherence/management?
    - NEW QUESTION: How did participation in this group change how you think about diabetes adherence or management?
- What has been the most helpful aspect of this intervention so far? The least helpful?
    - Flesh out more follow-up questions, especially since it sounds like talking to other people with similar experiences has been especially helpful.
- If you were recommending this intervention to a friend, how would you describe it?

    - If you could add one thing about the intervention, what would it be?
- What would you like to carry forward from this study into the rest of your life?
- Given how participants in sessions noted the value of community above all else, what value did interventionists provide? How did they interfere with group cohesion / support from other diabetics and caregivers?

Just try to make sure that we hear from both types of participants, don't necessarily need to limit who responds to questions below:

Specifically for participants with Type 1 diabetes:

- What were you hoping to get out of this intervention?
    - Were you surprised by anything? Were you disappointed?
- What aspects of this intervention most affected your relationship with diabetes?
- What about diabetes management has changed for you since starting the intervention?

Specifically for participants who are caregivers for people with Type 1 diabetes:

- What changes have you noticed in the lives of the diabetic or diabetics you care for?
- How has your relationship with diabetes changed?
    - With your own self-care and goals?

Specifically for interventionists:

- What were the easiest aspects of implementing 3T1? The most challenging?
- What would you change about the training and planning around 3T1 implementation?

- Describe the dynamics between interventionists? What are things you would add to the program to improve or change the dynamic?

Closing remarks

- Thank you very much for your active participation. If you have any other questions or feedback about 3T1, please feel free to send it to us at our email addresses in the chat. We hope this process has been helpful and appreciate your time and participation. We have kept attendance and will be sending you compensation for your participation within the next 48 hours.
- Please let us know if you have any questions or concerns, thank you again!

APPENDIX D - QUALITATIVE CODEBOOK

Code	Description and inclusion criteria
Benefits of Community theme	
Breaking isolation	Respondents refer to comments about "knowing I am not alone", particularly in terms that suggest this is desirable
Diabetes community is essential	Respondents refer to diabetes community as helping with coping and reducing diabetes distress
Knowledge transfer	Respondents refer to how community facilitated knowledge transfer between participants and/or interventionists.
Need for desired support	Respondents describe need for social support and touches on themes including that what they get has to be perceived as actually supportive, rather than just 'lip service'.
Sources of support	Respondents describe sources of support, particularly outside of the intervention
Life with T1D theme	
Negative relationship with diabetes sub-theme	
Adherence is hard or feels impossible	Respondents describe adherence as being elusive due to how multifaceted it is or when it seems to just becomes impossible to immediately resolve or regulate
Adherence versus quality of life	Respondents refer to T1D management, which is supposed to improve long-term QoL, as being opposed to typically short-term quality of life.
Diabetes is a battle	Respondents refer to diabetes as challenging, particularly when using combative or martial metaphors (e.g., fighting, battling, chasing, tackling)
Perfectionism	Respondents describe feeling that one needs to be perfect to have adequate diabetes control or else refers to behaviors aimed at achieving total, if impractical control over BG and other aspects of diabetic life. Also refers to moments where perfectionism was the explicit target that 3T1 was seeking to address in sessions.
Diabetic Pain sub-theme	
Diabetes distress comes from without	Respondents refer to how structural issues in society increase diabetes distress. *Note*: Diabetes distress (in this case, "distress from diabetes") encompasses poor mental health related to burnout and diabetes, but it is broader than that. It can include physical and mental exhaustion that does not need to reach clinical definitions of lack of care and lack of diabetes management. This is different than what the literature describes as lack of adherence, as this colloquial use of "diabetes distress" is different from the clinical definition.
Diabetes frustration	Respondents refer to how T1D management is often connected to feelings of anger, hopelessness, despair, annoyance, or other unpleasant emotions

Lack of understanding in daily life	Respondents refer to how people in daily life don't understand what T1D is really like, which is a common source of stress to diabetics and their families
T1D is a family disease	Respondents refer to how T1D affects more than an individual and can affect families by creating stress, particularly as tension between diabetics and their caregivers
Diabetes lifestyle sub-theme	
Diabetes supplies	Respondents refer to diabetes supplies (e.g., CGMs, insulin pump supplies) in positive, neutral, or negative ways. This code highlights the importance of having equipment that is often very expensive and is not always durable to effectively manage diabetes.
Exercise is helpful	Respondents refer to exercise as in positive ways. This code highlights the importance of exercise on diabetic life and how it is often associated with improved BG control, mood, and overall well-being.
Food	Respondents refer to food in positive, neutral, or negative ways. This code highlights the importance of food on diabetic life.
Other health issues	Respondents refer to other health concerns in positive, neutral, or negative ways. This code highlights the commonality of comorbid conditions among families with T1D and how other health issues often affect T1D and vice versa, often making both worse or harder to manage.
Schedule	Respondents refer to schedules for diabetes adherence behaviors in positive, neutral, or negative ways. This code highlights the importance of routine on diabetic life, and how effective routines often improve diabetes management and how diabetes management can occupy significant amounts of time in the schedules of families with T1D.
Medical guidelines versus lived experience	Respondents refer to how their experiences of life with diabetes is not always reflected in the clinical literature. It was also used to code descriptions of experiences where personal experience served as a guide in lieu of established guidelines. This code highlights the importance of balancing medical advice with intuition and insights from one's own experiences or insights from other diabetic families.
Value of adherence behaviors	Respondents refer to value in learning and practicing skills related to diabetes care, in and out of the intervention
Positive relationship with diabetes sub-theme	
Diabetic joy	Respondents refer to experiences when diabetes distress is reduced, when refocusing attention on things that make them happy, or even reframe T1D as something neutral or positive. Common examples include feeling happy due to having BG in range overnight, feeling content by connecting with others in the T1D in ways that promote feelings of well-being (e.g., many families with T1D are "cool" or "inspiring") and noting that living T1D may contribute to the positive qualities in others. This code also captured descriptions of feeling positive self-worth as a person living in a family with T1D.
Value of acceptance	Respondents refer to accepting the difficulties that come with T1D, particularly in ways that suggest it is important to reduce diabetes distress

Structure of 3T1 theme	
3T1 was well-structured sub-theme	
3T1 was strengthened by interventionist collaboration	Respondents refer to how interventionists working together made the intervention more seamless, efficacious, or pleasant
3T1 structure was helpful	Respondents refer to the fact that the overall way that 3T1 was designed helped to meet its objectives. While similar to the theme of "3T1 was well-structured", this code was included to capture specific excerpts where this belief was expressed
Addressing broad concerns surpassed diabetes	Respondents refer to how broader concerns about life with T1D were more important to discuss than getting information about diabetes during 3T1 sessions
3T1 benefited from being flexible	Respondents refer to how 3T1 interventionists responding to participant needs in real time rather than rigid session outlines led to more pleasant feelings and beliefs that 3T1 was effective in achieving its goals.
3T1 was poorly structured sub-theme	
3T1 had a deficit framework	Respondents refer to how 3T1 was structured to address deficits held by respondents rather than focus on emphasizing or reinforcing respondents' strengths.
3T1 needed more participant input	Interventionists describe how 3T1 would benefit in the planning and execution phases from having participants provide their input about what would work best for 3T1 prior to the intervention's implementation
3T1 structure was unhelpful	Respondents refer to the overall way that 3T1's design failed to help meet its objectives
3T1 structure was inconsistent	Respondents refer to beliefs that 3T1 was poorly organized, or was significantly different between sessions or from its initial conception
Incompatibility of group	Respondents refer to how interactions between participants felt ineffective or inappropriate (e.g., pairing a teenager with a much older participant) as their experiences may have occasionally felt at odds with one another or unrelated altogether.
Lack of intervention target clarity	Respondents refer to comments about how it was not always clear what 3T1 was supposed to be accomplishing or changing, resulting in confusion and less efficacy.
Need for prior diabetes education	Respondents refer to respondents' (particularly interventionists') needs for more diabetes education prior to beginning 3T1.
Need for prior group intervention education	Respondents refer to beliefs that more education about running a psychological intervention prior to 3T1's start would have helped interventionists function better.
Need for session zero	Respondents, especially interventionists, refer to the desire or apparent need for a full run-through of a session without Respondents to practice what will happen in session, coordinate, and practice with one another in order to improve upon 3T1.
Evaluation of 3T1 theme	
Negative evaluations of 3T1 sub-theme	

3T1 content was unhelpful	Respondents describe how information shared in 3T1 was not very useful, though not necessarily that the design was poor.
Interventionist uncertainty	Respondents refer to when interventionists described feeling uncertain or circumstances that caused uncertainty
Non-generalizable study	Refers to the 3T1 pilot study not relating to the broader T1D population
Poor coordination between interventionists	Refers to concerns that interventionists did not sufficiently communicate or coordinate during or before sessions resulting in awkwardness or less efficacy in the intervention.
3T1 generated positive emotions sub-theme	
Empathy	Respondents referred to experiences of empathy with any experiences shared by Respondents or expressing an awareness of shared struggle.
Giving grace	Respondents refer to how they were generous or forgiving with themselves and others. Similar but distinct from the "Value of Acceptance" based on grace towards self and others, as opposed to just accepting life with diabetes
Interventionist enjoyment	Interventionists refer to enjoying the intervention, separate from interventionist personal growth
Interventionist personal growth	Interventionists refer to having experiences in which they personally benefited from 3T1 due to increased knowledge, awareness, or appreciation for something
Participants identified personal strengths	Respondents refer to how participants identified strengths they used to manage diabetes
T1D relief	Respondents refer participants describing feeling less diabetes distress (or diabetes-induced struggle/discomfort), whether in their regular life or because of the intervention
Positive evaluation of intervention sub-theme	
3T1 addressed unmet needs	Respondents refer to how 3T1 offered something novel and that 3T1 had value over and above typical experiences.
3T1 had value	Respondents reported less distress and greater achievement of goals related to diabetes as a consequence of 3T1. This code captures comments separate from the value of 3T1 created by offering a community to Respondents, as community itself was identified as a separate benefit.
3T1 psychology content was helpful	Respondents refer to how psychological interventions, including skills training, were useful to participants and helped reduce or mitigate diabetes distress
Big wins	Respondents refer to accomplishments. It was noted by coders that sometimes diabetes successes might seem small out of context and that this code is for when someone is expressing being able to do something that is a big deal for them.
Combined group was beneficial	Respondents refer to how having the whole group present was beneficial, as hearing perspectives from both diabetics and caregivers supported the other group

Diabetic interventionists helped	Respondents refer to how having diabetic interventionists was either neutral or beneficial, suggesting that diabetic interventionists helped 3T1 function well due to this shared feature with participants.
Future orientation and planning / problem solving	Respondents refer to how 3T1 offered a place for participants to solve problems and practice skills for future use in session
Interventionists had expertise	Refers to comments that interventionists had appropriate skills and experience to deliver an intervention effectively.
Interventionists redirected participants	Respondents refer to descriptions of interventionists actively intervening. Noteworthy because the intervention centered on letting participants lead the discussions based on their interests. This code is intended to highlight moments when participants noted interventionists being more directive.
Nondiabetic interventionists helped	Respondents refer to how having non-diabetic interventionists was either neutral or beneficial, suggesting that not all interventionists need be diabetic for 3T1 to function well.
Skills training was useful	Respondents refer to benefitting from learning specific skills to manage diabetes distress or treatment adherence concerns
Small group was good	Respondents refer to benefiting from having separate diabetic and caregiver groups, rather than combined groups.
SMART goals were helpful	Respondents refer to how learning about, developing, or executing SMART goals was particularly useful to them.
Strategizing T1D management	Respondents refer to how they strategized about T1D management outside of session or else how strategies were a focus in 3T1 sessions
Transparent curriculum	Respondents refer to the 3T1 curriculum or training being evident/obvious to participants and interventionists, particularly when what was known about the curriculum facilitated the group
Value of debriefs	Respondents refer to how discussing issues outside of regular sessions was helpful in facilitating 3T1 or helped 3T1 operate better
Value of T1D education	Refers to positive impressions of the diabetes information that was shared during 3T1 sessions.

APPENDIX E - BIOLOGICAL SAMPLE PROCESSING

Hair collection and cortisol analysis protocols used by UO Global Biomarker Lab staff

The collected hair samples were 0.5-cm wide strips of hair that were isolated on the back midpoint (posterior vertex) of each participant's head, tied off with cotton string, cut, and stored in aluminum foil for later laboratory analysis. The sample was placed in separate pieces of foil with unique participant ID labels and direction of the hair growth (i.e., which side of the hair strands were the base and the end) and stored at room temperature in the Global Health Biomarker lab. The hair was washed, cut, weighed, ground into a powder, added to a solution, dried, re-constituted with a diluent, and assayed using a Cortisol Salimetrics EIA kit using the enzyme-linked immunosorbent assay (ELISA) protocol (see below). Samples were assayed twice, and mean cortisol concentrations and standard deviations were calculated. Percentage concentration coefficient of variance (CV%) was calculated by dividing the standard deviation by the mean and reported as a percentage. CV% is used to compare concentrations of different levels in lieu of just mean or standard deviation and is reported for population-level analyses. A microplate spectrophotometer analysis using 450 nanometer wavelengths was also conducted and CV% was also calculated for this method (450CV%) to establish pipetting precision. 450CV% represents a measure of optical density (i.e., greater differences in optical density indicate greater differences in concentrations of sample between analysis wells, and excessive density indicates poor pipetting of sample into wells). If CV% was above 7%, the assay was redone due to concerns about poor pipetting. Intra-assay reliability was determined through the 450CV%.

Igboanugo and colleagues (2024) conducted a meta-analysis of adult hair cortisol concentration studies and estimate that mean adult hair cortisol using Salimetrics equipment to

be 12.99pg/mg (95% prediction interval of 0 to 28.66pg/mg). The authors note that Salimetrics reports that healthy adults have estimated mean levels of 16.84pg/mg, SD = 23.27pg/mg with moderate, considerable, and extreme elevations in cortisol being represented by 1.5, 2, and 3 standard deviations from the mean respectively.

In the current study, the analysis was calibrated using controls of high and low cortisol concentration and reported in micrograms (one millionth of a gram) per deciliter of analyte fluid (ug/dL). The high concentration control yielded mean concentration of 0.863 ug/dL, SD = 0.028, percentage concentration CV% was 3.26, and the 450CV% was 2.34. The low concentration control yielded mean concentration of 0.096 ug/dL, SD = 0.012, CV% = 12.7, and the 450CV% = 2.34. Cortisol concentrations were transformed from mL to mg to reflect the state of the hair prior to being put into a solution and standard reporting practices. Different amounts of assay diluent were used for different weights of hair that were assayed (150uL for 15 and 10mg hair, and 100uL for 5mg hair sample). Total cortisol weight was calculated by dividing by assay diluent, dividing by 2/3 due to the 1mL of ethanol used in evaporation from 1.5mL to extract the sample, dividing by hair weight to generate concentrations of 150pg/mg for 15mg samples, 225pg/mg for 10mg, and 300pg/mg for 5mg. Final transformations reflect this by multiplying assays by the above concentrations.

Instructions on hair sample collection can be found at: https://vimeo.com/showcase/5310035. Below is a review of steps to analysis hair cortisol levels as described in UO Global Biomarker protocols. Protocols are framed below as instructions to the reader:

1. **Hair segmentation steps:**

Grab hair samples.

Ask your supervisor for instructions about how many biomarkers we are assaying for specific studies and for segmentation instructions if this information was not provided to you.

If we are assaying all hormones, we need at least 55 mg of hair for one assay, more for redo's.

The amount of hair we need for each biomarker is as follows:

- 15 mg for Cortisol
- 15 mg for DHEA and Testo
- 15 mg for Estradiol
- 10 mg for Progesterone

For human hair we weigh the hair before washing it to know how many hormones we will be able to extract and to send the weight of usable hair to the researchers if they want to know.

The length to cut the hair depends on the study question/what the researchers want, make sure to clarify with your supervisor.

Grab clean glass tubes from the cardboard box that is labeled 'Clean Test Tubes.'

With permanent marker write on the tube:

- Project Name
- Subject number/ ID number
- Male or female (if applicable)
- Date of collection (if applicable)
- Site (if applicable)
- Segment number (1^{st}, 2^{nd}, 3^{rd})

Turn the scale on to weigh the empty glass tube and set the scale to zero with the empty tube on it (and closed door).

Place a white piece of paper on the desk between yourself and the scale and have the tweezers and scissors ready.

Open the envelope and remove the foil package from the envelope.

Carefully open the foil and make sure the hair sample does not move.

The first segment should be the hair that is closest to the scalp. If there is an elastic band around the hair the band should be closer to the hairs close to the scalp. Or check if the researcher has written on the foil where the hairs close to the scalp are.

Place the caliper on the paper and set the caliper to the right length (for example: 1.5 cm/15 mm)

Carefully take the hair sample in your hands and inspect if all hair ends are in line with each other. If a couple of hairs are sticking out try to put them in line with the other hairs.

Put the hair sample on the white paper and measure with the caliper how long the segment should be. Take the piece where you will cut the hairs between two fingers.

Stick the hair sample in the glass tube and use the tweezers to make sure all hairs are in the tube, before you cut the hair sample with the scissors at the point you measured with the caliper, right where your two fingers are holding the hair sample. Use tweezers to push the samples down to bottom.

Repeat this step if the foil packet has multiple hair bundles with rubber bands.

Take notes (and pictures if needed) if the samples have been collected or packed poorly.

When the glass tube with the segmented hair sample is ready you put it on the scale and close the scale door.

Write on the segment sheets the ID/subject number and the sample weight for this tube with the first segment of hair.

Repeated these steps for the 2nd (and 3rd) segment. Grab a new empty glass tube for each segment.

When you are done with a sample, put the remaining hair sample in the foil and place the foil back in the envelope. Put the envelope in the box for segmented samples of that project.

Put the samples in the hair cabinet covered with foil and an appropriate label (Project name, segmented, ready to be washed).

2. **Hair washing steps:**

Grab the hair from the hair cabinet that is labeled: Segmented, ready to wash.

Put isopropanol in the squeeze bottle that is labeled isopropanol (if there is leftover isopropanol in the bottle, dump it out first). You need to add 5 mL to each glass tube. 5 ml is approximately ¼ of the test tube. If a tube has a lot of hair samples put a little bit more isopropanol in the glass tube (around 7 mL).

Put a rubber stopper on each glass tube and place the tubes in the rotator, make sure the rotator is balanced. Start the rotator and rotate for 3 minutes (use a timer).

Grab a large piece of paper towel. Remove tubes from the rotator and make sure all the hairs are at the bottom of the tube. Remove the rubber stopper from the tube and grab the metal spatula to keep the hairs in the tube while removing the isopropanol from the tube, pour into a waste beaker.

Be careful: the isopropanol will erase the permanent marker. Always have the tube label turned towards the ceiling while emptying the tube into a waste beaker and use a paper towel to wipe off any leftover isopropanol on the edges of the tube before putting it back.

Do this for every tube and make sure the rubber stoppers are in the same order as the tubes.

After all isopropanol has been removed from the tubes, repeat the procedure. Pour 5 mL of isopropanol in each tube, put the rubber stopper on the tube and rotate for 3 minutes.

Remove the isopropanol again.

Put the samples in the evaporator in the fume hood. Connect the transparent gas tube from the air nozzle to the gas input in the back of the evaporator. Make sure there is no water in the water bath and put the test tube holder in. Turn the evaporator on and turn the 'gas' button on to the bottom "manual" side.

Every column that has tubes should be switched on (if the switch is turned to the back it is on, and if you turn it towards yourself it is off). **The evaporator should be connected to the air NOT to the gas tank!**

Open the air flow (it is on the right side of the fume hood) until you feel the air coming out of the needles with your hand. Put the needles in the tubes and let the samples evaporate for overnight. Close the fume hood door so it reads as min flow. Remember to turn off the lights to create a darker environment for the samples.

Pour any leftover isopropanol from the squeeze bottle into the chemical waste bottle. Store the isopropanol under the sink.

If you are not coming back in the morning to remove the hair samples from the evaporator, you have to notify someone else to remove them. Turn off the air, switch off the gas button and the evaporator. Take the test tubes back to 012. Add them to the appropriate 'washed, ready to weigh tray' or cover them with foil and label them as 'Project Name, washed ready to weigh' and put them in the hair cabinet.

3. **Sample weighing steps:**

Use the pointy tweezers, with the really sharp ends, for this step, or the normal tweezers if that works better for you.

Grab a box of 2.0 mL DNA LoBind vials.

Copy the label from the glass tube to the 2.0 mL vial with a permanent marker.

Also include the letter of the biomarker(s)

- C for cortisol
- DT for DHEA and Testo
- E for estradiol
- P for progesterone

Include the segmentation number (e.g. 1st segmentation, 2nd segmentation) if there are more than one segmentation.

Put the 2.0 mL vial on the scale

Zero the scale

Remove the 2.0 mL vial and use the pointy tweezers to transfer hair from the glass tube to the 2.0 mL vial. Always do this on paper to catch hair that falls. Use white paper for black hair, use paper with darker color for white and gray hair.

For C you need 15 mg of hair,

Put the 2.0 mL vial back on the scale and wait a couple of seconds for the scale to adjust (sometimes it takes a long time to get the final weight). Before weighing the vial, make sure there is no hair outside the vial or caught in the cap.

When you have the correct weight (it should be between 15.00-15.49 mg (or 10.00 – 10.49 mg for P), put 3 beads into the tube and close it tightly. Write down the ID information and the mass on the weighing sheet.

Transfer the hair on the paper back to the test tube for possible future redo samples. Put the weighed samples test tube onto the ‘weighed’ tray.

Before start weighing the next sample, make sure there is no hair on the paper and tweezers.

After you are done with weighing, remember to put the weighted hair samples (in vials) and left over hair samples (in test tubes) back to the cabinet.

4. **Sample grinding**

After accurately weighing 15mg of hair (or 10mg for progesterone) and adding 3 beads to each vial, the samples should be stored in cabinet (in darkness) until they are ready to assay. Do not start grinding samples until a wet lab supervisor tells you to do this.

Make sure the caps of the vials are closed tightly. Put the samples in the white buckets next to the mixer mill. All spots must be filled, if you have open spots left use the blank vials with 3 beads next to the ball mill.

Place the white buckets in the ball mill and adjust button until the buckets are secure. The little metal button should slide into place and lock tightly **without space.** That is how they are safely secured.

Grind the samples for 8 minutes at 30Hz.

After 8 minutes turn off the ball mill and remove the white buckets from the ball mill. Very carefully inspect the vials for possible cracks. Small cracks can be covered with Parafilm (stretchy plastic) next to the ball mill.

Mark on the layout with “sample crack on vial + sample ID”.

If there are big cracks with hair powder leaking out, there are two options:

1) locate the sample in test tube, reweigh another new sample and grind it.

2) If there is not sufficient hair left, wrap the vial with cracks carefully with parafilm, keep processing this sample and mark on the layout “sample loss during grinding + sample ID”

5. **Extraction**

For DHEA, testosterone, cortisol

Add 1.5 mL of HPLC-grade methanol to each of the vials containing the powdered sample (and beads). There is a glass bottle in 012 labeled ‘methanol’ near the autoclave. Only use fresh methanol and put left over methanol in the chemical waste bottle.

Tap the vials to make the hair powder go down to the bottom and open them slowly and carefully (try not to lose any hair powder). You may use the repeat pipette for this procedure with the 10 ml tip. When using the repeat pipette never use the first stroke. Put the first stroke back into the reservoir. Pipette solvent very slowly and carefully into the vials. Cap the vials securely and place the samples in the rotator in the fume hood. Turn on the rotator and incubate the samples for 20-24 hours. Remember to turn off the lights to maintain a dark environment for the samples. After 24 hours, add tap water to the water bath until the bath is almost completely filled. Turn on the main button and water bath heat button and set the temperature of the water to 50 degrees for methanol.

Remove the samples from the rotator and take them to room 012. Put the samples in the microcentrifuge so they are balanced. Centrifuge the samples at 5000 rpm for 5 minutes.

HANDLE SAMPLES WITH EXTREME CARE AFTER THEY HAVE BEEN CENTRIFUGED. DO NOT DISTURB THE PELLET OF SAMPLES. MOVE THEM AS LITTLE AS POSSIBLE.

Remove the samples from the centrifuge buckets carefully and take them to room 09 and bring a blue pipette. Grab a bag of 2 mL microcentrifuge vials and copy the ID numbers to new clean vials (this specific step can be done earlier in the hair processing steps as well).

Place the centrifuged samples and the new clean vials in the fume hood. Let the centrifuged samples sit for 15 minutes so any hair powder settles.

For DT: use the clean Testo vials to transfer the clear liquid.

Set the blue pipette to 1000 uL. **Do not wet the tip or use Kimwipes for the following procedure:**

Very carefully open the cap of the sample and put the empty clean vial with the matching ID number in the same hand. Transfer 1 mL of the supernatant to the new clean vial. **Do not disturb the pellet of samples.** The transferred liquid should be clear and not contain powdered sample. If the sample was shaken by accident and the powdered sample was mixed with the liquid, centrifuge the sample again (5000 rpm for 5 min) and try to transfer again.

The first round of extraction.

[DAY 2] After 24 hours, remove the samples from the rotator and take them to room 012.

Remove the samples from the rotator and take them to room 012. Put the samples in the microcentrifuge so they are balanced. Centrifuge the samples at 5000 rpm for 10 minutes.

HANDLE SAMPLES WITH EXTREME CARE AFTER THEY HAVE BEEN CENTRIFUGED. DO NOT DISTURB THE PELLET OF SAMPLES. MOVE THEM AS LITTLE AS POSSIBLE.

Remove the samples from the microcentrifuge carefully and take them to room 09 and bring a blue pipette. Grab a bag of 2 mL microcentrifuge vials and copy the ID numbers to new clean vials (this specific step can be done earlier in the hair processing steps as well).

Place the centrifuged samples and the new clean vials in the fume hood. **Let the samples rest for 30 minutes in the fume hood in 09. Prevent vibrations inside the fume hood.**

Set the blue pipette to 1000 uL. **Do not wet the tip or use Kimwipes for the following procedure:**

Very carefully open the cap of the sample and put the empty clean vial with the matching ID number in the same hand. Transfer 1 mL of the supernatant to the new clean vial. **Do not disturb the pellet of samples.** The transferred liquid should be clear and not contain powdered sample. If the sample was shaken by accident and the powdered sample was mixed with the liquid, centrifuge the sample again (5000 rpm for 10 min) and try to transfer again.

Close the caps of these new vials (with 1 mL clear liquid) and put them into the refrigerator

The second round of extraction.

Add another 1 mL of new ethyl acetate into the vials from the first round (with hair powders, three stainless steel beads and about 0.5mL ethyl acetate). Close the caps and put them in the rotator. Turn on the rotator and make it rotate overnight.

Recommendations:

For estradiol extraction, you may grind hair and start the first round of extraction in the afternoon of DAY 1. After about 22-24 hours, return to lab in the afternoon of DAY 2, centrifuge the vials, transfer supernatant into new vials, add new ethyl acetate to start the second round of extraction. Then return to lab in early morning of DAY 3 (18 hours after second extraction started), centrifuge the samples at 5000 rpm for 10 minutes, let samples rest for 30 minutes in the fume hood and add the second 1mL of clear supernatant to the vials that were in the refrigerator.

6. **Evaporation**

After 24 hours **(or 18 hours after the second extraction started in case of estradiol)**, grab one of the white plastic containers. Add tap water to the water bath until the bath is almost completely filled. Turn on the main button and water bath heat button and set the temperature of the water to 50 degrees for methanol **(or 65 degrees in case of estradiol)**.

Dry down the methanol **(or ethyl acetate for estradiol**) using a nitrogen evaporator under the fume hood. The water bath should be heated to the right temperature at this point. Place the samples in the metal plate with the smallest holes. Start with the first sample at the front of the plate and work your way towards the back. Make sure the column switches are turned on for the columns containing samples. Place the needles in the vials but do not touch the chemicals. Check if the evaporator is connected to the nitrogen tank. Open the main valve of the nitrogen tank and adjust the plastic valve on the regulator to the right pressure. The first 10 minutes should be around 5 lpm (depending on the number of columns that are turned on), then check the vials for liquid level and increase 1 or 2 more lpm for another 5 minutes. Then check the vials again, if there is still liquid left, wait for another 2-3 minutes.

7. **Reconstitution**

Reconstitute the hormonal extract using assay diluent using the repeat pipette:

- 400 uL DHEA assay diluent to reconstitute DHEA and testosterone samples (DT vials)
- 150 uL cortisol assay diluent to reconstitute cortisol samples (use 100 uL for 5mg hair)
- 300 uL estradiol assay diluent to reconstitute estradiol samples

Vortex the samples for 1 minute using the large vortex machine in the fume hood.

- for DHEA you need new clean vials (copy the ID numbers) and use the repeat pipette to dilute with 150 uL DHEA assay diluent and then use a regular pipette to transfer 50 uL sample from the DT tube into the DHEA tube.

- for DHEA of monkeys, use the repeat pipette to dilute with 350 uL DHEA assay diluent and then use a regular pipette to transfer 50 uL sample from the DT tube into the DHEA tube.

Write down how much assay diluent is used to reconstitute each biomarker and how you diluent the DHEA samples on your plate layout.

Vortex the new DHEA vials for 10 seconds.

Assay the samples immediately.

C-Reactive Protein (CRP) Analysis

High sensitivity blood spot C-reactive protein (CRP) Biotinylated antibody protocol

Principle: ELISA. Eluted samples are incubated with mouse anti-human CRP previously bound to the surface of microtiter wells. Biotinylated mouse anti-human CRP and streptavidin HRP conjugate binds to the CRP-antibody complexes in each well. Color forms with the addition of chromogenic substrate, and the absorbance of the solution is read at 450nm. The quantity of CRP in each sample is determined based on comparison with a 4PL standard curve.
Sensitivity: 0.030 mg/L. Range: 0.050 mg/L to ~10.0 mg/L.
Reference: McDade, T.W., Burhop, J., and J. Dohnal (2004). High sensitivity enzyme immunoassay for C-reactive protein in dried blood spots. Clinical Chemistry 50: 652-654.

Reagents and Materials

Coating antibody Meridian Life Science mouse monoclonal anti-human C-reactive protein (3.7 mg/mL) (#M86005M). Store at 2-8°C.
Detection antibody Meridian Life Science mouse monoclonal anti-human C-reactive protein (6.0 mg/mL) (#M01319M). Store at 2-8°C.
Biotinylation reagents Pierce EZ-Link Sulfo-NHS-LC biotinylation kit (#21435). Store at 28°C and -20°C. Sufficient reagents for 10 labeling reactions. Biotin available in no-weigh format (#A39257), buy with Zebra column (#89891) and PBS (#28372) instead of kit.
Streptavidin-HRP conjugate R&D (#DY998) Store unopened at 2-8°C, stable for up to 6 months after opening. Do Not Freeze.
Streptavidin-HRP diluent reagent R&D (#DY995) Store unopened at 2-8°C. Stable for up to 30 days after opening when stored at 2-8 °C.
Standards Siemens N Rheumatology Standard SL (#OQKZ13). Standardized against International Reference Preparation CRM 470 for CRP. Store at 2-8°C. Stable for 14 days after opening, or until expiration date.
Controls Bio-Rad Liquichek Cardiac Markers Plus Control (#180X). Store unopened at –20 to 70°C. Stable for 20 days at 2-8ºC after opening. Do not refreeze after thawing.
Dilution buffer for standards
0.01 M phosphate buffer, 0.145 M NaCl, pH 7.2 (±0.3), 5.0g/L BSA
Coating buffer

0.01 M phosphate buffer, 0.145 M NaCl, pH 7.2 (±0.3)
Store at 2-8°C for up to 2 months. Approximately 12 mL needed for each microtiter plate.
Assay buffer

0.01 M phosphate buffer, 0.5 M NaCl, 0.1% Tween 20, pH 7.2 (±0.3)
Store at 2-8°C for up to 2 months. Approximately 400 mL needed per assay.

Chromogenic substrate ThermoFisher Scientific TMB Substrate Solution (#N301), Store at 28°C. Ready to use.

Stop solution (0.18 M sulfuric acid). 60 mL 3M H_2SO_4 is mixed into about 940 mL deionized water. Adjust volume to 1 liter.

Microtiter plates NUNC Maxisorp polystyrene 96-well flat bottomed, high-binding plates (product #439454; VWR #62409-002)

Preparation of reagents

I. Blood spot standards

4) Washed red cells: collect whole blood by venipuncture in EDTA vacutainer tubes (each tube yields approximately 1 mL of washed cells). Centrifuge at 1500 x g for 15 minutes. Remove plasma and buffy coat and add saline (0.86g NaCl/100 ml H_2O). Mix and centrifuge. Repeat for a total of 3 washes.
4) CRP calibrator: serially dilute calibrator in dilution buffer for standards.
4) Dilute the CRP calibrator and each calibrator dilution 1:2 with washed red cells. Also use dilution buffer 1:2 with washed RBCs for a zero standard. Mix for 10 minutes.
4) Apply standards to labeled filter paper cards (Whatman #903) in 50 µL drops, using a wide bore pipet tip. Dry overnight at room temperature and store at -23°C.

II. Standard dilution buffer: 0.01 M phosphate buffer, 0.145 M NaCl, pH 7.2, 5g/L BSA

$NaH_2PO_4 \cdot H_2O$	0.345 g
$Na_2HPO_4 \cdot 12H_2O$	2.680 g
NaCl	8.474 g
BSA	5.000 g

Dissolve in appx. 900 mL deionized H_2O
Check pH 7.2 (±0.3) and adjust to 1 liter

I. Coating buffer: 0.01 M phosphate buffer, 0.145 M NaCl, pH 7.2, (0.01% Thimerosal)

$NaH_2PO_4 \cdot H_2O$	0.345 g
$Na_2HPO_4 \cdot 12H_2O$	2.680 g
NaCl	8.474 g
Thimerosal	0.100 g

Dissolve in appx. 900 mL deionized H_2O
Check pH 7.2 (±0.3) and adjust to 1 liter
Store at 2-8°C for up to 2 months

II. Assay buffer: 0.01 M phosphate buffer, 0.5 M NaCl, 0.1% Tween 20

$NaH_2PO_4 \cdot H_2O$	0.345 g
$Na_2HPO_4 \cdot 12H_2O$	2.680 g
NaCl	29.220 g

Dissolve in appx. 900 mL deionized H_2O
Add Tween 20 1 mL
Check pH 7.2 (±0.3) and adjust to 1 liter
Store at 2-8°C for up to 2 months

III. Stop solution: Sulfuric acid (0.18 M H_2SO_4)

3M H_2SO_4 60 mL

Add acid to appx. 900 mL deionized H_20

Adjust to 1 liter

IV. R&D Streptavidin-HRP Diluent Reagent (1:10 dilution)

Mix 20 mL diluent reagent and 180 mL dH20

V. Coating plates with antibody

A. Dilute the coating antibody (4.9 mg/mL) to 2 ug/mL.

For coating 1 plate:

1. Add 5.7 uL coating antibody to 14.0 mL coating buffer

For coating 10 plates:

1. Add 41 uL coating antibody to 100 mL coating buffer

For coating 25 plates:

1. Add 102 uL coating antibody to 250 mL coating buffer

B. Add 100 µL of diluted coating antibody to each well. Rotate gently (350 rpm) for 15 minutes.

C. Cover with plastic and incubate overnight at 4°C. Plates may be stored for several months if wrapped in plastic, maintained at 4°C, and not allowed to dry out.

VI. Biotinylating the detection antibody

1. Calculations for 1 mg of antibody:

→1 mg Ab x 1 mmol IgG/150,000 mg IgG x 20 mmol Biotin/1 mmol IgG = 0.000133 mmol Biotin

(calculating number of mmols biotin needed based on MW of IgG, and a desired 20:1 ratio)

→0.000133 mmol Biotin x 557 mg/mmol Biotin x 400 uL/2.2 mg = 13.5 uL Biotin solution

(calculating volume of needed Biotin solution based on MW, and concentration of solution)

2. Dissolve 2.2 mg Biotin in 400 uL dH_2O (or use 181.82 uL dH2O/mg biotin)

Note: Biotin is very sensitive to moisture. Bring vial to room temperature before opening. Open briefly and recap quickly. Place small amount of biotin on weigh boat; calculate volume of dH2O based on weight of biotin.

3. Add 13.5 uL Biotin solution to 1 mg antibody.
4. Incubate at RT for 60 minutes.
5. Prep spin columns:
    1. Place column in 15mL collection tube. Spin 2 min at 1,000 x g. Discard storage buffer.
    2. Add 2.5 mL PBS to top of resin bed. Spin 2 min at 1,000 x g. Discard flowthrough. Repeat 3 times.
6. Add PBS to Biotin-antibody solution to bring total volume up to 1 mL

(if using 1 mg of antibody with concentration of 6 mg/mL, there will be 167 uL of ab + 13.5 uL biotin = 180 uL total. Therefore add 820 uL PBS).

7. Place spin column in new collection tube. Add antibody-biotin to center of resin bed. Allow sample to absorb into bed. Spin 2 min at 1,000 x g. Biotinylated antibody is in flow-through.
8. Calculate concentration of biotinylated antibody (e.g., 1 mg Ab + 1 mL volume = 1 mg/mL)
9. Aliquot (75 uL/tube) and store at -80□C until use.

Protocol

1. Punch out **one** 3.2 mm disc of blood spot standards, samples, and controls. Elute overnight at 4°C in 250uL Assay Buffer.
2. Next day: Remove samples from refrigerator. Rotate at 300 rpm for 1 hour at RT.
3. Remove a coated microplate and wash 4x with Assay Buffer (CRP_BLOCK wash protocol leaves 350uL Assay Buffer in each well).
4. Soak for 30 minutes, then aspirate (CRP_ASPIRATE protocol). This blocks the plate and reduces non-specific binding.
5. Add 100 uL eluate from blood spot standards, samples, and controls. Cover the plate and rotate at 250 rpm at RT for 90 minutes.
6. Wash the wells 4 times with Assay Buffer (CRP wash protocol).
7. Dilute the detection antibody (1 mg/mL) to 5 ng/mL:
    a. Pipette 10 uL antibody into glass tube with 3.990 mL (4 mL is OK) assay buffer (1:400 dilution). Mix.
    b. Pipette 20 uL of this dilution into a glass tube and add 11.976 mL (12 mL is OK) assay buffer (1:500 dilution). Use this final dilution in the assay.
8. Add 100 uL working antibody solution to each well.
9. Cover and rotate at 250 rpm at room temperature for 90 minutes.
10. Wash 4 times as before.
11. Dilute the streptavidin-HRP (5.0 ug/mL to 0.025 ug/mL).
    a. 60 uL of the R&D strep in 12 mL of the R&D diluent reagent
12. Add 100 uL working dilution of streptavidin-HRP to each well.
13. Cover the plate and rotate and 350 rpm for 30 minutes. Remove 11mL of TMB from refrigerator and allow to sit at room temperature.
14. Wash 4 times as before.
15. Add 100 uL of the TMB chromogenic substrate to each well.
16. Cover the plate, protect from the light, and incubate for 22 minutes at RT (optimize incubation time, 15 to 30 minutes, to color development).
17. Add 100 uL of stop solution to each well. Incubate 5 minutes at RT.
18. Read the absorbance at 450 nm. Use a 4PL fit to calculate unknown CRP concentrations.

APPENDIX F – QUANTITATVE ANALYSES

RQ1 - Participant ratings of 3T1's acceptability, appropriateness, and feasibility over the course of the intervention

I examined the implementation data for anomalous data, as determined by data with triple the Median Absolute Deviation values (MAD; Mellenbergh, 2019). While there were data that exceeded MADx3 values, all data were kept due to the participants rating this measure similarly between weeks, the narrow range of values in responding to Likert-type questions, and the absence of evidence that participants were misrepresenting their responses in any way. Data from the AIM measure had 8 instances out of 34 total responses with triple MAD values (5 participants across 6 weeks) in which a participant rated all three Acceptance items in the same way (e.g., completely agree). The FIM measure had 7 instances out of 34 total responses with triple MAD values (4 participants across 6 weeks) in which a participant rated all three Feasibility items in the same way (e.g., completely agree or neither agree nor disagree). The Ease of Participation measure had 2 instances out of 30 total responses with triple MAD values (2 participants across 2 weeks) in which a participant rated one item as "Neither agree nor disagree" and two other items as "Disagree".

Tests of normality were conducted for responses to each implementation measure using Shapiro-Wilk normality tests. Acceptance of the intervention $W(9) = .680$, $p < .001$, ease of participating in 3T1 $W(9) = .797$, $p = .019$, and appropriateness of 3T1's pacing $W(9) = .752$, $p = .006$ were non-normally distributed, and therefore inappropriate for parametric tests (e.g., repeated measures ANOVAs).

Most implementation values appeared to decrease between weeks 1 and 12 and an analysis was conducted to determine if there were any significant reductions. Due to the small

sample size (n = 6) and non-normal distributions of residuals, it was not appropriate to run parametric tests to determine differences in implementation ratings over time, so non-parametric tests were used. Due to missing data between weeks, a Wilcoxon test was conducted (Siebert & Siebert, 2017). All implementation measures met assumptions for criteria for Wilcoxon signed-rank tests as they had the same participants across time, used a continuous variable, and the distributions of the differences between weeks 1 and 6, weeks 6 and 12, and weeks 1 and 12 were roughly symmetric around the median. Two-tailed Wilcoxon signed-rank tests showed no significant differences between any levels between weeks 1 and 6 of the intervention, weeks 6 and 12, or weeks 1 and 12 (see Table 13 for Wilcoxon test results). No tests were conducted for study-specific measures between weeks 6 and 12 and 1 and 12 because those measures related to reviewing materials covered in the past week.

Table 13

Two-tailed Wilcoxon signed-rank tests for participant implementation measures

	Week 1 Compared to Week 6 test-value	*p*	Week 6 Compared to Week 12 test-value	*p*	Week 1 Compared to Week 12 test-value	*p*
Acceptability	.00	1	-1.34	.18	-1.07	.29
Appropriateness	-.45	.66	-1.00	.32	-.45	.66
Feasibility	-1.34	.18	-1.41	.16	-.45	.66
Ease of participation	-1.34	.18	-	-	-	-
Appropriateness of Pacing	-.27	.79	-	-	-	-
Behavioral Outcomes	-1.63	.10	-	-	-	-
Composite 3T1 measure	-.184	.85	-	-	-	-

There were no significant differences in ratings over time. The high ratings in implementation measures across time are consistent with my hypothesis that participants would have positive perceptions of the acceptability, appropriateness, and feasibility of the intervention.

RQ2 - Interventionist ratings of 3T1's acceptability, appropriateness, and feasibility over the course of the intervention

Only one of seven implementation measures were found to be mostly normally distributed per Shapiro-Wilk normality tests (combined 3T1 rating, $W(19) = .912$, $p = .079$), while all others appeared significantly non-normally distributed, and therefore inappropriate for non-parametric tests. There was only one anomalous rating in this data (as defined by a value of MAD x 3) when an interventionist rated that Pacing was completely inappropriate for one session in week 4. Given that she rated Pacing as both too fast and too slow, it was determined that she may not have been paying attention to the question and her response was replaced with the median response (from "Completely agree" to "Neither agree nor disagree") to reduce potential outlier effects.

Only one measure met assumptions for a Wilcoxon signed-rank test (i.e., had the same participants across time, used a continuous variable, and the distributions of the differences between weeks 1 and 6 were roughly symmetric around the median). A two-tailed Wilcoxon signed-rank test showed no significant differences between weeks 1 and 6 on the Composite 3T1 measure ($Z = -1.604$, $p = .109$). The distributions of differences between week 1 and week 6 for Acceptance, Appropriateness, Feasibility, Ease of participation, Pacing, and Behavioral Outcomes of 3T1 were not symmetrical, and Kendall's Coefficient of Concordance tests were used instead as its assumptions were met (same participants across time, use of a continuous variable, independent observations, and all items were completed without ties; Siebert & Siebert, 2017). Kendall's W tests showed no significant differences between weeks 1 through 6 for any measures. Only the data from the three interventionists who were present for all 6 sessions were analyzed (see Table 14 for Kendall's test results).

Table 14

Kendall's Coefficient of Concordance Tests of interventionist implementation measures

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Kendall's W statistic	Chi square	df	*p*	*n*
Acceptability	2.50	2.17	3.17	2.83	5.33	5.00	.631	9.47	5	.09	7
Appropriateness	2.33	3.00	3.00	2.67	5.00	5.00	.481	7.22	5	.21	7
Feasibility	3.17	3.17	1.83	3.83	3.83	5.17	.419	6.28	5	.28	7
Ease of participation	1.83	3.50	3.00	3.50	4.17	5.00	.400	6.60	5	.25	7
Pacing	3.00	3.17	4.00	3.33	4.00	3.50	.071	1.07	5	.96	7
Behavioral Outcomes	1.83	3.67	2.50	3.50	4.83	4.67	.421	6.31	5	.28	7

RQ5 - Psychosocial measures of diabetes management and family stress over the course of the intervention

I examined the psychosocial data for anomalous data, as determined by MADx3 values (Mellenbergh, 2019). While there were data that exceeded MADx3 values, all data were kept due to the participants rating this measure similarly between weeks, the narrow range of values in responding to Likert-type questions, and the absence of evidence that participants were misrepresenting their responses in any way. Triple MAD values were found for: Negative DOES (3 instances out of 25; 1 participant across 3 weeks), Positive DOES (2 instances out of 24; 2 participants across 2 weeks), Total DOES (8 instances out of 25; 3 participants across 4 non-consecutive weeks), PMCSMS (2 instances out of 25; 1 participant across 4 non-consecutive weeks), DDS (3 instances out of 27; 2 participants across 3 weeks), and finally, DSMQ-R (1 instance out of 27; 1 participant across 1 week).

Bivariate Pearson correlation coefficients were computed to identify associations between variable of interest for all participants (see Table 15). A few notable findings include that being diabetic was not significantly associated with any measures except glycated hemoglobin ($r(18) = .659$, $p = .002$), that as anticipated DSES was positively correlated with

DOES (r(23) = .800, $p < .001$) and negatively correlated with diabetes distress)r(14) = -.651, p = .006), that DOES was positively associated with both PMCSMS (r(23) = .797, $p < .001$), and DSMQ-R (r(14) = .784, $p < .001$) and was negatively associated with DDS (r(14) = -.674, p = .004), and that total DDS was negatively associated with DSMQ-R (r(25) = -.534, p = .004).

Table 15

Bivariate Pearson correlation matrix for participant psychosocial measures

Variable	*n*	1	2	3	4	5	6	7	8	9	10	11
1. T1D status	49	-										
2. DSES	25	-.20	-									
3. Neg DOES	25	-.06	.68‡	-								
4. Pos DOES	24	-.20	.43*	-.05	-							
5. DOES	25	-.14	.80†	.76†	.62†	-						
6. PMCSMS	25	-.29	.82†	.61†	.51*	.80†	-					
7. DDS	16	-.06	-.65†	-.29	-.69†	-.67†	-.61*	-				
8. DSMQ-R	16	-.09	.85‡	.51*	.60*	.78‡	.72†	-.53†	-			
9. Past month PedsQL	15	-.26	.90‡	.71†	.55*	.90‡	.87‡	-.72†	.77‡	-		
10. Past week PedsQL	13	-.22	.87‡	.69†	0.47	.83‡	.85‡	-.67*	.74†	.96‡	-	
11. HbA1c	16	.66†	.24	.35	-.05	.23	.25	-.44	.14	.31	.25	-

Note: Pearson values rounded up to the second decimal point.

T1D status = correlation with having T1D; DSES = Diabetes Self-Efficacy Scale; Neg DOES = Negative Diabetes Outcome Expectation Subscale; Pos DOES = Positive Diabetes Outcome Expectation Subscale; DOES = Diabetes Outcome Expectation Scale; PMCSMS = Perceived Medical Condition Self-Management Scale; DDS = Diabetes Distress Scale; DSMQ-R = Diabetes Self-Management Questionnaire-Revised; Past month PedsQL FIM = PedsQL Family Impact Measure related to experiences in the past month; Past week PedsQL FIM = PedsQL Family Impact Measure related to experiences in the past week; HbA1c = Glycated hemoglobin levels

‘*’ – Significant at the $p = .05$ level

‘†’ – Significant at the $p = .01$ level

‘‡’ – Significant at the $p = .001$ level

Due to missing data between weeks, as well as a small N, non-parametric tests were used. Most psychosocial measures met assumptions for criteria for Wilcoxon signed-rank tests as they had the same participants across time, used a continuous variable, and the distributions of the differences between weeks 1 and 6, weeks 6 and 12, and weeks 1 and 12 were roughly symmetric around the median. The exceptions that did not meet symmetry criteria were DSES T_0 vs. T_2, DOES T_0 vs. T_2, DDS T_1 vs. T_2, DSMQ T_1 vs. T_2, and Monthly Total PedsQL T_0 vs. T_2. Psychosocial measures did change somewhat over time (see Figures 8a-c for standardized means when psychosocial measures were administered).

Figure 8a

Participant standardized psychosocial measures by week #1

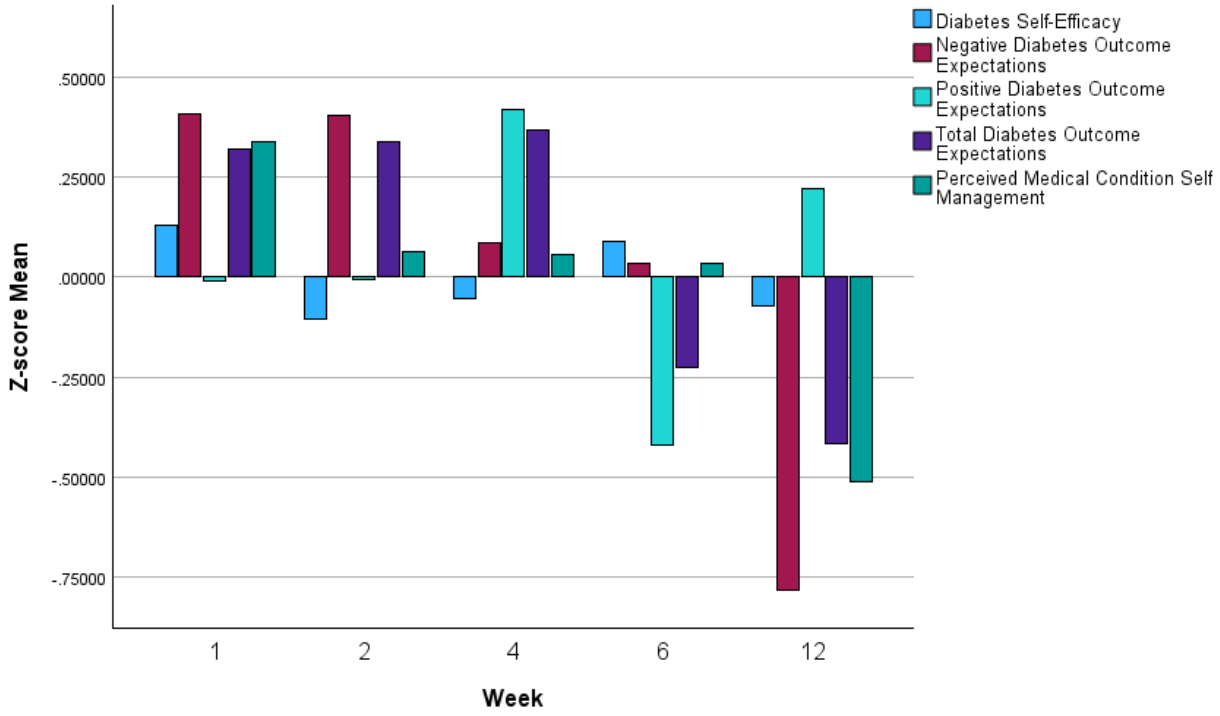


Figure 8b

Participant standardized psychosocial measures by week #2

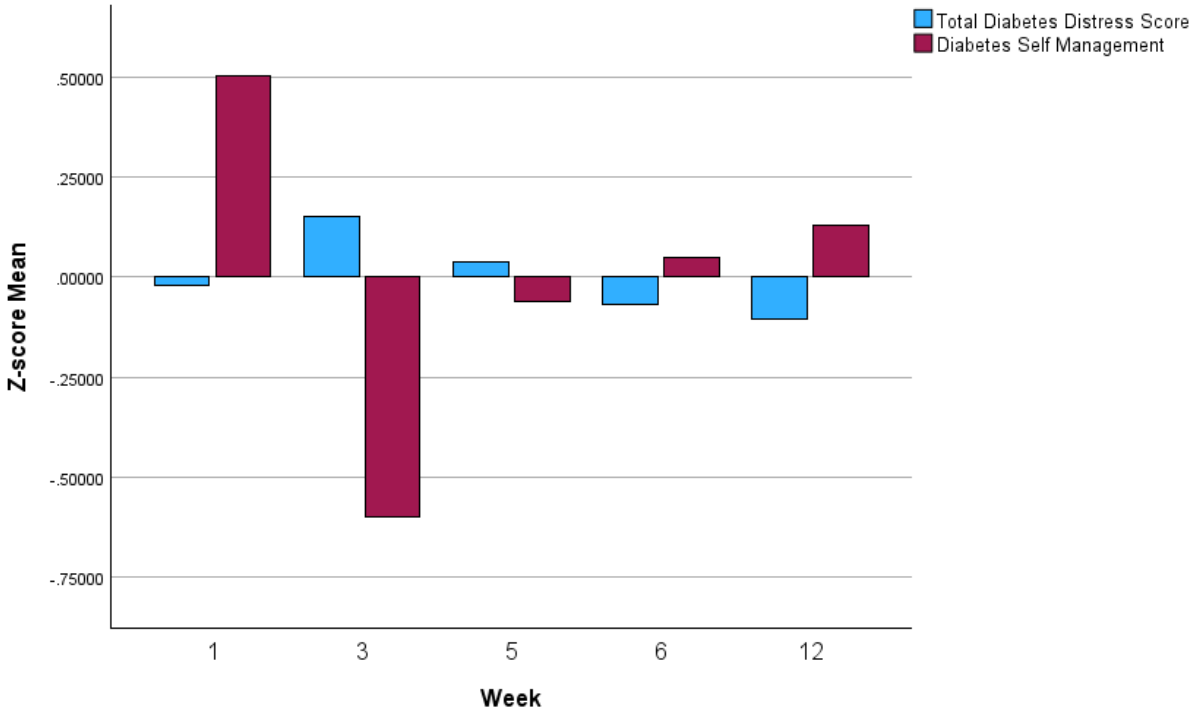
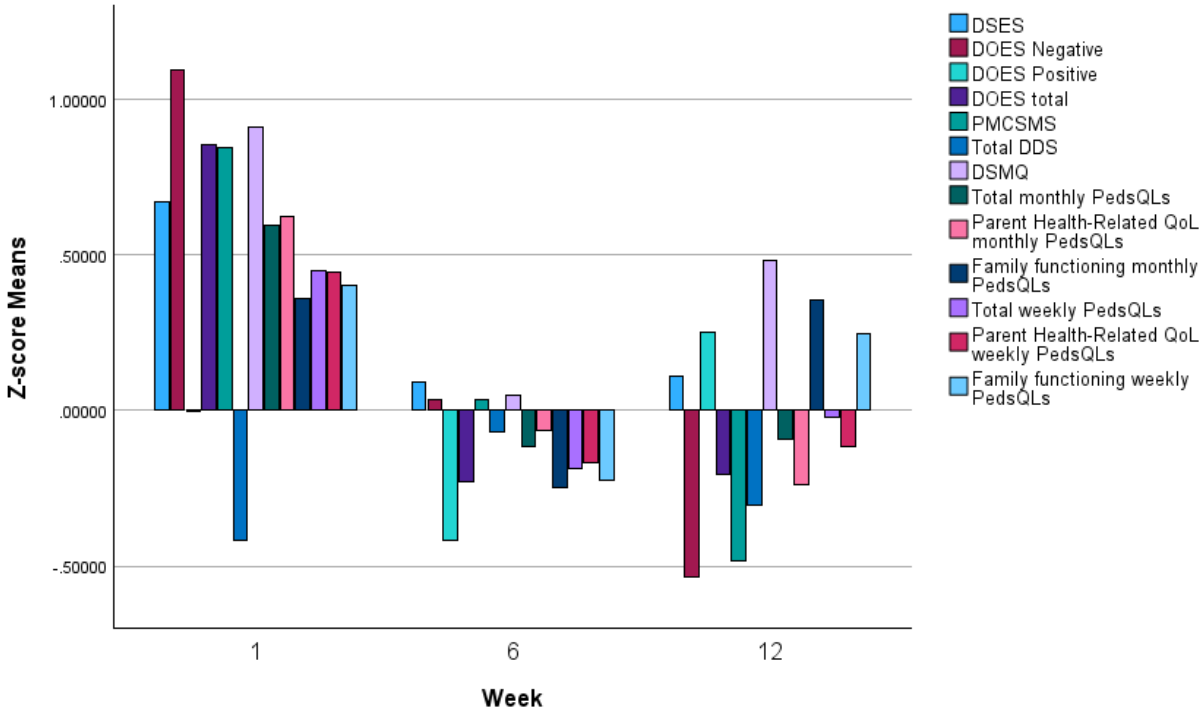


Figure 8c

Participant standardized psychosocial measures at start, end, and follow-up



Two-tailed Wilcoxon signed-rank tests showed no significant differences between any levels between weeks 1 and 6 of the intervention, weeks 6 and 12, or weeks 1 and 12 (see Table 16). The only significant ($p < .05$) results from the Wilcoxon tests were the drops in Perceived Medical Condition Self-Management from weeks 1 to 6, $Z = -2.032$, $p = .042$ and the total monthly Family Impact Module (PedsQL), $Z = -2.201$, $p = .028$, which respectively measure disease management self-efficacy and family functioning. Among measures that were not symmetrical, none were statistically different using a non-parametric paired sign test (See 16 for summaries of Wilcoxon tests).

Table 16

Two-tailed Wilcoxon signed-rank tests for participant psychosocial measures

	Week 1 vs Week 6 test-value	*p*	Week 6 vs Week 12 test-value	*p*	Week 1 vs Week 12 test-value	*p*
Diabetes Self-Efficacy	-.67	.50	-.73	.465	-	-
Neg. Diabetes Outcome Expectations	-.73	.465	-1.60	.109	-1.60	.109
Pos. Diabetes Outcome Expectations	-1.48	.138	-1.83	.068	-1.63	.102
Diabetes Outcome Expectations	-1.75	.08	-1.60	.109	-	-
PMCSMS	-2.03	.042*	-.45	.655	-1.63	.102
Total Diabetes Distress	-.74	.461	-	-	-1.07	.285
Diabetes Self-Management	-1.30	.194	-	-	-.45	.655
Total monthly PedsQL	-2.20	.028*	0.00	1	-	-
Monthly Health-Related QoL	-1.83	.068	0.00	1	-1.07	.285
Monthly Family Functioning PedsQL	-1.80	.072	-1.34	.18	-.54	.593

Total weekly PedsQL	-1.10	.273	-1.60	.109	-	-
Weekly Health-Related QoL	-1.10	.273	0.00	1	-	-
Weekly Family Functioning PedsQL	-1.46	.144	-1.60	.109	-	-

Note: Wilcoxon test values rounded to two decimal places. PMCSMS = Perceived Medical Condition Self-Management Scale. * – Indicates significance at the $p = .05$ level.

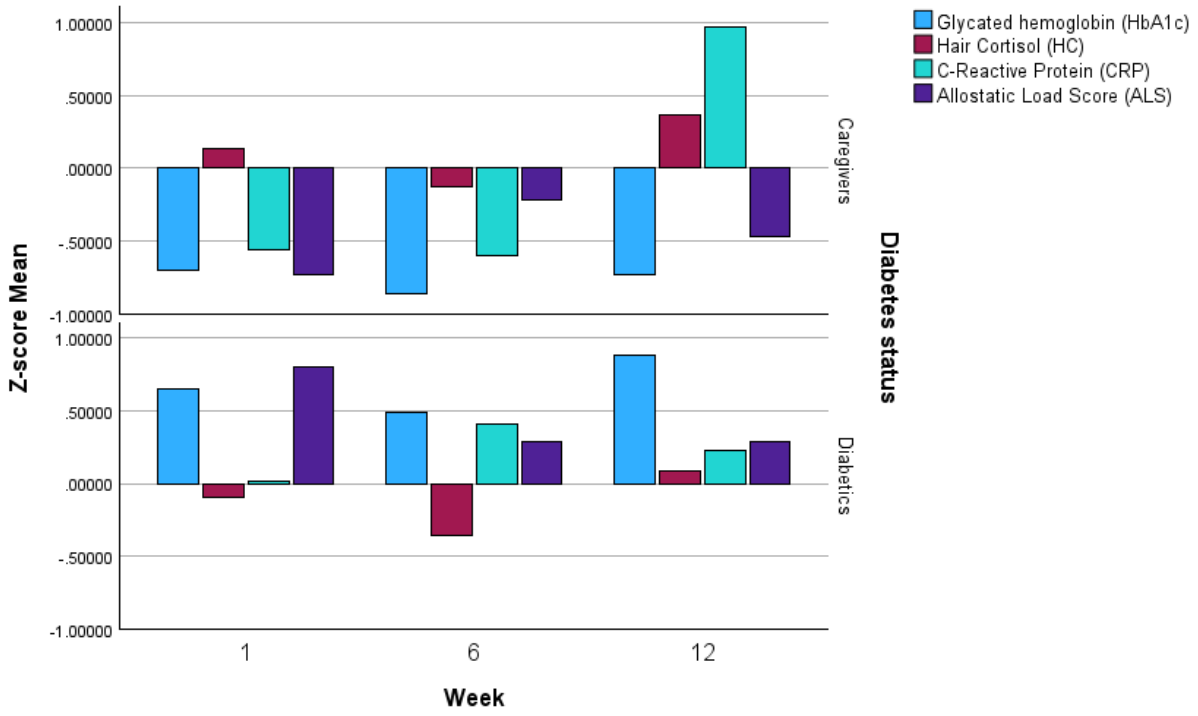
RQ6 – Biological measures change over the course of the intervention

Among the 4 diabetic participants, there was significant variation in HbA1c values as one participant who endorsed extreme focus on BG in her daily life had an HbA1c of 4.70 at week 1 compared with the highest value among diabetics of 8.00. The participant with an initial value of 4.70 saw an increase in HbA1c over the 12 weeks between session 1 and the follow up (up to 6.00 at week 6 and 5.70 at the follow up), aligning with her stated goals of increasing her HbA1c to reflect a reduced focus of glycemic control in her life. This case is notable because most measures and understandings of HbA1c in healthcare literature reference lower HbA1c as the principal goal for people with T1D.

All data were kept because biomarker levels vary broadly between individuals, although outlier values were noted and may have skewed the data somewhat. Of note: Hair cortisol levels had four instances with triple MAD values (2 participants, one caregiver and one diabetic, with a high of 15.15pg/mg). Additionally, CRP levels had three instances with triple MAD values (3 participants, one caregiver and two diabetics, with a high of 3.46mg/L). One diabetic participant had non-detectable levels of CRP in her sample in weeks 1 and 6 and her data was rounded up to .001mg/L by the laboratory analyzing her blood spots. See Figure 9 for standardized mean values of HbA1c, cortisol, CRP, and ALS by diabetes status.

Figure 9

All participant standardized HbA1c, Cortisol, CRP, and ALS by week by diabetes status



Due to the small sample size (n = 7) and non-normal distributions of residuals, it was not appropriate to run parametric tests (e.g., t-tests) to determine differences in biomarkers over time, so non-parametric tests were used. The HbA1c data met assumptions for a Wilcoxon signed-rank test as they have the same participants across time, use a continuous variable, and the distributions of the differences between weeks 1 and 6 and weeks 6 and 12 are roughly symmetric around the median, with one outlier elevated outlier in week 1. Two-tailed Wilcoxon signed-rank tests showed no significant differences between HbA1c levels between week 1 and week 6 of the intervention (Z = -.399, p = .735) or week 6 and week 12 (Z = -.509, p = .611). The distribution of differences between week 1 and week 12 was not symmetrical and a paired-samples sign test was used instead as its assumptions were met (same participants across time, use of a continuous variable, independent observations, and difference scores were from a

continuous distribution). A two-tailed paired-samples sign test showed no significant differences between HbA1c levels between week 1 and week 12 (p = 1.000).

Participants with T1D have HbA1c values that are typically more elevated than non-diabetics (except in very rare cases, as noted in the outlier case above) and are more variable than non-diabetics. To evaluate whether the intervention was associated with changes in this subgroup, a separate analysis was conducted on diabetics alone (n = 4). Residuals of HbA1c values remained non-normal and the small sample made them inappropriate for parametric tests, however HbA1c data in this sample were roughly symmetric around the median for each collection timepoint. Two-tailed Wilcoxon signed-rank tests showed no significant differences between HbA1c levels between week 1 and week 6 of the intervention (Z = -.365, p = .715), week 6 and week 12 (Z = -.552, p = .581), or week 1 and week 12 of the intervention (Z = -.365, p = .715).

Regarding the stress hormone cortisol, it was extracted from hair taken at week 1 of the intervention, week 6, and week 12 (follow up). Cortisol analyses are generally run on larger populations rather than the 6 who opted into the cortisol assay. The cortisol data met assumptions for a Wilcoxon signed-rank test as they have the same participants across time (n=6), use a continuous variable, and the distributions of the differences between weeks 1 and 6, weeks 1 and 12, and weeks 6 and 12 are roughly symmetric around the median. Cortisol levels were not significantly different between weeks 1 and 6 (Z = -1.363, p = .173), weeks 6 and 12 (Z = -1.782, p = .075), or weeks 1 and 12 (Z = -1.897, p = .058). With diabetic participants only (n=4), the cortisol data met assumptions for a Wilcoxon signed-rank test as they have the same participants across time, use a continuous variable, and the distributions of the differences between weeks 1 and 6, weeks 1 and 12, and weeks 6 and 12. There were likewise no significant differences

among diabetic participants between weeks 1 and 6 (Z = -1.069, p = .285), weeks 6 and 12 (Z = -1.604, p = .109), or weeks 1 and 12 (Z = -1.069, p = .285).

C-reactive protein levels were analyzed from dried blood spots taken at week 1 of the intervention, week 6, and follow-up at week 12. The cortisol data met assumptions for a Wilcoxon signed-rank test as they have the same participants across time (n=7), use a continuous variable, and the distributions of the differences between weeks 1 and 6, weeks 1 and 12, and weeks 6 and 12 are roughly symmetric around the median. CRP levels were not significantly higher in week 6 than week 1 (Z = -1.153, p =.249), week 12 than week 6 (Z = -1.183, p = 0.237), or week 12 than week 1 (Z = -1.690, p = 0.091).

With diabetic participants only (n=4), the cortisol data met assumptions for a Wilcoxon signed-rank test as they have the same participants across time, use a continuous variable, and the distributions of the differences between weeks 1 and 6, weeks 1 and 12, and weeks 6 and 12. There were no significant differences on the Wilcoxon test between week 6 and week 1 (Z = -1.604, p =.109), week 12 and week 6 (Z = 0.00, p = 1.000), or week 12 and week 1 (Z = -.730, p = 0.465).

Composite allostatic load scores (ALS) were calculated for each participant at each timepoint with biomarker values exceeding critical values being scored 1 and sub-critical values scored 0 for a possible total of 8 points. Biomarkers used were systolic blood pressure, diastolic blood pressure, heart rate, HDL, triglycerides, total cholesterol, HbA1c, and CRP. The ALS data met assumptions for a Wilcoxon signed-rank test as they have the same participants across time (n=7), use a continuous variable, and the distributions of the differences between weeks 1 and 6, weeks 1 and 12, and weeks 6 and 12 are roughly symmetric around the median. ALS values were not significantly higher in week 6 than week 1 (Z = 0.00, p = 1.00), week 12 than week 6 (Z = -

1.134, $p = 0.257$), or week 12 than week 1 ($Z = -338$, $p = 0.408$). See Table 17 below for biomarker Wilcoxon test results. Given that it was a component of ALS, it was expected that HbA1c had a significant Pearson correlation with ALS, $r(19) = .449$, $p = .041$, while being diabetic was almost significantly correlated with ALS, $r(19) = .420$, $p = .058$.

Table 17

Two-tailed Wilcoxon signed-rank tests for participant biomarkers

	Week 1 Compared to Week 6 test-value	*p*	Week 6 Compared to Week 12 test-value	*p*	Week 1 Compared to Week 12 test-value	*p*
HbA1c	-.399	.735	-.509	.611	-	-
Hair cortisol	-1.363	.173	-1.782	.075	-1.897	.058
CRP	-1.153	.249	-1.183	.237	-1.690	.091
Composite ALS	0.00	1.00	-1.134	.257	-.828	.408

Note: HbA1c = Glycated hemoglobin; CRP = C-reactive protein; ALS = Allostatic load score; T1D = Type 1 diabetic

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