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Original Research

Improving Diabetes Outcomes with a Multimodal Intervention for Less Advantaged Adults with Type 2 Diabetes

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Abstract

If proper self-management behaviors are not maintained, diabetes may lead to reduced quality of life (QoL), decreased engagement in everyday activities, disabling health complications, and even death. Less advantaged adults with limited income, lower education, and fewer resources find diabetes self-management (DSM) particularly challenging due to

healthcare and social inequalities. DSM education is important to understanding diabetes-related behaviors and improving QoL. There are few evidence informed DSM education programs directed specifically at less advantaged adults. The purpose of this study was to develop and test feasibility and preliminary efficacy of a novel virtual intervention that merged prior evidence-informed yoga, occupational therapy, and nutrition education (MY-OT-ED) practices. Five participants were recruited throughout communities near the research university for a nine-week DSM education program that was held twice a week. DSM-related health and QoL measures were tested at baseline, immediately after MY-OT-ED, and six to eight weeks following the intervention. Primary outcomes studied included QoL, DSM, diabetes distress, and diabetes self-efficacy. Percent change was calculated to assess if any significant DSM-related changes occurred. Positive changes were found in all outcomes following the nine-week intervention and were maintained at follow-up. While limitations of the study were noted, results provide preliminary evidence that MY-OT-ED was feasible, acceptable, and has the potential to improve diabetic outcomes for less advantaged adults.

Keywords
Type 2 diabetes; yoga; occupational therapy; nutrition education; multimodal interventions; diabetes self-management; quality of life; diabetes distress; diabetes self-efficacy

1. Introduction

Recent forecasting predicts the worldwide number of people living with diabetes could increase 10% in the next decade, unless culturally relevant national prevention and intervention programs are created [1]. As a chronic metabolic disorder, type 2 diabetes mellitus (T2DM) may lead to: reduced quality of life (QoL) [2]; reduced engagement in social and community activities [3]; and disabling and costly complications [4, 5]. Although diabetes education aims to empower people to direct the management of their condition to prevent or decrease complications [6-8], only one-third to one-half of people receiving diabetes education were fully adherent with their health professional's recommendations [9].

Low adherence to diabetes self-management (DSM) can in part be attributed to several psychosocial factors (e.g., social environment and care provider-patient relationships) [10]. As well, people with T2DM report diabetes management can interfere with other daily responsibilities and roles [3], often described as burdensome [11]. Attempts to balance DSM with preferred activities [12], and incorporate DSM into daily routines can negatively impact QoL [2].

Unfortunately, adults with limited income, lower education, and fewer resources find DSM particularly challenging, partially related to health care and social inequities [13]. Additionally, few education opportunities exist for less advantaged adults with diabetes [14, 15]. This is troubling as these same demographic variables, along with being from a minority racial or ethnic background, are associated with greater risk for diabetes [16], increased complications after diagnosis [17], and higher mortality rates [18]. Therefore, there is considerable need to develop DSM education programs targeting less advantaged adults with T2DM.

The aim of this pilot study was to examine feasibility of a multimodal approach to educating less advantaged adults with diabetes to integrate DSM into their daily lives. Based on the medical standards of diabetes care, which recommends integration of both physical activity and education into one's lifestyle [6], we merged physical activity (yoga), and habit and lifestyle management (occupational therapy – OT) and nutrition education, into one intervention: **M**erging **Y**oga, **O**ccupational **T**herapy, and nutrition **ED**ucation (MY-OT-ED).

1.1 Merging Essential Aspects of Diabetes Management

The American Diabetes Association (ADA) recommends physical activity be integrated into one's lifestyle [6]. Yoga, a form of physical activity, improves blood glucose levels, and reduces common risk factors associated with complications from T2DM [19-21]. Yoga, compared to standard exercise, is believed to address physical and cognitive factors related to poor DSM [21], as well as emotional factors [22]. Other single arm studies examining yoga's impact on adults with diabetes have shown improvements in everyday activities, self-efficacy [23], and QoL [24-26]. However, participants in recent yoga studies expressed the need for additional education and social support to learn to integrate DSM behaviors into daily routines [23, 25]. This suggests yoga alone is not sufficient to change DSM, as self-management is comprised of a complex set of behaviors that varies greatly between individuals [27].

Occupational therapists, health professionals qualified to work with people with diabetes [11, 28], can play an important role in helping people living with chronic conditions, to develop habits and routines, that promote a healthy lifestyle and address QoL [29]. Developing and modifying habits can help people with chronic conditions sustain behavioral changes beyond the intervention period [30]. There is a unique role for OT to enable individuals with diabetes to integrate DSM into their daily routines and habits [11, 31, 32].

In particular, the integration of meal planning and healthy eating into lifestyle changes is essential for management of diabetes [33]. While there is not a one-size-fits-all approach, for example, portion control, combining macronutrients, and tools to support meal planning are essential aspects to healthy eating. One successful nutrition education program available to less advantaged families is the Expanded Food and Nutrition Education Program (EFNEP). This federally funded nutrition education program targets families to influence nutrition and physical activity behaviors but is not specific to T2DM. In 2020, 91% of Colorado EFNEP participants reported improved diet quality practices and 80% reported improving their level of physical activity [34].

Currently there are no proven group interventions that prioritize integration of DSM into daily activities and routines while simultaneously including guided physical activity and nutrition education. Our preliminary work includes yoga studies with people with diabetes [23, 25], occupation-focused DSM influenced by best practices [32], and research related to merging yoga and occupational therapy [35, 36]. Thus, the purpose of this study was to develop and test the feasibility and benefits of a novel multi-modal intervention, the **M**erging **Y**oga, **O**ccupational **T**herapy, and nutrition **ED**ucation (MY-OT-ED) intervention. As a result, our two research questions were: 1) is MY-OT-ED feasible, and 2) does MY-OT-ED improve QoL and DSM among an underserved population of less advantaged adults with T2DM?

2. Materials and Methods

2.1 Design

The non-control feasibility and longitudinal pilot study of MY-OT-ED included multiple assessments completed before and after the intervention, as well as 6 to 8 weeks post intervention. All aspects of MY-OT-ED were delivered via a secure virtual format due to COVID-19 restrictions. All procedures were approved by the institutional review board.

2.2 Participants

Recruitment included online and print media, E-mail, and distribution of flyers to local laundromats, support groups, community centers, food pantries, and health centers. Inclusion criteria included: a) being an adult with type 2 diabetes; b) currently receiving or qualifying for federal food assistance; c) being able to speak, read, and understand English; and d) having a child or grandchild ≤18 years in the home (secondary to EFNEP federal programming regulations). All participants consented and received $25 for each assessment completed (up to $75.00).

2.3 Outcome Measures

Participants completed assessments online, with assistance as needed provided by trained research assistants. Demographic and diabetes characteristics were collected at baseline. Feasibility benchmarks were set a priori, based on our prior studies [35, 36], and included: recruitment; safety; attendance; and participants' ability to complete the intervention. MY-OT-ED was considered feasible if: 30% of screened participants consented, ≤1 participant experienced a serious adverse event, all participants attended ≥ 50% of sessions, and 80% of participants completed the intervention. Following completion of MY-OT-ED, participants completed nine satisfaction questions on a Likert scale of 1 (very dissatisfied) -7 (very satisfied).

All outcome measures were assessed before (T1), after the nine-week intervention (T2), and 6-8 weeks later (T3). We assessed four primary outcomes: QoL, diabetes self-management, diabetes distress, and diabetes self-efficacy.

We assessed QoL using the World Health Organization Quality of Life Brief (WHOQOL-BREF). The WHOQOL-BREF contains 26 items that measure QoL in four domains: physical health, psychological health, social relationships, and environment [37]. The WHOQOL-BREF is a valid and reliable measure for T2DM [38] and higher scores indicate greater QoL, with a possible score of 100 after raw score transformation.

We assessed diabetes self-management using the Diabetes Self-Management Questionnaire (DSMQ) which contains 16 items, including four self-management subscales: glucose management, dietary control, physical activity, and health care usage [39]. The DSMQ is considered a valid and reliable measure [40]. Transformed scores range from 0 to 10; higher scores indicate more suitable self-management behaviors.

We assessed diabetes distress using the Diabetes Distress Scale (DDS) which includes 17-items and produces an overall distress measure and four subscale scores: emotional, physician-related, regimen-related, and interpersonal distress [41]. A mean score of 3 or more in any subscale indicates "moderate distress" and a need for clinical care [42]. Higher DDS scores are associated

with poorer quality of self-care behaviors, elevated blood lipid levels, and depressive affect (r>0.33) [41].

Last we assessed diabetes self-efficacy with the Stanford Diabetes Self-Efficacy Scale (Stanford-DSES) which consists of 8 items with an overall score indicating self-efficacy or confidence in being able to complete DSM activities [43]. The DSES measure is sensitive to note DSE related changes among adults with T2DM [44]. Higher scores indicate higher levels of self-efficacy [45].

2.4 Intervention

We developed MY-OT-ED as a standardized group intervention that merged an evidence-based nutrition education class (EFNEP) [45], group occupational therapy, and elements of our prior yoga for with this population [23-26] (Table 1). Materials and incentives (e.g., glucose monitoring supplies, food to try diabetic recipes, and yoga materials) were delivered to participant homes. Additionally, we loaned technology resources (e.g., tablets and Wi-Fi hot spots) to participants as needed. MY-OT-ED occurred twice weekly for 9 weeks. The majority of content was delivered synchronously, where the leaders and participants engaged with each other on-line at the same time. For each week, the first session focused on nutrition and the second session addressed OT and yoga.

Table 1 MY-OT-ED session topics organized by week.

Week	Nutrition Education	Occupational Therapy	Yoga
1	Welcome to Eating Smart Being Active • Program and staff introduction • Knife safety and skills review	Introduction to Diabetes & Understanding Activity, Health and My Life • Program and staff introduction • Recognizing and being aware of Diabetes as first step in change	• Centering • Joint free series • Spinal movements • Side chair twists/warrior one • Forward Fold • Modified sun salutation • Triangle series • Head & neck movements • Pranayama (controlled breathing) • Meditation • Final Relaxation *All poses practiced seated
2	Get Moving! • Balance food intake with activity • Physical activity intensity & frequency	Live Active • Benefits of an active lifestyle • Problem-solving for changing daily life	Same Week 1 yoga elements

	• Reduce screen & seated time	• Goal and habit plan development	
3	Plan, Shop, $ave • Planning meals & snacks • Unit pricing • Reading nutrition facts labels	Be Aware of You & Your Diabetes • Habit plan checklists • Recognizing high and low blood sugar; complications of unsafe blood sugar levels	Same Week 1 yoga elements
4	Fruits & Veggies: Half Your Plate • Saving money on produce • Vitamins & minerals in produce • Why fruits & vegetables are important	Use MyPlate for Diabetes • MyPlate for Diabetes • Goal and habit plan development	Same Week 1 yoga elements
5	Make Half Your Grains Whole • Whole vs. refined grains • Identifying whole grain foods	Adjust Eating at Home: Part 1 • Planning meals with available foods • Goal and habit plan development	Same Week 1 yoga elements + Hamstring Strap Series
6	Go Lean with Protein • Animal vs. plant proteins • Choosing lean sources of protein • Recommended daily servings • Protein food safety guidelines	Adjust Eating at Home: Part 2 • Habit Plan check-in • Recipe adaptations • Communication strategies	Same Week 5 yoga elements + Dynamic Arm Movements
7	Build Strong Bones • Importance of calcium • Dairy food safety guidelines	Care for You and Your Diabetes • Diabetes' effect on energy, mood & stress • Meaningful activities for restoration	Same Week 6 yoga elements + standing poses: • Lateral Flexion • Modified Sun Salutation • Tree Pose

8	Make a Change • Comparing types of fats and making healthy choices • Identifying and reducing fat, salt, and sugar in diet	Plan for Eating Away from Home • Strategies for making healthy choices when away from home • Advocacy & communication skills	Same Week 7 yoga elements
9	Review • Review lessons 1-8 • Mindful eating • Sharing food tasks	Celebrating • Celebrate & plan for the future	Same Week 7 yoga elements

The nutrition program included: online video sessions viewed prior to the weekly synchronous discussions led by the trained EFNEP peer educator. The 30 to 45-minute discussion sessions included topics such as diet quality, physical activity, food resource management, food safety, and food security [45].

OT and yoga were both 50-minute sessions. Group OT, delivered by a licensed occupational therapist, included information on diabetes, its impact on everyday life, and the development of habits and routines to support engagement in DSM while enjoying daily life. We designed sessions following best practice guidelines for the role of occupational therapy in DSM interventions [11, 32] and unpublished descriptive data collected during a pilot study designed to develop 1-to-1 occupation focused DSM education for people with T2DM.

Yoga sessions were delivered by a certified yoga therapist and modified for the T2DM population [23]. Yoga sessions included modified physical postures, breathwork, hand mudras, and meditation. To ensure participant safety, we visually monitored participants and didn't include floor postures. Verbal and visual cues reminded participants to take breaks, focus on breathing and follow individualized accommodations for physical limitations. Each week, participants monitored blood glucose levels before and after yoga.

2.5 Data Analysis

Data were analyzed using the Statistical Package for the Social Science 26 [46]. Descriptive statistics were conducted to report demographics, diabetes characteristics, and feasibility data. Due to the small sample size, we calculated percent change for each outcome measure between baseline (T1) and post (T2) assessments (T1-T2/T1x100), and between post (T2) and six to eight week follow-up (T3) (T2-T3/T2x100).

3. Results

3.1 Participants

The mean age of the five MY-OT-ED participants was 52.8±10.6 years old. Three participants were female individuals; two male individuals. All participants reported being disabled or not working and received either Medicaid or Medicare insurance. See Table 2 for a synthesis of additional demographic and diabetes related information.

Table 2 Demographic information of MY-OT-ED participants.

Demographic Measures	**n = 5**
Time Since T2DM Diagnosis	
< 1 year	1 (20%)
1-4 years	2 (40%)
4+ years	2 (40%)
Marital Status	
Partnered	3 (60%)
Divorced	2 (40%)
Ethnicity	
Hispanic/Latinx	2 (40%)
Non-Hispanic/Latinx	3 (60%)
Education	
Completed some school	1 (20%)
High School/GED	1 (20%)
Some College	1 (20%)
Graduated College	2 (40%)
Family History of Diabetes	
Family History	5 (100%)
Secondary Diabetic Complications	
Pain	5 (100%)
Chronic Fatigue	4 (80%)
Numbness	3 (60%)
Visual Changes	3 (60%)
Mood Changes	3 (60%)
Monthly Household Income	
≤$1,000	3 (60%)
$1,100 - 3,000	2 (40%)

3.2 Feasibility

Regarding recruitment, 16 of 22 people screened were eligible (73%), and 5 agreed to participate (31% of eligible). Reasons for ineligibility included: pregnancy, no children in the home, or not having a diagnosis of T2DM. Reasons eligible individuals didn't participate included: stress (e.g., children completing school at home, busy schedules, family illness, or lack of childcare), having a daytime job, or not comfortable with or wanting to participate in the online format. Related to safety, no adverse events were reported. Participants attended 78-83% (7-7.5 sessions) of the nutrition education, occupational therapy, and yoga sessions. Reasons for missing MY-OT-ED sessions included pain, illness, home invasion/property theft, scheduled medical appointments, parenting responsibilities, and internet connectivity issues. All participants completed the intervention; there was no attrition. All five participants agreed or strongly agreed that they were satisfied with all aspects of the intervention. In addition, all participants were "very satisfied" with instructors' knowledge and the intervention's ability to improve their daily lives. All participants were either

"satisfied" or "very satisfied" with the instructors' abilities to facilitate the weekly sessions. Two participants (40%) reported the nutrition and cooking knowledge gained from the intervention were helpful; two participants (40%) also indicated the focus on exercise habits, walking, and yoga were helpful. Three participants (60%) indicated that learning from other participants or staff was the most helpful aspect of the intervention.

3.3 Outcomes Measures

Overall, outcome measures improved after the MY-OT-ED intervention (see Table 3 and Figures 1-3). All WHOQOL-BREF domains showed improvement. DSMQ Glucose Monitoring and Physical Behavior scores increased while Dietary Control scores decreased (3%). DSMQ Healthcare Utilization scores decreased (49%), as one participant decreased emergency room visits. Additionally, Diabetes Self-Efficacy scores positively increased, and Diabetes Distress Scale scores decreased in all subscales, with the exception of Physician Distress.

Table 3 Change in outcome measure scores over time.

Outcome Measures (range: low – high)	**T1 Mean (SD) n=5**	**T2 Mean (SD) n=5**	**% Change T1 – T2**	**T3 Mean (SD) n=4**	**% Change T2 – T3**
WHOQOL-Physical (0 – 100)	20.2 (9.9)	61.2 (7.1)	↑203%	64.3 (15.4)	↑5.1%
WHOQOL-BREF Psychological (0 – 100)	21.4 (5.4)	62.6 (13.9)	↑193%	70.3 (13.8)	↑12.3%
WHOQOL-BREF Social (0 – 100)	51.4 (20.5)	70.0 (12.0)	↑36%	75.0 (21.0)	↑7.1%
WHOQOL-BREF Environmental (0 – 100)	22.6 (6.8)	80.0 (5.4)	↑254%	78.5 (11.0)	↓1.9%
DSMQ Glucose Management (0-10)	6.67 (1.2)	6.93 (2.0)	↑4%	5.7 (2.9)	↓17.7%
DSMQ Dietary Control (0-10)	6.17 (2.3)	6.0 (2.6)	↓3%	7.1 (2.2)	↑18.3%
DSMQ Physical Activity (0-10)	3.21 (3.1)	4.89 (1.5)	↑52%	4.2 (2.5)	↓14.1%
DSMQ Healthcare Usage (0-10)	7.41 (1.5)	3.78 (1.7)	↓49%	5.6 (2.5)	↑48.1%
Diabetes Self-Efficacy Mean (0-10)	6.25 (.96)	8.38 (1.4)	↑34%	8.5 (1.1)	↑1.4%
Diabetes Distress Survey Overall (1-6) $\geq$ 3 = mod distress	3.07 (.39)	1.56 (.38)	↓49%	1.5(.4)	↓3.8%
Diabetes Distress Survey Emotional Burden (1-6) $\geq$ 3 = mod distress	3.20 (.68)	1.48 (.30)	↓54%	1.5 (.5)	No Change
Diabetes Distress Survey Regimen Distress (1-6) $\geq$ 3 = mod distress	3.80 (1.0)	1.92 (.63)	↓49%	1.6 (.5)	↓16.6%
Diabetes Distress Survey Interpersonal Distress (1-6), $\geq$ 3 = mod distress	2.67 (1.0)	1.0 (0)	↓63%	1.0 (0)	No Change
Diabetes Distress Survey Physician Distress (1-6) $\geq$ 3 = mod distress	2.30 (1.1)	1.65 (1.1)	↓28%	1.7 (.9)	↑3.0%

WHOQOL-BREF=World Health Organization's Quality of Life, Field Trial Version
DSMQ=Diabetes Self-Management Questionnaire

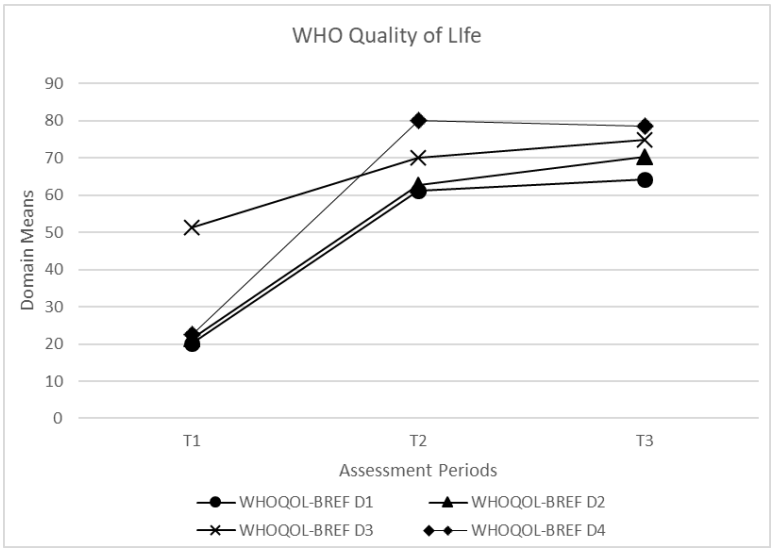

Figure 1 Change in mean scores in QoL over time.

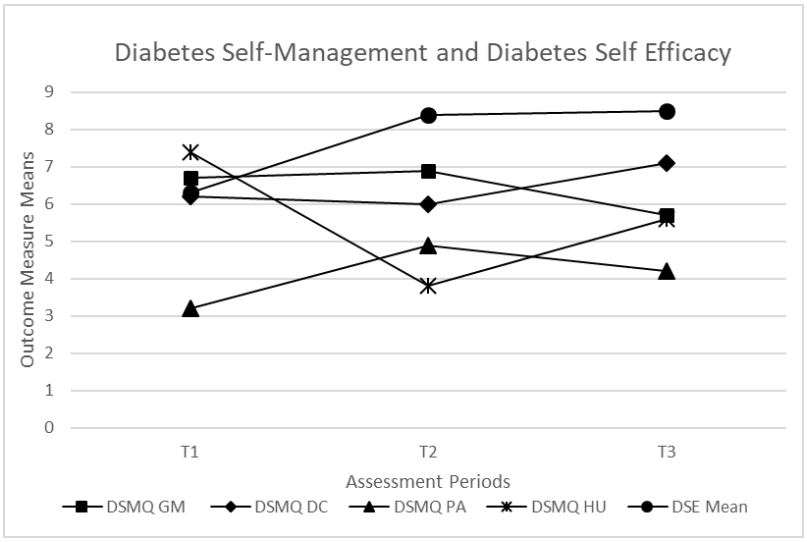

Figure 2 Change in mean scores in DSM and DSE over time.

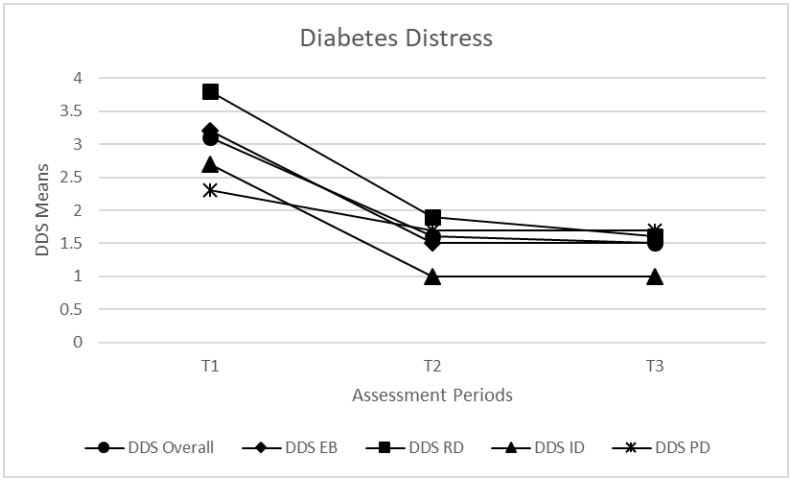

Figure 3 Change in mean scores in DDS over time.

Four of five participants completed the T3 follow-up assessments. The majority of follow-up (T3) scores either stayed the same or improved when compared to T2 scores, indicating the initial gains made following the nine-week intervention were sustained. Within the DSMQ, glucose management improved, and health care utilization increased.

4. Discussion

Results from this feasibility and longitudinal pilot study provide initial evidence that the nine-week multimodal virtual group MY-OT-ED intervention was feasible, acceptable, and potentially beneficial. Our results add to the current evidence that offering group interventions directed at less advantaged adults to develop or establish DSM behaviors can improve their well-being [32]. However, continued development and additional research are required.

4.1 Feasibility

The initial examination of feasibility and acceptability of the MY-OT-ED highlighted some important findings as well as areas for continued study. The synchronous virtual intervention was potentially successful and safe to deliver, likely due to blood glucose monitoring before and after yoga, along with modification of yoga postures. However, it was not efficient to merge materials from the general nutrition education program (EFNEP) directly into MY-OT-ED for diabetes. For example, EFNEP education highlights 'MyPlate', the nutrition guide published by the USDA as a central educational tool taught for healthy eating among healthy individuals [45]. In the OT group intervention, the leader employed the 'Plate Method' for diabetes [47, 48] as a central tool to support healthy eating, shopping, and meal planning. In retrospect, use of the Plate Method for Diabetes in the EFNEP education would have simplified learning, reduced confusion, and provided additional time for the integration of the 'Plate Method' as an important tool to help manage blood glucose. Although MY-OT-ED appears feasible, sessions were frequently shortened due to technology and video conferencing access issues. Simplification of the multimodal intervention may address some of these issues, and improve the explicit connections between nutrition education, OT, and yoga. Due to participants feedback that MY-OT-ED needed to be longer, the length and number of sessions requires additional study.

The challenge to recruit more participants for the virtual intervention may be related to the timing of the study during the COVID-19 pandemic. Eligible individuals who choose not to participate expressed they were experiencing many changes and increased stress due to COVID-19 (e.g., children suddenly at home, COVID-related deaths, and limited resources). For future testing of similar multimodal interventions, we recommend removing the EFNP inclusion criteria of having children living in the home, likely allowing more people to participate in and benefit.

Participation in MY-OT-ED exceeded benchmarks established for attendance, and session completion rates. Free and at-home participation may have supported feasibility and accessibility. Perhaps isolation related to COVID-19 quarantines enhanced attendance as participants sought a venue for social interactions. Additionally, participants received multiple weekly reminders and 1:1 virtual technology support. These supports were provided to address commonly expressed concerns and challenges with the use of technology in telehealth services [49]. We recommend continued exploration of ways to use more user-friendly technology and address the instability of internet connections, particularly in rural areas. Development of virtual programming employing

technology that participants already use daily, such as social media platforms, may be more effective.

More than two-thirds of MY-OT-ED was offered synchronously, which is a less frequently described approach to online delivered DSM education [50]. The results of this study aid in understanding how less advantaged adults felt about a synchronous online format for DSM education. While caution must be taken due to the small sample size, participants' satisfaction with synchronous programming suggests the importance of continued research in this area. Although the virtual delivery resulted in some limitations (i.e., not being able to engage in food preparation during in person EFNEP's interventions), the participants' high satisfaction with being able to learn from others suggests the synchronous sessions supported participants' ability to connect with each other in a supportive environment. Although results were not compared to a control group due to COVID-19 related changes, we recommend a randomized control trial (RCT) trial in order to compare delivery methods, including in-person, virtual, and or combination of in-person and online.

Online yoga for diabetes was feasible and supported accessibility for our participants who may not have had access to formal yoga classes (e.g., time constraints, high cost, lack of inclusion for minority populations). Social and cultural norms around yoga do not always include culturally diverse samples or individuals with disabilities [51]. Therefore, virtual yoga allowed participants to do yoga at home with equipment found around the house and provided through the study. Many MY-OT-ED participants chose incorporating yoga into their daily routines as goals during weeks five through eight. Two participants reported doing some of the yoga postures every day by the end of the study.

4.2 Outcome Measures

The results of this study report notable findings related to self-reported improvements in QoL and diabetes self-efficacy and decreases in diabetes distress immediately following completion of MY-OT-ED. While changes reported on the DSMQ were smaller, participants did report a 52% increase in physical activity behaviors. This may be related to provision of yoga resources in their home, opportunity to engage in weekly virtual yoga, and or 4 out of 5 participants intentionally working on integrating yoga into a habit. The lack of more notable changes in DSM maybe because moving new behaviors into habits requires additional time and practice [30].

Additionally, all five participants reported on the satisfaction survey that participation in MY-OT-ED positively influenced and changed their lives. Although we do not know what led to the changes in scores, the work by Jiang and colleagues [52] found that self-efficacy was the strongest predictor of DSM and also had a mediating role in the connection between diabetes distress and DSM. We believe that the merging of several interventions providing knowledge, guided physical activity, and opportunities to practice new behaviors with discussion of how to move behaviors into habits may be a critical feature. Several of these aspects are strongly supported by social cognitive theory [53] and are recommended in the national standards for DSM [54].

Due to the ongoing need for DSM education and the challenge of integrating DSM into daily life, development of multimodal interventions that aim to enhance and sustain self-efficacy among less advantaged adults with T2DM remains critical. Current national standards for DSM education do not provide recommendations for length of programs [54], but all participants in this study recommended additional sessions or weeks of the intervention to allow time to integrate the

knowledge and skills into everyday life. Perhaps future multimodal interventions should also include breaks or booster sessions to promote connection with participants. Continued research is needed to determine the important dosage of multimodal DSM education.

Participants who completed the follow-up assessments (T3; n=4) demonstrated the gains in QoL and diabetes self-efficacy and a reduction in distress were generally maintained six to eight weeks after completion of MY-OT-ED. DSMQ Dietary Control behaviors continued to improve over this time, which is encouraging given the fact the study timeline spanned COVID and year-end holidays. On the other hand, DSMQ Physical Activity behaviors declined, which may speak to the importance of ongoing support recommended to sustain progress made during DSM education [54]. Loss of the group support, which participants frequently mentioned as the intervention ended may be a major factor. Future development and testing will be required to examine the characteristics and format for creating personalized follow-up plans.

4.3 Limitations and Future Directions

This study contains several limitations. First, researchers were unable to complete a control group due to COVID-19. Secondly, given the small sample size and geographic location, results are not generalizable. Third, participants received COVID-19 related government-funded relief packages, potentially influencing outcomes related to QoL and distress. Given these findings, larger studies are recommended. Future studies should also compare the outcomes of virtual vs. face-to-face or hybrid delivery formats with integration of diabetes specific nutrition education into the OT group.

5. Conclusion

Even though COVID-19 required the transition to virtual format, MY-OT-ED appeared to be feasible and potentially efficacious for less advantaged adults with T2DM. Further research is required to incorporate recommendations included in this report, to continue to study the delivery format of DSM education designed for less advantaged adults. Overall, we recommend simplification of the programming and continued focus on strengthening the merger of multimodal interventions for this population, with special attention paid to delivery of culturally relevant interventions. It is essential to continue to create accessible DSM for less advantaged adults to provide them with supports and resources to learn how to incorporate DSM into their daily lives while improving their QoL and ability to enjoy living life.

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Author Contributions

Karen E. Atler – Principal Investigator of the AOTF grant; designed and implemented the occupational therapy group intervention; assisted with data collection and fidelity checks; authored and edited manuscript. Deana Muñoz – edited occupational therapy intervention; assisted with data collection and fidelity checks; authored and edited manuscript. Carly Knowles – primary data

collector; edited occupational therapy intervention; assisted with fidelity checks; data analysis; authored and edited manuscript. Angie Noe – designed and implemented yoga therapy intervention; assisted with data collection and fidelity; reviewed and edited manuscript. Christine A. Fruhauf – assisted the research team in development of assessments, reviewed and edited manuscript. Kathryn McGirr – co-author of the nutrition education curriculum *Eating Smart • Being Active*; trained and supervised the EFNEP peer educator; reviewed and edited manuscript. Tracy Nelson – assisted research team with study design, reviewed and edited manuscript. Arlene A. Schmid – mentor for the Principal Investigator; co-developer of occupational and yoga intervention (MY-OT); authored and edited manuscript.

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Competing Interests

The authors have declared that no competing interests exist.

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