Journal of Student-Run Clinics
Original Study

Evaluation of a Diabetes Prevention Program Implementation in a Student-Run Free Clinic Setting

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Published: February 17, 2022

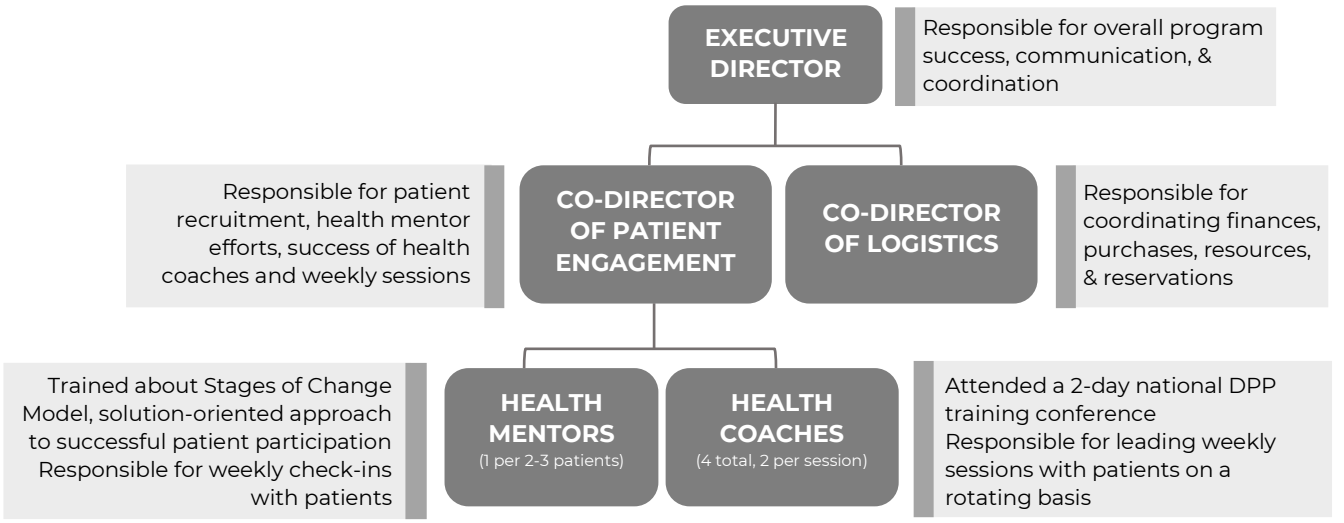
Abstract

Introduction: The Diabetes Prevention Program (DPP) can prevent or delay the development of type 2 diabetes in at-risk individuals. Although low-resource and minority communities have higher rates of type 2 diabetes, these communities often have limited DPP participation due to cost and program accessibility. We evaluated whether a high-fidelity, reduced-cost 16-week DPP could feasibly be implemented by student volunteers and be effective in facilitating the target 5% weight loss goal among participants.
Methods: Uninsured, Spanish-speaking participants and their invited guests were recruited from Vanderbilt University Medical Center's student-run clinic. Weekly DPP sessions were conducted using the CDC's Prevent T2 curriculum in Spanish, delivered in-person for 6 weeks and virtually for the remaining 10 weeks due to the Coronavirus Disease 2019 pandemic. Participant attendance and weight data were collected. Pre- and post-program health-related quality of life was assessed using the EuroQoL 5D5L tool, and qualitative program feedback surveys were administered. Changes in weight and quality of life as a function of program session attendance and patient demographics were determined primarily using Wilcoxon tests.
Results: Of the 17 participants actively engaged in the student-led DPP, 13 were clinic patients and 4 were invited guests. The median weight loss achieved by participants was 5.90% of their total body weight. 13 of the 17 participants (76.50%) achieved the 5% weight loss goal. Age, sex, pre-program body mass index, and English proficiency were not associated with the achievement of the 5% weight loss goal. Though not statistically significant, patients' average self-scored general health rating (0-100) improved from 72.30 to 81.50 (p=0.12), and the greatest reductions in health limitations were reported with regards to pain (1.94 to 1.70, p=0.28) and daily activities (1.53 to 1.35, p=0.36).
Conclusion: A student-run DPP implementation among low-resource participants is feasible and appears capable of achieving the target 5% weight loss.

Introduction

Over 30 million US adults have type 2 diabetes, and 88 million are at risk of developing it.[1] This risk is higher in low socioeconomic groups,[2] and low socioeconomic status is associated with worse di-

Figure 1. Student leadership structure



Student volunteers were recruited to fill five unique roles in the student-led DPP.
DPP: Diabetes prevention program.

abetes outcomes and complications.[3] The Centers for Disease Control (CDC) National Diabetes Prevention Program (DPP) is an evidence-based lifestyle intervention shown to reduce the risk of developing type 2 diabetes in participants who achieve 5% weight loss.[4] However, with a $500 average cost of program delivery per participant, cost and consequent limited local offerings may prohibit eligible people from participating.[5]

The DPP is historically less effective for low-income participants,[6] and financial burden is a key barrier to recruitment and retention in large group programs.[7] Moreover, low income has been associated with higher risk of retention failure after enrollment in lifestyle interventions, likely due to social barriers, including transportation and childcare.[8] Therefore, a DPP addressing socioeconomic barriers has the potential to increase enrollment and retention for low-resource populations. In addition, lifestyle interventions adapted to local social and cultural contexts have shown lasting, significant benefits,[9] and when administered by non-professional staff, may lower costs without sacrificing effectiveness.[10] Thus, a volunteer student-facilitated DPP may reduce program cost to reach low-resource communities while providing comparable efficacy.

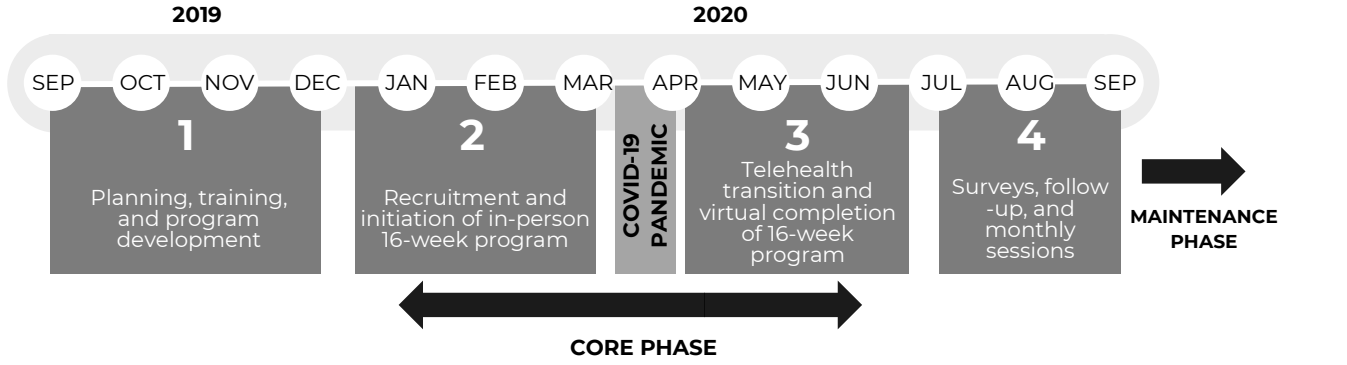
Student-run programs avoid significant professional fees while advancing educational training. Despite hundreds of academic medical centers nationwide, there are no published models of a student-led DPP. Therefore, health professions students at Vanderbilt University School of Medicine conducted a novel implementation of the DPP in January 2020 with Spanish-speaking patients from the free, school-affiliated Shade Tree clinic. When Coronavirus Disease 2019 (COVID-19) social distancing guidelines were instituted, program leaders continued offering the program virtually while maintaining all essential program elements. The primary objective was to evaluate the feasibility and efficacy of a reduced-cost, student-run DPP implementation in achieving 5% weight loss among low-resource participants.

Methods

Study Design

This study is a non-randomized, non-controlled implementation of the National DPP. Participants were recruited from a student-run clinic that provides free healthcare to uninsured community members. All eligible patients, in addition to any adult friends and family who desired to participate, were offered free-of-charge enrollment in the DPP. This program was led by health professions students (Figure 1) with the mentor ship of academic medical faculty outside of group sessions. Students leading sessions were

Figure 2. Intervention timeline



The timeline shows the progression of the program between September 2019 and September 2020. The first course session occurred on January 25, 2020 and the sixteenth session (last of the core phase) occurred on June 6, 2020

advanced or native Spanish speakers, and they attended CDC-recognized DPP health coach training in person. Other students received basic training in motivational interviewing and diabetes-related nutrition and exercise counseling. The study protocol was approved by the local Institutional Review Board.

Eligibility and Recruitment

Clinic participants were identified using a medical record query with the following criteria: prediabetic (hemoglobin A1C 5.6-6.5% in the last 5 years or having a diagnosis of prediabetes or gestational diabetes listed in their Problem List history), 18-75 years old, and body mass index (BMI) ≥24kg/m^2. Providers also referred patients to the program if at risk for diabetes per the CDC risk calculator.[11] Individuals were excluded if they had diabetes mellitus in their Active Problems list, were pregnant or planning to become pregnant, or were otherwise deemed medically unsuitable for weight loss and/or unsupervised exercise by clinic directors. It was logistically impossible to conduct simultaneous sessions in more than one language, so with consultation from clinic leaders about which patients may have the greatest need and opportunity, only Spanish-speaking persons were included in this initial cohort.

All patients identified through provider referral or query were manually reviewed by clinic directors for eligibility. Eligible patients were recruited via phone and encouraged to invite friends and family members. Informed consent was obtained from all who enrolled in the program to collect and analyze de-identified survey data, and clinic patients also consented to access of their medical records.

Intervention

Sixteen DPP sessions were conducted weekly using the Prevent T2 curriculum in Spanish.[12] These sessions offered education and strategies for improving nutrition, exercise, and mental wellness (Online Appendix).[12] Materials from the CDC website were printed and distributed during the in-person phase of the program. Following the transition to telehealth, curriculum handouts were shown when appropriate via screen sharing. In addition to the standard DPP curriculum, each participant was assigned to a health mentor for the duration of the program. Health mentors called participants weekly between program sessions to discuss progress, record self-reported weights (sessions 7-16 only), and troubleshoot obstacles to participant success in the program. The study timeline (Figure 2) included a 6-week in-person start, 2-week lapse due to COVID-19, and 10-week continuation of the program virtually via Zoom software (Version 5.0, Zoom Video Communications, San Jose, California).

Program Transition to Telehealth

Following suspension of in-person activities due to COVID-19, a trial virtual session was conducted with mentors assisting to troubleshoot technical issues. Subsequently, weekly sessions were conducted virtually for the next 10 weeks.

In-home bathroom scales were distributed to all patients who did not have access to one, and participant weights were self-reported. Roughly one third of patients joined via video with the remaining joining via audio. Program materials, if not available from in-person participation, were not printed and shipped to participants after the telehealth transition due to cost constraints.

Outcome Measures

Weight Loss and Attendance

Weekly participant attendance and weight were captured in a secure Research Electronic Data Capture (REDCap) database hosted at Vanderbilt University.[13,14] REDCap is a secure, web-based software platform designed to support research studies with validated data capture and seamless data downloads to common statistical packages. Baseline clinical data (height, hemoglobin A1C, prediabetes diagnosis, etc.) were collected from the medical record. Attendance during the 16-week program was used as a surrogate for engagement, as many studies have found a positive relationship between session attendance and weight loss outcomes.[15]

Health-Related Quality of Life

Health-related quality of life was assessed using the EuroQoL 5D5L tool.[16] Pre-program surveys were administered to patients on-paper during the first session that they attended in January, and results were transcribed into REDCap. For the two patients who joined following the telehealth transition, surveys were administered over the phone. Post-program surveys were administered one week following the 16th DPP session via phone, including both the EuroQoL 5D5L survey and a qualitative feedback survey.

Analysis

Statistical analysis was conducted using R software (Version 4.0.0, R Foundation for Statistical Computing, Vienna, Austria). Only data from participants actively enrolled at the end of the 16 weeks (i.e., attended more than two sessions, spanning at least 10 weeks) were included. Descriptive statistics were used to analyze basic cohort composition and baseline characteristics. Wilcoxon signed rank test for means was used to assess differences in pre- to post-program EuroQoL 5D5L scores and body weights since these were not normally distributed by Shapiro-Wilk and quantile-quantile plots. A longitudinal model was fitted to calculate weight change for the entire study period, the first 6 in-person sessions, and the next 10 telehealth sessions using age, sex, and pre-program BMI. Sex and week interactions were added to evaluate if the weight loss over time differed by sex. Wilcoxon tests, Fisher tests, and proportion tests were used to explore the relationship between cohort characteristics (sex, age, pre-program weight, and BMI) and program weight loss.

Results

Enrollment and Retention

Seventeen patients remained actively enrolled at the end of 16 weeks (Figure 3). Out of the 37 eligible participants identified, 32 were contacted successfully. Twenty-five patients were interested, but 13 were unable to attend sessions at the selected time. A total of 20 eligible, clinic-identified patients attended at least one session in the first 6 weeks. Eight participants joined the cohort as a guest of a recruited patient, and 2 clinic patients became available and joined the cohort after 6 weeks due to the COVID-19 pandemic.

Baseline Demographics

Baseline information was captured for the final cohort of 17 patients (Table 1). All participants identified as either Latino/a or Hispanic and were uninsured. The final cohort was predominantly female (82%), and the average participant age was 48. Eight of the 13 patients with known pre-program hemoglobin A1C were prediabetic per A1C criteria. Sixteen owned a smartphone, and 7 had a computer with WiFi access at home.

Weight Loss Outcomes

Overall, the mean total body weight loss achieved by program participants was 5.90% in 16 weeks. Thirteen of the 17 participants achieved the 5% weight loss target. The rate of weight change was -0.78lbs/week when the model was adjusted for age, sex, and pre-program BMI. In the model, the coefficients for age, sex, and BMI

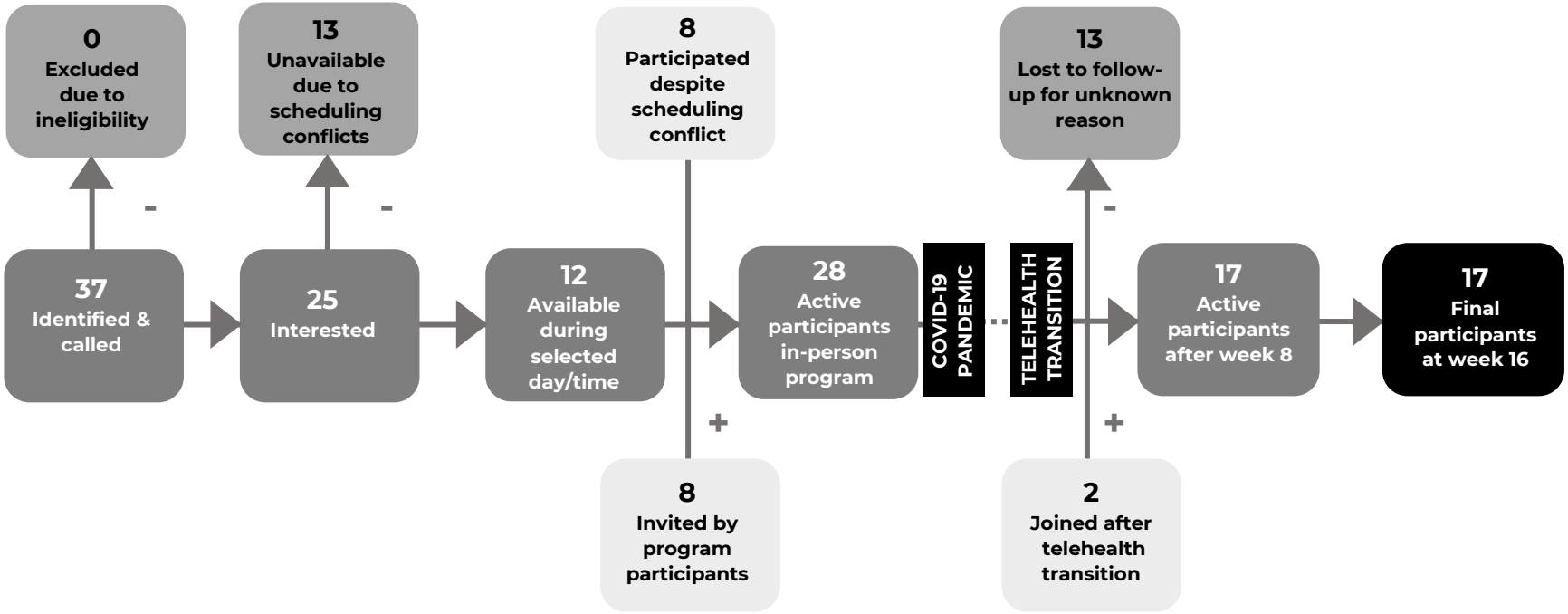
Table 1. Patient demographics (by weight loss achievement)

Characteristic	Overall final cohort (n=17)	5% Wt. loss achieved (%)	5% Wt. loss not achieved (%)	P-value
Number of participants	17	13	4	-
Age				
Mean	47.53	48.54	44.25	
Median	45	45	45.50	0.69*
Standard deviation	12.65	10.75	19.31	
Range	21-67	36-67	21-65	
Sex				
Female	13	9 (69.23)	4 (30.77)	0.52†
Male	4	4 (1.00)	0 (0.00)	
BMI category				
Normal (<25)	0	0 (0.00)	0 (0.00)	
Overweight (25-30)	6	4 (66.67)	2 (33.33)	0.58†
Obese (>30)	11	9 (69.23)	2 (30.78)	
Prediabetes				
Prediabetic at program start	8‡	7 (87.50)	1 (12.50)	0.66§
Mean A1C at program start ± SD (range)	6.3±7.00 (5.3-8)	-	-	-
Verbal English proficiency				
"I can't speak or understand any English"	1	1 (100)	0 (0.00)	
"I can understand a little in English, but I don't like to speak"	10	9 (90.00)	1 (10.00)	0.21†
"I can understand and speak English"	6	3 (50.00)	3 (50.00)	
Written Spanish literacy				
"I can read and write, but I'm not confident"	4	3 (75.00)	1 (25.00)	-
"I can read and write easily"	7	5 (71.43)	2 (28.57)	
Access to Technology				
Own a smartphone	16	12 (75.00)	4 (25.00)	1.00†§
Own a computer with internet access	7	5 (71.43)	2 (28.57)	1.00†§
Qualification method for DPP				
Blood test (prediabetes)	8	7 (87.50)	1 (12.50)	
Physician recommendation + meets criteria per ADA risk tool	3	3 (100)	0 (0.00)	
Physician recommendation + does not meet criteria per ADA risk tool	2	1 (50.00)	1 (50.00)	-
No health data (family/friends)	4	2 (50.00)	2 (50.00)	

Baseline demographic information for the 17 patients in the final cohort at week 16 of the student-led DPP.
**Wilcoxon test; †Fisher test; ‡Out of 13 patients for whom access to EMR was available; §Proportion test*
BMI: Body mass index; DPP: Diabetes Prevention Program; ADA: American Diabetes Association

were -0.47, -8.72, and 4.33, respectively. Only BMI was significant ($p<0.05$). Adding sex and session interaction time did not improve the model significantly. In the longitudinal models for in-person and telehealth sessions, the rate of weight change was -1.17lbs/week and-0.48lbs/week, respectively. Participant body weight change was plotted as a function of progression through the 16-session program and sub-divided into participants that did and did not meet the 5% weight loss goal (Figure 4). None of the participant demographic factors, including age ($p=0.69$), sex ($p=0.52$), pre-program BMI category ($p=0.58$), English proficiency ($p=0.21$), or technology access

Figure 3. Cohort flow diagram



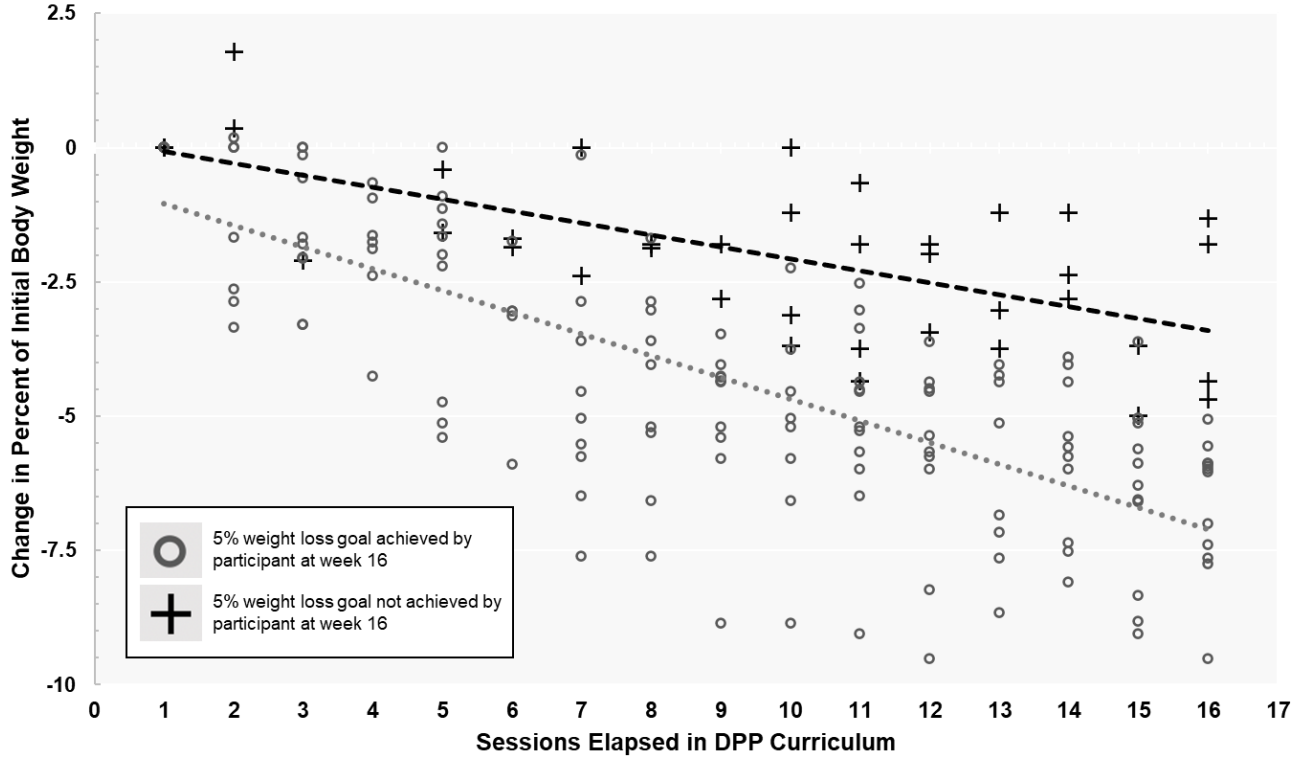
The flow diagram shows the Diabetes Prevention Program (DPP) participant flow from recruitment through the end of the 16-week DPP curriculum.

Table 2. Patient-reported quality of life

QoL dimension (range)	Mean pre-program score (SD)	Mean post-program score (SD)	P-value*
Mobility (1-5)	1.47 (0.81)	1.35 (0.72)	0.69
Self-care (1-5)	1.18 (0.54)	1.12 (0.50)	0.60
Usual activities (1-5)	1.53 (0.73)	1.35 (0.72)	0.36
Pain/discomfort (1-5)	1.94 (0.72)	1.70 (0.93)	0.28
Anxiety/depression (1-5)	1.70 (0.86)	1.47 (0.73)	0.42
Overall health (1-100)	72.3 (19.31)	81.5 (18.38)	0.12

Participant self-reported measures of quality of life using the validated EuroQoL 5D5L tool.
**Wilcoxon test*
QoL: Quality of life; SD: Standard deviation

Figure 4. Participant weight loss during 16-week core curriculum



The graph shows weekly percent weight loss per participant throughout the 16-week Diabetes Prevention Program curriculum grouped by whether the target 5% weight loss at week 16 was met.

Table 3. Qualitative program feedback

Unique strategy implemented	**Average perceived impact, 1-10 (SD)**
The program was offered free of charge	10.00 (0.00)
The program offered classes with practical instructions for home exercise options	9.70 (0.70)
The program offered resistance bands and yoga mats for in-home use free of charge	8.70 (2.30)
The program offered a scale for in-home use free of charge	10.00 (0.00)
A student was assigned as a health mentor to check in on them regularly	9.70 (0.60)
Participants were allowed to invite family/friends at any point during the program	8.80 (2.50)
The program offered free childcare during in-person sessions	8.30 (3.40)
Other reported post-program outcomes (ranked 1-10)	**Average score, 1-10 (SD)**
"How likely are you to recommend this program to a friend?"	9.70 (0.80)
"How much impact has this program had on your cooking and eating habits?"	9.50 (1.10)
"How much impact has this program had on your exercise habits?	8.20 (2.20)
"How confident are you that you will continue the lifestyle changes that you have made after the program is done?"	9.20 (1.10)

Qualitative program feedback gathered from participants through a survey at the end of the 16-week program.
SD: Standard deviation

(p=1.00) were significantly associated with the achievement of 5% weight loss (Table 1).

Attendance

Though we did not find a significant relationship between sessions attended and weight lost, all patients who attended ≥ 13 sessions achieved the 5% goal. The weight loss per session was greater for the initial in-person phase (0.76%) than in the telehealth phase (0.59%). This difference was not significant (p=0.19). On average, 9.2 participants attended each in-person session and 10.5 participants attended each virtual session.

Patient-Reported Quality of Life

Qualitatively, patients reported overall improved health after the 16-week DPP with the average self-scored rating (0-100) increasing from 72.3 to 81.5 (p=0.12). Though scores decreased in all five domains of EuroQoL health impairment, indicating reduced health-related disruption to quality of life, none of these differences were statistically significant due to our low sample size. The greatest improvements were a reduction in pain/discomfort from 1.94 to 1.70 (p=0.28) and difficulty with daily activities from 1.53 to 1.35 (p=0.36) (Table 2).

Impact of Barrier Reduction Strategies

Numerous strategies (Figure 5) were implemented to mitigate potential barriers to program participation. Participants rated the impact of these strategies on their success in the program on a scale of 1-10 (Table 3). Notably, all strategies were rated over 6/10. The highest average scores were reported for provision of scales for home use and zero cost to participate.

Discussion

Overall, this study demonstrates that a student-run implementation of the CDC's DPP 16-week core curriculum is both effective and feasible. At the end of the program, 17 participants remained engaged, and 9-10 participants on average attended every session. Thirteen participants achieved the 5% weight loss target, and the mean weight loss for the group was 5.90%. Widespread student involvement allowed for continuous offering of weekly sessions with only 2 weeks needed for transitioning to a telehealth format during the COVID-19 pandemic.

This program utilized the full Prevent T2 core curriculum because condensed DPP adaptations often fail to achieve the 5% weight loss target despite reporting generally positive clinical outcomes.[17,18] Though many studies have demonstrated a high financial and logistical burden of training staff to screen and enroll patients in the DPP,[14,19] our study supports evidence from community-academic partnerships targeting low-SES minorities that such programs can be conducted effectively with little training and no recruiting cost.[20] We found a high degree of interest in the program during recruitment, which matches published findings that the referral rate for DPPs underestimates the community interest in such programs.[14,21]

Despite the disruption of COVID-19 and unanticipated virtual transition, participants consistently attended throughout the duration of the program. Participants continued to lose weight after the telehealth transition but at a slower rate, with an average of 0.76% total body weight lost per session attended in person versus 0.59% per virtual session. Though our small sample size resulted in a non-significant p-value for this difference, the authors observed that health behavior maintenance and overall weight loss were perceivably diminished during the telehealth phase. This is likely multifactorial, as numerous aspects of the COVID-19 pandemic created barriers to healthy eating and regular exercise that are particularly pronounced in low-income communities.

In addition to encouraging weight loss, aggre gate survey data showed that participants reported widespread improved quality of life, though this study was not powered to detect a significant difference in the low score value changes expected in relatively healthy patients over a short time period. Participant feedback on the program was overwhelmingly positive with a high average willingness (9.2/10) to recommend the program to others. Participants also found the program helpful on average for influencing future eating and cooking habits (9.5/10) and exercise habits (8.2/10). These findings support a high value and sustainability of future program offerings.

Figure 5. Problem-based program elements

BARRIER	SOLUTION
EXERCISE ACCESSIBILITY	Provided exercise bands and yoga mats to all participants. Offered student-led exercise classes after weekly sessions.
PROGRAM COST	Program was free to all participants. Funding was available for supporting program-related costs (e.g. food).
INABILITY TO MONITOR HEALTH PROGRESS	Provided scale to all participants.
PROGRAM ACCESSIBILITY	Chose a program location based on zip codes of interested participants.
NUTRITION RESOURCES	Partnered with community food banks to offer teaching kitchen classes and nutrition support.
PROGRAM MENTORSHIP	A student volunteer was assigned to call each patient every week to encourage progress.
COMMUNITY SUPPORT	Each participant had the ability to invite friends and family to participate in the program.
CHILDCARE	Free, on-site childcare was offered during every session.

Based on participant input, program elements were designed and implemented to address barriers to successful participation in the 16-week program.

Based on participant input, numerous program elements were implemented to improve engagement and were deemed helpful. Participants unanimously reported the provision of scales as 10/10 in terms of impact on their success in the program. This could have applicability to other chronic disease prevention programs, such as the provision of cuffs for blood pressure management in low-income individuals. Other DPP literature has recommended the use of socially-oriented health workers to identify barriers to participation and assist with enrollment,[22] and the novel use of student health mentors to fill this role both contributes to their education and creates a well-received source of accountability and personal connection for enrolled participants. Though 13 patients were lost to follow-up, attrition was mitigated through efforts such as inter-session participant phone calls with student volunteers. A 2018 study in Medicaid beneficiaries found little benefit from direct financial incentives in low-income DPP participants,[23] and our experience suggests that other incentives (e.g. exercise bands, yoga mats, free childcare) were beneficial and received favorably. Our in-person unique program elements incorporated findings from literature about successful behavior change, skill acquisition, and skill practice in both cooking and exercise.[24]

There were numerous limitations to our study. As a pilot program, our sample size (n=17) is small compared to many published programs, and we had significant attrition of 13 participants. Since we only measured 16-week outcomes, we cannot evaluate the long-term health benefits of our program. Equally of note, the COVID-19 pandemic and resulting transition to telehealth was unpredictably disruptive. Though the Prevent T2 curriculum was followed during the telehealth phase, we were unable to provide physical copies of program materials and instead had to rely on screen sharing and informal methods of progress tracking. Many male participants were unable to continue participating with the same consistency due to changed work schedules in the telehealth phase. Additionally, though we encouraged participants to track their exercise, we did not record exercise minutes and therefore are unable to comment on the efficacy of this program in achieving the 150-minute weekly goal. Since we allowed invited guests to participate throughout the program's duration, 5 of the 17 participants enrolled following the first program session, with two of them as late as session 7. While many efforts were made to integrate these participants, their pre-program weight and survey data cannot be considered equivalent to those whose attendance was spread over the full 16 weeks. Finally, quality and learning measures

self-reported by participants are non-objective[25] and highly subject to various forms of bias.[26]

Much effort has been devoted to extending the reach of the DPP to at-risk groups, yet none has incorporated health professions students. Our study demonstrated that a DPP implemented in this style could achieve the National DPP weight loss targets and achieve positive patient-reported quality of life outcomes. The use of health mentors for consistent communication with participants between program sessions was critical to program success. If scalable, this implementation design offers a reduced-cost strategy to bring the DPP to underserved communities at high risk for diabetes while simultaneously enhancing the education of healthcare trainees. Future work will focus on expanding the program size and scalability, developing implementation materials for use by other healthcare trainee groups, and making general recommendations for optimizing community-based chronic disease prevention programs.

Conclusion

Implementation of the National DPP's 16-week curriculum is both effective and feasible when facilitated by health professions students. Despite the disruption of COVID-19 and unanticipated transition to a virtual format, participants remained engaged throughout the duration of the program and continued to lose weight, though at a slower rate than while attending in person. In addition to encouraging weight loss, participants reported improved quality of life and favorably perceived added program elements to mitigate barriers to successful program participation, such as the provision of exercise equipment and personal health mentors. These findings support a high value and sustainability of future program offerings in a student-run free clinic setting. Further work in program development to optimize participant engagement in community-based prevention programs is warranted.

Acknowledgements

This work was supported by the Vanderbilt Institute of Clinical and Translational Research, VR53470 Grant Award and by the National Center for Advancing Translational Sciences, CTSA Award No. UL1 TR002243. Its contents are solely the responsibility of the authors and do not necessarily represent official views of the National Center for Advancing Translational Sciences or the National Institutes of Health.

Disclosures

The authors have no conflicts of interest to disclose.

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