

Diabetes Community Health Promotion Program

Background

Type 2 Diabetes Mellitus (T2D) is a growing problem around the world that will only get bigger as obesity rates and unhealthy lifestyle factors increase. T2D is a complex multisystem disorder that affects the liver, muscle, kidneys, fat cells, gut, and the brain.¹ With the global prevalence projected to be 7079 per 100,000 by 2030, the resulting morbidity and mortality is almost incalculable.² However, unlike the communicable diseases that have historically driven public health crises, there is no vaccine or single therapeutic that can solve this problem. While medications aimed at controlling T2D exist, emerging evidence is clear that lifestyle changes, such as diet and exercise, can decrease insulin resistance and delay the onset of diabetic neuropathy.^{3,4} For this reason, I will propose a community-based health promotion program aimed at increasing physical activity in people with pre-diabetes or diagnosed T2D in order to delay or prevent disease progression. All of these interventions will address determinants at the individual and interpersonal levels as they will target individual lifestyle behaviors within a small group setting.

Physical therapists are uniquely qualified to deliver lifestyle change programs due to our expertise in the human movement system in the presence of pathology. We are able to assess a patient's unique functional deficits and then administer programs that address their impairments and improve their movement capacity. This is important when implementing an exercise program with people who were previously sedentary or have baseline impairments, such as diabetic neuropathy. The goal of this program is to increase participant's balance, aerobic capacity, and exercise self-efficacy through

group-based balance and walking programs along with patient education based on principles of the Social Cognitive Theory. Results will be measured using the mini-BESTest for balance assessment, the six-minute walk test for exercise capacity, and the Self-Efficacy for Exercise Scale for self-efficacy.

The first component of this program will be group-based balance exercises. Peripheral neuropathy is a common complication of T2D, resulting in sensory and motor deficits that can alter gait characteristics and lead to balance impairments.⁵ Patients with peripheral neuropathy tend to have lower gait velocity, decreased cadence, shorter stride length, and higher step variability compared to healthy controls.⁵ If a walking program is another key component of this health promotion program, we must ensure that all participants feel safe and stable. Fortunately, there is research to support group-based balance programs as effective for increasing balance measures in adults with T2D. A recent systematic review with meta-analysis found that exercises such as balance training, core stability, Tai-Chi, and proprioceptive training can cause significant improvement in Berg Balance Scale scores and postural stability in people with diabetic neuropathy.⁶ Allet et al. studied a specific group-based gait and balance program over the course of 12-weeks in people with diagnosed diabetic neuropathy.⁵ Groups of 5-8 participants participated in one-hour sessions twice a week that included a 5-minute warm-up, 40-minute circuit of gait and balance exercises, 10-minutes of interactive games, and 5-minutes of feedback and suggestions for home exercises. Gait and balance exercises included stance on heels and toes, tandem stance, walking up and down a slope, stair climbing, sitting to standing, etc. Task complexity was progressively increased over time. “Interactive” games included badminton, obstacle courses, etc.

Researchers found the experimental group had significant in-group and between-group differences in static balance, dynamic balance, performance-oriented mobility, hip and plantar flexor strength, and falls efficacy at the conclusion of the 12-week program. Even more importantly, all of these improvements remained significant compared to the control group at 6-month follow-up except for static standing balance and ankle plantar flexor strength. These are important results because they support the use of group-based balance programs for increasing strength, balance, and self-efficacy. The outcome measure I will use to track balance improvements is the mini-BESTest. This is a valid and reliable tool that is shorter than the Berg Balance Scale, has higher reliability levels, and greater accuracy in classifying individuals who show improvement in balance.⁷ Furthermore, the miniBEST has been validated as a measure for identifying fall risk in older adults with T2D.⁸ The minimal clinically important difference (MCID) for the mini-BESTest in adults with balance disorders is 4 points.⁷

The second component of this community program is a group-based aerobic exercise program that utilizes brisk walking. Physical activity has been identified as one of the most important factors in the treatment of T2D.³ However, developing physical activity habits can be difficult, especially without community support or access to exercise equipment. For these reasons, a group-based walking program seems well-positioned to get previously sedentary people moving. Motahari-Tabari et al. found that 24 exercise sessions over 8-weeks resulted in a significant decrease in fasting blood sugar and plasma insulin compared to a control group who did not exercise.³ The exercise consisted of a 10-minute warm-up, 30 minutes of brisk walking at 60% maximum heart rate (MHR), and a 10-minute cool-down. Dixit et al. found similar

positive results with a less-structured 8-week aerobic exercise program.⁴ Participants were educated on AHA guidelines for physical activity (150 min/week of moderate to vigorous exercise) and instructed to walk 3-6 days per week at 40-60% MHR to accumulate between 150 and 560 minutes/week of exercise. The experimental group had a significant improvement in diabetic neuropathy as measured by an increase in nerve conduction velocity (NCV) in the peroneal and sural nerves. These studies provide evidence that brisk walking programs can have a positive influence on insulin resistance and diabetic neuropathy. As physical therapists we cannot measure blood markers, nor is it feasible to conduct NCV testing at a large enough scale. Instead, we will utilize a quick and non-invasive option, the six-minute walk test, to track patient's exercise capacity over time. This test is shown to have high reproducibility and correlate significantly with maximum physical workload in diabetic patients, making it a useful test for assessing exercise capacity.⁹ There is no MCID data available specifically for the diabetic population, but the MCID is 50m for older adults and 54m for adults with COPD.^{10,11}

There will not be a dedicated education component of this community health promotion program. However, educational themes will be weaved into the balance and walking components during the warm-up and cool-down portions of group sessions. The goal of this educational component is to promote long-term health behavior change through constructs of the Social Cognitive Theory (SCT). SCT examines personal factors, such as self-efficacy, self-regulation, and barriers, and their effects on behavior in an environmental context.¹² By identifying personal factors that shape behavior you can motivate, lead, and enable people to comply with health promotion behaviors.¹² A

study by Ghoreishi et al. found that an educational program consisting of six 40-minute sessions based on the constructs of SCT had a positive effect on diabetes self-care.¹² The constructs of emotional adaptation, self-efficacy to overcome barriers, and self-regulation had the biggest impact on diabetes self-care. Therefore, the educational component of this program will target these constructs. To measure a change in self-efficacy, we will use the Self-Efficacy for Exercise Scale (SEE). Resnik and Jenkins found a relationship between high-self efficacy and better physical and mental status using the SEE.^{13,14} They also established internal consistency, reliability, and construct validity for the SEE¹³. There is no published normative data for this outcome measure, but it can still be used to track participant's progress throughout the program. Giving patients tools, such as increased self-efficacy and self-regulation, will hopefully promote increased compliance even after their time in the community program has ended.

This community health promotion program can positively impact a population that can be helped significantly by healthy lifestyle change. While physical activity is only one component of broader lifestyle change, it has been shown to have measurable impacts on the disease course of diabetes and may be the first step towards empowering participants towards further lifestyle change.

Program Goals:

1. At the end of this 12-week program, participants will regularly participate in at least 30 minutes of moderate-to-vigorous activity, 5 days a week, in order to fulfill the Physical Activity Guidelines, 2nd edition recommendations.¹⁵
2. At the end of this 12-week program, participants will have at least a 4-point improvement in their performance on the mini-BESTest, in order to achieve a clinically important change in balance.⁷
3. At the end of this 12-week program, participants will increase their six-minute walk test distance by greater than 60 meters, in order to achieve clinically important changes in exercise capacity.^{9,10}
4. At the end of this 12-week program, participants will have a Self-Efficacy for Exercise score of >85, in order to show higher confidence in their ability to complete exercise and predict long-term exercise compliance.^{14,16}

Methods

Recruitment, enrollment, and logistics:

The easiest place to recruit for this program is within the walls of the outpatient PT clinic where I would be based. However, I would also like to reach people who may not have made it through the doors of a PT clinic yet. Thus, we will also advertise using flyers in community areas, such as grocery stores, community centers, and churches. Finally, we will meet with leaders of churches and other organizations, such as the Durham Center for Senior Life.¹⁷ This is an example of a constituent-involving strategy, because it draws on the input and experience of people in our target audience in order

to most effectively recruit for and implement our program.¹⁸ Our target audience is community members in the Chapel Hill/Durham area who have a diagnosis of pre-diabetes, diabetes, and/or diabetic neuropathy.

Recruitment will take place for three months, with a goal of 20-30 participants enrolling for the first ever cohort. I will be teaming up with students from the first year and second year DPT classes at UNC, who will be able to enroll in a 1-credit hour elective course for helping out with this community program. The week before the official start of the program, all participants will come in for a scheduled 30-minute appointment in the evenings between 5-9pm. During this appointment, patients will be screened for diabetic neuropathy using the Ipswich Touch Test and then taken through all baseline outcome measures, including the mini-BESTest, six-minute walk test, and Self Efficacy for Exercise questionnaire.¹⁹ The testing and program sessions will take place in an accessory gymnasium that East Chapel Hill High School has allowed us to reserve. East Chapel Hill High School is located fairly close to the Chapel Hill/Durham line and is accessible by bus, making it accessible to residents of both Chapel Hill and Durham. Prior to this week of baseline testing, the DPT students helping out will be taught and assessed in their ability to conduct these measures to ensure the highest reliability possible.

At the end of baseline testing, participants will be able to sign up for the group sessions based on their scheduling needs. They will need to sign up for one 50-minute aerobic session and one 50-minute balance/strength session per week. Aerobic sessions will be offered Mondays and Tuesdays from 6:00-6:50pm, and Thursdays from 7:00-7:50pm. Balance/strength sessions will be offered from Mondays and Tuesdays

from 7:00-7:50pm, and Thursdays from 6:00-6:50pm. These times are selected to give participants the greatest flexibility possible with scheduling. Sessions will be led primarily by DPT student volunteers, who will also be trained in the implementation of balance and aerobic programs. At least one licensed DPT will be present each night to supervise activities and ensure safety. Ideally, there would be one student per 2-4 participants so that each person is able to get individualized attention. On top of this, participants will be encouraged to fill out an activity log to track how much aerobic and balance/strength activity they are doing throughout the week outside the structured sessions.

After the 12-week program has been completed, participants will come in for one last scheduled 30-minute appointment to re-take all baseline measures and fill out a survey of the program. This survey is aimed at reflecting on the perceived benefits from the program, as well as giving feedback on the components that went well or need to be improved for future cohorts. Finally, there will be a 6-month follow-up phone call to survey patients on whether they have sustained their exercise goals in the months since completing the program.

Balance and Strength Program:

Time	Component	Details – adapted from Allet et al. ⁵																																									
6:00-6:05	Warm-up	Walk 1-2 laps around gym at moderate pace																																									
6:05-6:40	Balance circuit	Gait and balance exercise circuit: every exercise is performed “on the minute”, so participants will do the exercise as long as possible during that minute. Audible tones will be sounded every minute to indicate a change in exercise. A different tone will be sounded to indicate initiation of a rest break																																									
		<table border="1"> <thead> <tr> <th>Exercise 1</th> <th>Exercise 2</th> <th># of rounds</th> <th>Ways to progress difficulty</th> </tr> </thead> <tbody> <tr> <td>Stance on heels x 1 min</td> <td>Step-ups (stairwell) x 10-20</td> <td>3</td> <td>Stand on unstable surface, change step frequency or volume</td> </tr> <tr> <td colspan="4" style="text-align: center;">3-minute rest</td> </tr> <tr> <td>Stance on toes x 1 min</td> <td>Sit <> stand x 10-20</td> <td>3</td> <td>Stand on unstable surface, change sit<>stand frequency or volume</td> </tr> <tr> <td colspan="4" style="text-align: center;">3-minute rest</td> </tr> <tr> <td>Semi-tandem stance x 1 min</td> <td>Stair climbing x 3 flights</td> <td>3</td> <td>Full tandem stance, stand on unstable surface, increase # of flights of stairs</td> </tr> <tr> <td colspan="4" style="text-align: center;">3-minute rest</td> </tr> <tr> <td>Sideways walking x 1 min</td> <td>Backwards walking* x 1 minute</td> <td>3</td> <td>Crossover stepping, seed of sideways walking, gentle perturbations from SPT</td> </tr> <tr> <td colspan="4" style="text-align: center;">2-minute rest</td> </tr> <tr> <td colspan="2"></td> <td>**Walking through balance obstacle course (includes stepping over objects, bending over to pick up objects, walking on unstable surface, sudden stops, etc.) x 1 min</td> <td>3</td> <td>Increase difficult of obstacles by increasing height of things to be stepped over, make surfaces more unstable, adding perturbations</td> </tr> </tbody> </table>	Exercise 1	Exercise 2	# of rounds	Ways to progress difficulty	Stance on heels x 1 min	Step-ups (stairwell) x 10-20	3	Stand on unstable surface, change step frequency or volume	3-minute rest				Stance on toes x 1 min	Sit <> stand x 10-20	3	Stand on unstable surface, change sit<>stand frequency or volume	3-minute rest				Semi-tandem stance x 1 min	Stair climbing x 3 flights	3	Full tandem stance, stand on unstable surface, increase # of flights of stairs	3-minute rest				Sideways walking x 1 min	Backwards walking* x 1 minute	3	Crossover stepping, seed of sideways walking, gentle perturbations from SPT	2-minute rest						**Walking through balance obstacle course (includes stepping over objects, bending over to pick up objects, walking on unstable surface, sudden stops, etc.) x 1 min	3	Increase difficult of obstacles by increasing height of things to be stepped over, make surfaces more unstable, adding perturbations
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		*Performed parallel to a wall with SPTs closely supervising and discontinuing if participant appears unsafe performing																																									
		** The shaded box will not be included in the first 6-weeks of training. After 6-weeks, rest-breaks will be shortened to 2-minutes and the shaded box will be introduced																																									
6:40-6:50	Cool-down/ education	Patients will walk 1 lap around the gym and then receive education component before being dismissed (outlined below)																																									

Aerobic program

This will be completed 1x/week in-person. However, participants will be encouraged to participate at home at least one more time per week and track their activity in an activity log.

Time	Component	Details – adapted from Motahari-Tabari et al. ³
7:00-7:10	Warm-up	Dynamic warm-up exercises in standing include: walking 1 lap around gym, 2x10 half-squats, standing hip abduction x 10 each leg (hands on wall), standing hip extension x 10 each leg, standing quad stretch x 30 sec each leg, standing hamstring stretch x 30 sec each leg.
7:10-7:40	Brisk Walking	30-minutes of brisk walking at %60 MHR*. HR will be monitored occasionally for each participant using a portable SpO2 monitor. SPTs will check participants heart rates periodically to make sure their pace isn't too fast or slow. Music will be played, and participants will be encouraged to walk in groups to facilitate community and friendships
7:40-7:50	Cool-down	Seated stretches will be performed while educational component is given (stretches include hamstring stretch, butterfly stretch, split stretch 2 x 1 minute each stretch)

*MHR will be calculated for each individual using the formula $MHR = 206.9 - (0.67 \times \text{age})$

Educational Component

The educational component of this program will be incorporated during the 10-minute “cool-down” portion of every session. Topics (detailed below) will be briefly introduced followed by discussion amongst participants in large or small groups. Discussions are encouraged to continue after the official session time is over. By exposing participants to small amounts of these concepts every week, we hope to make some of the concepts stick. The information is based on a program by Ghoreishi et al, which used educational sessions based on the Social Cognitive Theory to increase self-care behaviors in adults with diabetes.¹²

Weeks	Topic	Details
1-3	Promoting emotional adaptation	<ul style="list-style-type: none"> • Information about health maintenance • Guidance regarding diabetes coping skills • Stress management • Relaxation methods
4-8	Promoting Self-Efficacy to Overcome Barriers	<ul style="list-style-type: none"> • Education on diabetes self-care habits and the benefit of exercise • Identifying common advantages and barriers of diabetes self-care and exercise • Self-reflection about individual barriers to self-care and regular exercise • Brainstorming ways to overcome barriers • Goal setting in order to overcome barriers

9-12	Promoting Self-Regulation	<ul style="list-style-type: none"> • Identifying positive and negative consequences of creating an exercise habit • Identifying the best of time day participants can realistically participate in exercise • Monitor one's own progress towards positive self-care and exercise behaviors • Reflecting on progress towards short- and long-term goals and re-assessing whether goals of achievable • If goals are not being achieved, reflecting on some of the barriers and identifying ways to overcome • Creating a sense of community with other individuals who have similar goals • Reflect on the benefits they are feeling if they are meeting their goals
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Abbreviations used	min = minute; sit<>stand = sit-to-stand; SPT = student physical therapist; sec = seconds; MHR = max heart rate
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Program Evaluation

Broadly, a successful outcome for this program would be that participants meet the program goals and develop a long-term habit of physical activity that persists after the program ends. We will use various methods to measure whether we are on track or have met these goals.

The most obvious way to measure success will be through the baseline and final outcome measurements discussed above. This would fall under the category of “gathering credible evidence,” a step in the CDC’s guide to evaluation health promotion programs.²⁰ The first goal of meeting physical activity guidelines will be assessed by participants submitting a physical activity log. This will allow us to assess how much activity they are doing outside of dedicated exercise sessions and how many people are meeting the activity guidelines. The second goal of improving balance will be measured using the mini-BESTest. The third goal of improving exercise capacity will be measured

using the six-minute walk test. Finally, the fourth goal of increasing exercise self-efficacy will be measured using the Self-Efficacy for Exercise scale. The specific improvements we are trying to achieve for each outcome measure can be found in the “Program Goals” section. For this first round of the program, we will set a goal to have 85% of participants reach at least 2 of the program goals and 50% of participants reach all program goals. Finally, we do not have a specific goal for peripheral neuropathy because we will not have access to nerve conduction velocity testing. However, we will re-assess the Ipswich Touch Test (ITT) at the end of the program to see if any patients have a change in their neuropathy. There is no research about tracking changes in ITT after an exercise program. However, research has shown the ITT to have good reliability, moderate sensitivity, and high specificity.^{21,22} Therefore, while it is not a primary goal of the program to reduce peripheral neuropathy, it will be interesting to see if any participants see improvements on the ITT.

The next way we will evaluate the progress of this program is through “engaging stakeholders”, another concept discussed in the CDC’s guide to evaluating health promotion programs.²⁰ We will do this by surveying the participants and the SPTs helping implement the program at the half-way point (6-weeks) and end of the program. Survey questions will involve logistical questions (i.e., scheduling, times, etc.), satisfaction questions (i.e., “how satisfied are you with the programming and assistance from SPTs?”), and activity compliance questions (i.e., “how many times per week are you able to do physical activity outside of official sessions?”). The subjective and objective feedback will be analyzed and taken into consideration for future cohorts.

Attendance will also be tracked to analyze participant's involvement and whether attendance starts to dip over time. Those who begin missing sessions multiple weeks in a row will be contacted to check-in and identify the barriers that are preventing their attendance. Attendance over the entirety of the course will be analyzed at the completion of the program to determine if scheduling or session times need to be altered in the future.

Finally, we will conduct a 6-month follow-up phone call and interview participants about their current state of overall health and physical activity frequency. They will be verbally asked about whether they are still meeting physical activity guidelines, and if not, what some of the barriers are. This is not the most reliable way to measure physical activity because it leaves room for self-report bias. However, this is the most practical way to conduct a long-term follow-up.

All of the information will be analyzed and synthesized in order to make judgements on the overall success of the program and justify conclusions.²⁰

Conclusion

Type 2 Diabetes Mellitus is a growing condition that affects many areas of people's lives. While pharmaceutical interventions may be one component of a multimodal treatment approach, there are lifestyle changes that we know cause meaningful change in the lives of those with T2D.^{3,4} This community health promotion program is aimed at arming people with or at risk for T2D in the Chapel Hill/Durham community with the tools they need to make meaningful lifestyle change in the form of physical activity.

Physical activity has been shown to decrease insulin resistance and delay the onset of diabetic neuropathy by improving nerve conduction velocity.^{3,4} However, for people who are previously sedentary, there are many barriers to initiating a more active lifestyle. Barriers may include lack of time, lack of knowledge about exercise, lack of community, and lack of confidence in making lifestyle changes. This program is designed to equip participants with the knowledge of how to participate in various forms of exercise, such as balance, strength, and aerobic exercise. Participants will attend two 50-minute group exercise sessions a week led by Doctor of Physical Therapy students and supervised by a licensed physical therapist. Participants will also be encouraged to partake in at least 1-2 more days of physical activity outside of the sessions and track their activity using an activity log.

This program will also facilitate community amongst group members and help individuals identify barriers to lifestyle change in their own lives. By goal setting and performing consistent exercise for 12-weeks, patients will increase their self-efficacy for completing an exercise. This is an important factor in adopting a long-term active lifestyle even after the program has ended.

Overall, this program has the potential to make meaningful changes in the lives of people with T2D in the Chapel Hill/Durham area. We want to empower people to take their health into their own hands and experience all of the benefits consistent physical activity brings along with it.

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