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Examining the Effectiveness of Physical Activity Patient Education in Improving HbA1c

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Abstract

Regular physical activity plays an important role in maintaining good health and managing and reducing HbA1c among type 2 diabetes patients. The goal of this study is to examine the effectiveness of physical activity in reducing the HbA1c among the type 2 diabetes patients of a local community health center in San Leandro, California. A quasi-experimental, pretest-posttest single site design project was conducted among a sample of 24 patients who had type 2 diabetes. The participants were selected to attend regular patient education classes promoting physical activity, diet, and lifestyle change as a measure of controlling diabetes. A paired sample t-test and Wilcoxon Signed-Ranked-rank pretest/posttest comparison of the A1c mean values was conducted. The participants included 16 females (66.67%) and 8 males (33.33%). Physical activity was measured using the International Physical Activity Questionnaire (IPAQ-SF) for each week for a duration of 16 weeks total. The findings of this study showed a significant reduction of 6.9% in A1c at the end of the program. The study also showed females achieved more benefits than males, 7.1% to 6.4%. While the A1c was reduced at the end of the program, the total physical activity did not reach the level to significantly impact the A1c reduction. The implication of this finding is that the patients could gain health benefits from a patient education program including physical activity, diet, and lifestyle change.

Key words: Diabetes, physical activity, patient education.

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Introduction

According to Levy (2021) about 34.1 million American adults of 18 years or older or about 13.0% of US population had Diabetes Mellitus Type 2. And one third of them did not even know they had diabetes (Philpott, 2017). Office of Disease Prevention and Health Promotion (ODPHP), (n.d.) reports that diabetes is 7th leading cause of death in USA. This report shows that 18.7% of diabetes adults had HbA1c above 9.0 in 2013-2016. HbA1c is a measure of glucose, or sugar level, in the blood and is used to diagnose and monitor people with diabetes (Wang & Hng, 2021). Consequently, diabetes and lowering the HbA1c to 9.0 or less has become serious public health issues that need to be addressed as they are also part of Healthy People 2030 objectives (ODPHP, n.d.).

Despite the proven benefits of physical activity, many patients fail to adhere to the recommendations due to real or perceived barriers. Among the barriers, poor socioeconomic status, low education, neighborhood security, low motivation, lack or difficulty of accessing the recreational facilities have been cited (Park, et al. 2020). A patient education program has been recommended as an effective strategy to counter the barriers and in promoting physical activity, lifestyle change and adherence to treatment plans (Bekele et al. 2020).

Significance

The American Diabetes Association (2018) has estimated the yearly economic and healthcare cost of diabetes patients to be around $327 billion dollars, an increase of 26% for a five-year period. According to this report, the United States Government pays for about 67% of the cost of diabetes care in this country. Subsequently, the increased cost of diabetes care would make prevention and management of diabetes even more important (O'Connell et al., 2019).

Diabetic individuals with high and uncontrolled HbA1c are at an elevated risk of other health complications such as heart disease, stroke, kidney, and vision damage (Taggart et al., 2013).

While there are many new drugs available for managing diabetes, more than 50% of type 2 diabetes patients fail to reach their desired target (Fujiwara et al., 2019). Thus, a complementary approach to disease management based on healthy lifestyle including physical activity and diet change has been suggested (Fujiwara et al., 2019). A physical activity program alone could help in controlling the blood sugar level and HbA1c, reducing the risk of heart attacks, managing weight, and improving overall health (Amanat et al., 2020).

The rationale for promoting physical activity for diabetic control is that physical activity has been proven to be an effective non-pharmacotherapy strategy in lowering blood sugar level (Wake, 2020). People in highest quartile of physical activity had 42% lower prevalence of diabetes compared with those in lowest quartile (Zhao, et al. 2020). Physical activity helps diabetic individuals in lowering blood glucose levels and making the body more sensitive to insulin (Mukhtar, 2020).

To promote regular exercise as an effective strategy in managing diabetes, an educational program should provide the patients with relevant information and awareness to control their diabetes issues through self-care management (Knight et al., 2006). Such an educational program should use the elements of the patients' culture, beliefs, and values to increase knowledge, and skills in diabetes self-care (Powers et al., 2017). These educational interventions would be more effective when they are grounded in a theory facilitating the care and communication with the patients (Azeez et al., 2018).

Theoretical Framework

Reviewing the research literature, Albert Bandura's Social Cognitive Theory has been identified as an effective and appropriate guide in applying theory-based interventions on changing the behaviors through education. This change of behaviors would be guided to ultimately result in achieving the goals of the intervention (Lent et al., 1994). This theory includes three key constructs that together would create a triadic reciprocal interaction (Bandura, 1999) as depicted in Figure 1.

The three constructs of the Social Cognitive Theory include cognitive factors, behavioral factors, and environmental factors. Age, knowledge, expectation, and attitudes are considered cognitive factors whereas skills, practice, and self-efficacy are considered behavioral factors. Environmental factors include access to resources, support from family or friends. These constructs work together to change a person's behavior through education for lifestyle change and exercise (Oyibo, et al., 2018).

The Social Cognitive Theory suggests that behavior change can take place when persons feel they have the sufficient knowledge, skill, and capability to execute a specific behavior if they have a reasonable expectation of reaching the desired outcome (Wong and Monaghan, 2020). The constructs in the Social Cognitive Theory allow for physical activity behavioral changes that could lead to using the gained knowledge and awareness to benefit from the culturally appropriate intervention (Yates, 2008). For example, constructs self-efficacy and outcome expectations could be utilized in formulating an education intervention to assist the healthcare providers in health promotion. Self-efficacy means the individual has the belief and self-confidence that he or she has the ability to take action and overcome barriers. A diabetes patient through self-efficacy can change behaviors to make the lifestyle change and self-manage his/her diabetes medication plans. A diabetes patient through self-efficacy can set realistic and incremental goals to achieve mastery (Jiang et al. 2019). Diabetes patients can set a goal of doing regular physical activity to lower his/her HbA1c.

This theory has been widely used in cases involving education intervention to promote increased physical activity and appropriate diet change to manage the HbA1C (Thojampa & Sarnkhaowkhom, 2019). Plotnikoff (2008) also conducted a study that applied the Social Cognitive Theory to promote physical activity among diabetes patients and the result was positive. In another case in Thailand, Thojampa and Sarnkhaowkhom (2019) reported an intervention plan based on the Social Cognitive Theory resulted in significant improvement and adherence to the medication plans.

Literature Review

There is a growing body of research regarding the effectiveness of physical activities in reducing HbA1c or delaying onset of Diabetes Mellitus type 2 (Pahra, et al. 2017). Pai (2016) researched 10 Chinese and English databases and found the physical activities were effective in lowering the HbA1c and even better results were obtained with more vigorous physical activities. This report also found yoga to be the most effective exercise in lowering the blood sugar. Research by Zhao et al., (2020) also confirms the direct association between moderate to vigorous physical activities (MVPA) and a reduction in HbA1c among DM type 2 patients. Another study (Smith et al., 2016), shows 150 minutes of moderate to vigorous physical activity (MVPA) or 75 minutes vigorous physical activity (VPA) a week compared with inactive individuals resulted in 26% reduction in type 2 diabetes risk. Doubling the physical activities to 300 minutes a week resulted in another 10% reduction in diabetes type 2 risk for a total of 36% (Wahid et al., 2016).

Practice Gap

The literature reviews show the effectiveness of physical activity in reducing blood sugar level and HbA1c (Boniol et al. 2017). However, despite recommendations many diabetes patients do not participate in physical activity programs and consequently fail to reach their target HbA1c level. In fact, a report (Thomas, et al. 2004) shows only 34% of diabetes patients do regular physical exercise. This report cites perceived lack of time, perceived difficulty in attending a physical activity program and lack of local facilities as barriers to participate in exercise programs.

The gaps indicate that there is still a strong need to educate diabetes patients and healthcare policy planners about the benefits of physical activity in improving their HbA1c. Currently, this clinic does not have a regular patient education program for diabetes control. Implementing this project at this clinic should raise the knowledge level among the diabetes individuals of the positive impact of physical activity in controlling diabetes.

Methods

Study Design

This quality improvement project uses a quasi-experimental, pretest-posttest single site design to examine the impact of a physical activity education program on reducing HbA1c level. Quasi-experimental projects use convenience sampling where a cause-and-effect relationship exists. The purpose of this design is to measure the daily physical activity for the duration of this project and determining the effects that this physical activity has on reducing the HbA1c level. This quality improvement patient education project is IRB-exempt.

Project Setting

This project was conducted in a single site local community health center in San Leandro, Alameda County in California. This clinic provides a variety of healthcare services such as medical, dental, and mental health to a mostly underserved patient community of diversified cultural background. The medical team includes five providers of physicians and nurse practitioners, and I am one of the nurse practitioners as the project leader. The clinic's patient population mix includes mostly members of White (40%), African American (31%), Asian (23%), Hispanics (%4), and other communities (%2).

Participants and Project Sample

Inclusion Criteria

The participants for this project included a convenience sample of adults with type II diabetes mellitus recruited from the clinic's patients. The eligible patients were aged 18-79 years, received care at the clinic, had a diagnosis of type II diabetes mellitus and HbA1C of 6.5 or more within three months before the program starts. Participants understood and were able to communicate in English language as the educational sessions were conducted in English. Participants were able to engage in at least moderate exercises.

A convenience sample size of 30 adults were recruited who met eligibility criteria. This group were willing to commit to a program of 3 months of physical activity patient education at the clinic.

Exclusion Criteria

The program is patient education involving physical activity. So, patients who had conditions that prevented them from engaging in at least moderate physical activity were excluded. In addition, those patients who had new medications or dosage changes were excluded because this might have confounded the outcome. Patients who did not meet the age and HbA1c level requirements were also excluded.

Intervention

The intervention is a patient education of physical activity program. This program presented the benefits of physical activities so that participants were encouraged and motivated to manage their diabetes through increased physical activity and lifestyle change. The educational materials were information gathered mostly from well-known government sites like CDC that promote physical activity, diet and lifestyle change as strategies to control diabetes. A sample has been included in Appendix A.

Data Collection

Demographic information was collected through a questionnaire at the time of the initial patient education session. Gender, age in years, weight in pounds, height in inches, education level in years, and occupation was collected to examine the possible effects of those on the HbA1c outcome.

Physical Activity (PA) were measured using the 7-item International Physical Activity Questionnaire Short Form (IPAQ-SF), which measured the physical activities in a 7-day week. These instruments have been validated in 12 countries and in many languages including English. But research on the validity of these instruments in the USA is limited. Despite its limitations, these instruments have acceptable measurements properties to measure the physical activities of adult individuals. (Wolin et al., 2008).

The physical activities were measured in 4 levels of vigorous activity, moderate activity, walking, and sitting. These domains as defined by IPAQ Research Committee (2005) included leisure time physical activities, domestic and gardening (yard) activities, work-related physical activities, and transport-related physical activities (see Appendix B, IPAQ-SF).

The literature review indicates extensive use of these instruments in measuring the physical activities of individuals in clinical research. Shamizadeh et al. (2019) used the long form of IPAQ questionnaire in their research measuring the physical activities of individuals in a rural community in Iran. Zhang et al. (2020) also used a Chinese version of this instrument to assess the impact of physical activities on improving the quality of life among patients of Diabetes Mellitus type 2 in China. Duclos et. al. (2015) used the IPAQ instruments to measure the physical activities of the diabetes participants in a French project. However, a common concern about these IPAQ instruments is the potential for over-reporting of physical activities which the investigators should be careful about (Hallal et al., 2010).

Data collected from IPAQ forms were converted to metabolic equivalent scores (MET-min/week). Metabolic Equivalent of Task (MET) indicates how much energy has been consumed during physical activities. One MET is defined as the amount of oxygen expended while sitting quietly at rest and is 3.5 ml/kg for an average person (Jetté & Blümchen, 1990). Values of 8.0 METs for vigorous physical activities, 4.0 METs for moderate activities and 3.3 METs for walking activities is used (Shamizadeh et al., 2019). Duration of physical activities were measured in minutes and the physical activities were measured for each day. Because this form measured the PA for the previous 7-day week, our measurements were collected and calculated for each week and for a total of 14 weeks. The information collected were saved on the computer for later processing and analysis by Intellectus Statistics software package.

Outcome Variables

The primary outcomes for this project were patient physical activity and their HbA1C. HbA1cs were measured using the routine laboratory test at the beginning and at the end of the program. The total amount of physical activity for the duration of the program was calculated for each participant. These amounts then were analyzed to examine the impact of the physical activity on the HbA1c.

Procedures

Planning

Recruitment fliers were posted in visible locations around the clinic to inform our patients, staff, and other providers of these programs. The fliers informed the patients that these educational programs were free and contact information was posted. A copy of such recruitment flier is attached as Appendix C. We also contacted our patients to inform them of the availability of the program. The clinic is relatively small, and 15-20 adults was the most I could gather in one place.

Physical Activity Education Program

Classes were held in a room designated for this project in the clinic. Educational materials were prepared in advance and distributed among the participants in each session. In each session, I presented selected educational materials that provided the plan participants with relevant and appropriate information. These presentations highlighted the proven benefits of physical activities and lifestyle changes that could help in controlling diabetes and reducing the HbA1C. Please see Appendix A for information regarding these materials.

The project duration was 16 weeks. Educational classes were conducted every other week for 14 weeks, translating into 7 sessions. Each session lasted two hours. In each session the participants turned in their completed physical activity questionnaire form for the previous two weeks. We assisted the participants with any questions regarding their questionnaires. Then participants took new questionnaire forms for the next education session. If someone did not make it to the education session, we contacted him/her to get his/her data for the questionnaire. The materials and the educational sessions were in English since these patients understood and communicated in English in our encounters in the clinic. The Spanish versions were also available for those who needed them.

In the first session, I recorded the participants HbA1c, weight, and height to create a baseline database. These measurements were taken again at the last session for comparison purposes. The IPAQ-SF forms were completed by participants at each patient education session, giving data for each week's activity. Assistance was provided to those who needed help in completing these forms.

At the end of each session, I collected the data and entered it manually into the computer using Microsoft's Excel. Finally, at the end of the 14 weeks education period, once again the HbA1c of the participants were measured along with weight, and height for comparison to the baseline HbA1c established at the start of the program.

Training

The clinic's staff were informed of the launch of this patient education program. The staff and associates were provided with contact information in case the participants of the program contacted them for information or support. Our clinic had multilingual staff that could have provided translation assistance if needed.

Analysis

This study uses the Intellectus Statistics software package for data analysis. This is a software application that facilitates the task of analysis by providing an intuitive and easy to use interface for the researchers (Intellectus Statistics, 2023). All variables are reported using descriptive statistics. Paired samples t-test was used to compare mean HbA1c before and after the completion of the education program. This is a parametric statistical test that compares the means of two variables of the same group of samples when pretest/posttest comparisons are made (Hedberg & Ayers, 2015). Alternative, nonparametric Wilcoxon Signed-Rank test was used when the use of parametric paired samples t-test was not appropriate. Statistical significance in all analyses is determined by p-values <= 0.05.

Results

Descriptive Statistics: Participant Metrics

Initially a total sample of 30 candidates were selected for this project. The candidates were two thirds female (n = 20, 66.67%) and males (n = 10, 33.33%). However, several candidates dropped out of the program so these participants were excluded for the data analysis. As a result, the final sample population was reduced to 24 individuals.

Final samples included 16 female participants (66.67%) and 8 male participants (33.33%). Among the racial groupings, the most frequently observed category was Hispanic (*n* = 9, 37.50%) followed by Asians (*n* = 6, 25.00%). The participants' ages ranged from 27 to 79 with the mean of 56.12 and median of 57.00 years. The most frequently observed age grouping was 51-70 (*n* = 13, 54.17%) followed by the grouping of 35-50 (*n* = 7, 29.17%). The demographic data also shows that a little more than half of the sample had completed high school or a 4-year college degree (*n* = 13, 54.17%). The observations for Height had a range of 59.00 to 71.00 inches and an average of 64.19 inches. The participants' demographic data is presented in Table 1.

Table 1

Demographic Data

Variable	*n*	%
Gender		
Female	16	66.67
Male	8	33.33
Missing	0	0.00
Race		
Others	4	16.67
Hispanic	9	37.50
African/American	1	4.17
Asian	6	25.00
White	4	16.67
Missing	0	0.00
Age group		
51-70	13	54.17
35-50	7	29.17
18-34	1	4.17
71 Plus	3	12.50
Missing	0	0.00
Highest Level of Education		
High school	9	37.50
Less than high school	11	45.83
4-year College	4	16.67
Missing	0	0.00

Note. Due to rounding errors, percentages may not equal 100%.

Attendance

The attendance level ranged from 11 to 15 people each session with an average of 12 in-person attendance. Those participants who failed to attend the in-person sessions would come to the clinic to turn in their exercise questionnaires and pick up the new educational materials. In addition, those who missed the in-person sessions were contacted by phone to discuss their education and retrieve their physical activity data. Observations for the attendance level can be found in Table 2.

Table 2

Frequency Table for Attendance Level

In-person attendance level	*n*	%
More than 10 sessions	11	45.83
Less than 5 sessions	10	41.67
Between 5 & 10 sessions	3	12.50

Weight, HbA1C Reduction and Physical Activity

The observations for A1c before the program ranged from 5.80 to 13.00 with a mean of 8.55 while the observations for the A1c after the program ranged from 5.6 to 10.80 with a mean of 7.83. The observations for the weight of the participants before the program ranged from 121.00 to 348 with a of while the observations for the weight ranged from 122.60 to 354.00 lbs. with a mean of 191.12 lbs. The summary statistics can be found in Table 3.

Table 3

Summary Statistics Table for Variables

Variable	*M*	*SD*	*n*	Min	Max
A1c after the program	7.83	1.60	24	5.60	10.80
A1c before the program	8.55	1.99	24	5.80	13.00

Table 3

Summary Statistics Table for Variables

Variable	*M*	*SD*	*n*	Min	Max
Weight after the program	191.12	57.83	24	122.60	354.00
Weight before the program	189.44	57.65	24	121.00	348.00
Total physical activity in MET	21,431.90	19,350.77	24	3,234.00	78,538.00

Note. '-' indicates the statistic is undefined due to constant data or an insufficient sample size.

Pearson Correlation Analysis for Physical Activity and HbA1c

A Pearson correlation analysis was conducted between total physical activity and the A1c changes. The result of the correlation was examined based on an alpha value of 0.05. There were no significant correlations between total physical activity and A1c. Table 4 presents the results of this correlation.

Table 4

Pearson Correlation Results Between Total Physical Activity and A1c Improvements

Combination	*r*	95.00% CI	*n*	*p*
Physical Activity-A1c improvements	0.12	[-.30, .50]	24	0.573

Two-Tailed Paired Samples *t*-Test for Weight

A two-tailed paired samples *t*-test was conducted to examine whether the mean difference of weight before and after was significantly different from zero. A Shapiro-Wilk test was conducted to determine whether the differences in weight before and after the education could have been produced by a normal distribution (Razali & Wah, 2011). The results of the Shapiro-Wilk test were not significant (alpha=0.05, $W = 0.92$, $p = 0.053$). This result suggests the possibility that the differences in weight before and after the education were produced by a normal distribution cannot be ruled out, indicating the normality assumption is met.

The result of the two-tailed paired samples *t*-test was significant (alpha=0.05, t (23) = -2.39, p = 0.025) indicating the null hypothesis can be rejected. This finding suggests the difference in the mean of weight before and after the education was significantly different from zero. The mean of weight before the education was significantly lower than the mean of weight after the education. The results are presented in Table 5.

Table 5

Two-Tailed Paired Samples t-Test for the Difference Between Weight before and Weight After

Weight before		Weight after				
M	*SD*	*M*	*SD*	*t*	*p*	*d*
189.44	57.65	191.12	57.83	-2.39	0.025	0.49

Note. N = 24. Degrees of Freedom for the *t*-statistic = 23. *d* represents Cohen's *d.*

Two-Tailed Paired Samples *t*-Test for A1c Before and After the Program

A two-tailed paired samples *t*-test was conducted to examine the mean difference of A1c before and after the program. A Shapiro-Wilk test was conducted to determine whether the differences in A1c before and after the program could have been produced by a normal distribution (Razali & Wah, 2011). The results of the Shapiro-Wilk test were significant (alpha value of 0.05, W = 0.89, p = 0.016). This result suggests the differences in A1c before and after the education are unlikely to have been produced by a normal distribution, indicating the normality assumption is violated.

Then a Levene's test was conducted to assess whether the variances of A1c before and after the education were significantly different. The result of Levene's test was not significant based on an alpha value of 0.05, F (1, 46) = 0.46, p = 0.500. This result suggests it is possible that A1c before and after were produced by distributions with equal variances, indicating the assumption of homogeneity of variance was met.

Since assumption of homogeneity of variance was met, the result of the two-tailed paired samples *t*-test was significant based on an alpha value of 0.05, t (23) = 2.40, p = 0.025, indicating the null hypothesis can be rejected. This finding suggests the difference in the mean of A1c before and after the program after was significantly different from zero. The mean of A1c before was significantly higher than the mean of A1c after the program. The results are presented in Table 6.

Table 6

Two-Tailed Paired Samples t-Test for the Difference Between A1c Before and A1c After

A1c before		A1c after				
M	*SD*	*M*	*SD*	*t*	*p*	*d*
8.55	1.99	7.83	1.60	2.40	0.025	0.49

Note. N = 24. Degrees of Freedom for the *t*-statistic = 23. *D* represents Cohen's *d*.

Because the normality assumption had not been met, a Wilcoxon Signed-Rank Test was conducted to confirm the findings of the paired sample t-test. The two-tailed Wilcoxon signed rank test is a non-parametric alternative to the paired samples *t*-test and does not share its normality distributional assumptions (Conover & Iman, 1981).

Two-Tailed Wilcoxon Signed Rank Test

A two-tailed Wilcoxon signed rank test was conducted to examine whether there was a significant difference between A1c pre and post intervention. The results of the two-tailed Wilcoxon signed rank test were significant based on an alpha value of 0.05, V = 201.00, z = -2.42, p = 0.016. This indicates that the differences between A1c before and A1c and after the intervention are not likely due to random variation. The median of A1c before the program was 8.2 which was significantly larger than 8.00, the median of A1c after the program. This confirms that there was statistically significant improvements in A1c.

Discussion

Key findings

Providing an educational program for patients with elevated A1C offers a unique opportunity to improve the health of diabetic patients. This study shows that physical activity patient education indeed helped most of the participants in lowering their HbA1c. The improvement of almost 6.9% in HbA1c obtained through this program shows that it is possible to gain even better results if patients follow a physically active lifestyle and commit to regular exercises. A reduction of 5% in HbA1c is considered a significant improvement (Lisi, 2018).

Weight gain is attributed to the impact of weight gain during holidays like Thanksgiving. Since part of this education program coincided with the Thanksgiving and Christmas holidays, the outcomes of the program was negatively impacted. For example, a study by Hull, et al (2006) reported that the entire sample population gained weight during the Thanksgiving holidays. This is indeed confirmed by some of the participants in the education program that they were losing weight before Thanksgiving but gained weight during the holidays.

Another finding of this project was that improvement in HbA1c was correlated with the amount of physical activity, but the correlation was insignificant (r-value = 0.12). The study could not find a significant relationship between the amount of physical activity and the amount of improvement in the HbA1c.

Limitations of the Project

Temporal and Weather Barriers

The results of this study were impacted by the start of rainy season, holidays, and a new surge in COVID. Adverse weather conditions such as temperature and rain have been determined to be a barrier to habitual physical activity (Chan & Ryan, 2009). Some of the participants indeed commented that they could not exercise as much as they wished because walking or going to gyms were difficult for them in the bad weather.

Personal Barriers

In addition, some participants had additional job requirements that kept them busy or working overtime during the holiday and thus prevented them from participating as much as they hoped. This impacted their attendance level and also in the performing the exercise programs.

COVID as a Barrier

The lingering effects of Covid continued to negatively impact the patients' participation in the education program. Some of the participants opted for skipping the in-person classes for the safety of their home because they were worried about the spread of the Covid. Furthermore, because of Thanksgiving and Christmas holidays, some of the participants had travel plans and did not attend the in-person sessions but continued their exercise plans.

Sample size

The result of this project was impacted by the small sample size. The clinic is relatively small and as a result it was very challenging to recruit a sufficiently large sample size for the project. The size of a sample is crucial for a project so that the outputs can be interpreted appropriately.

Conclusion

This study found an overall positive result from physical activity patient education. The study confirmed the general understanding that regular physical activity would result in improvements in the HbA1c of type 2 diabetes patients. The participants made significant improvements in lowering their HbA1c and were informed of the importance of physical activity and lifestyle change in managing their HbA1c.

The findings of this study should encourage similar clinics with diverse populations to implement similar patient education programs. In fact, the feedback received from the participants were very positive and showed their interest in continuing this class and other chronic health issues.

While in-person patient education is desirable, a flexible education model allows the participants to attend the classes in-person or online whatever suits them the best. Due to the patient barrier with in-person class attendance, future research can explore the effectiveness of other modes of education that allow flexibility. These include online options, video conferencing and others. Any education program, online or in-person, that raises awareness among the participants could lead to improved healthcare outcomes among the patients.

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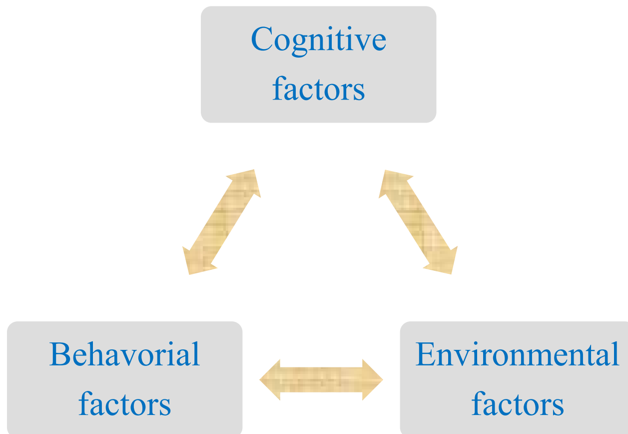
Figure 1

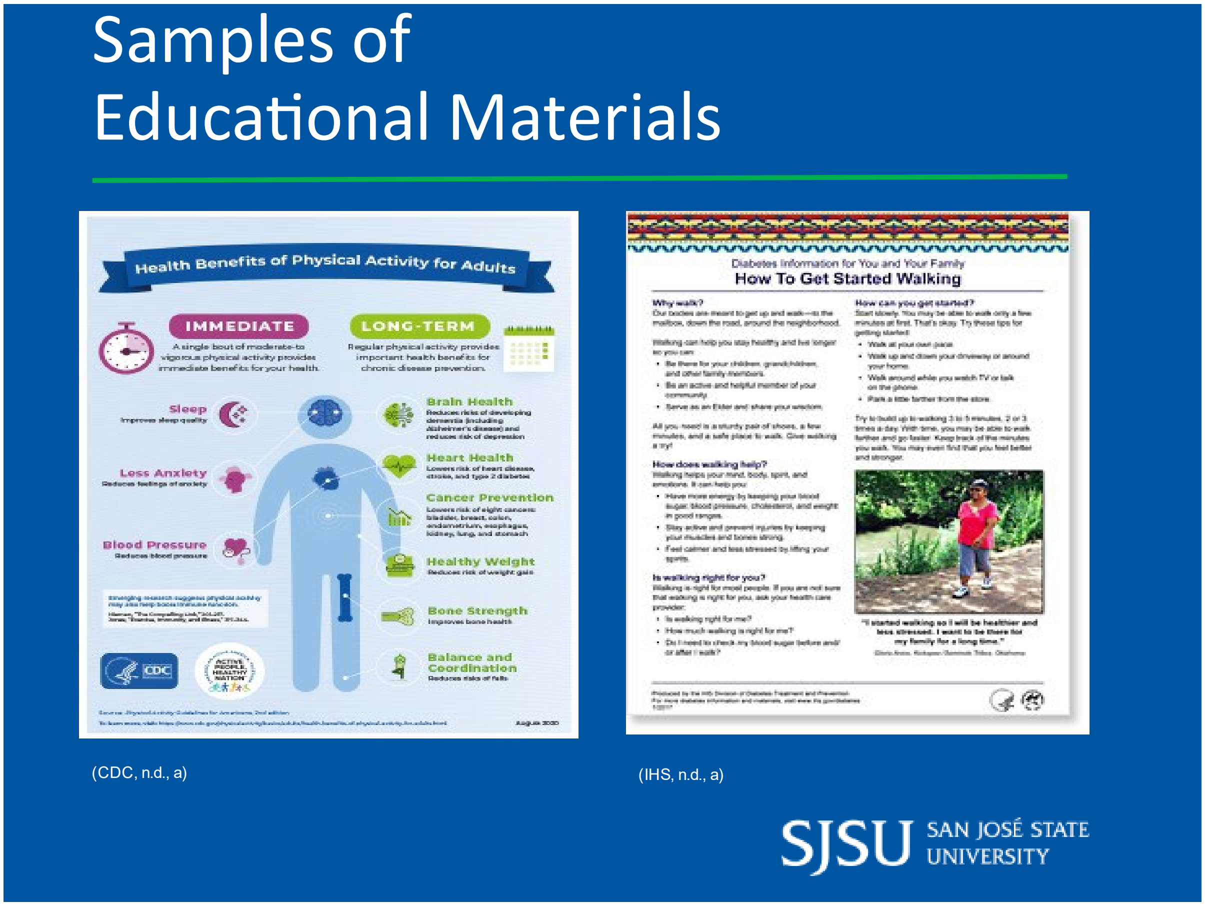
Triadic reciprocal determination

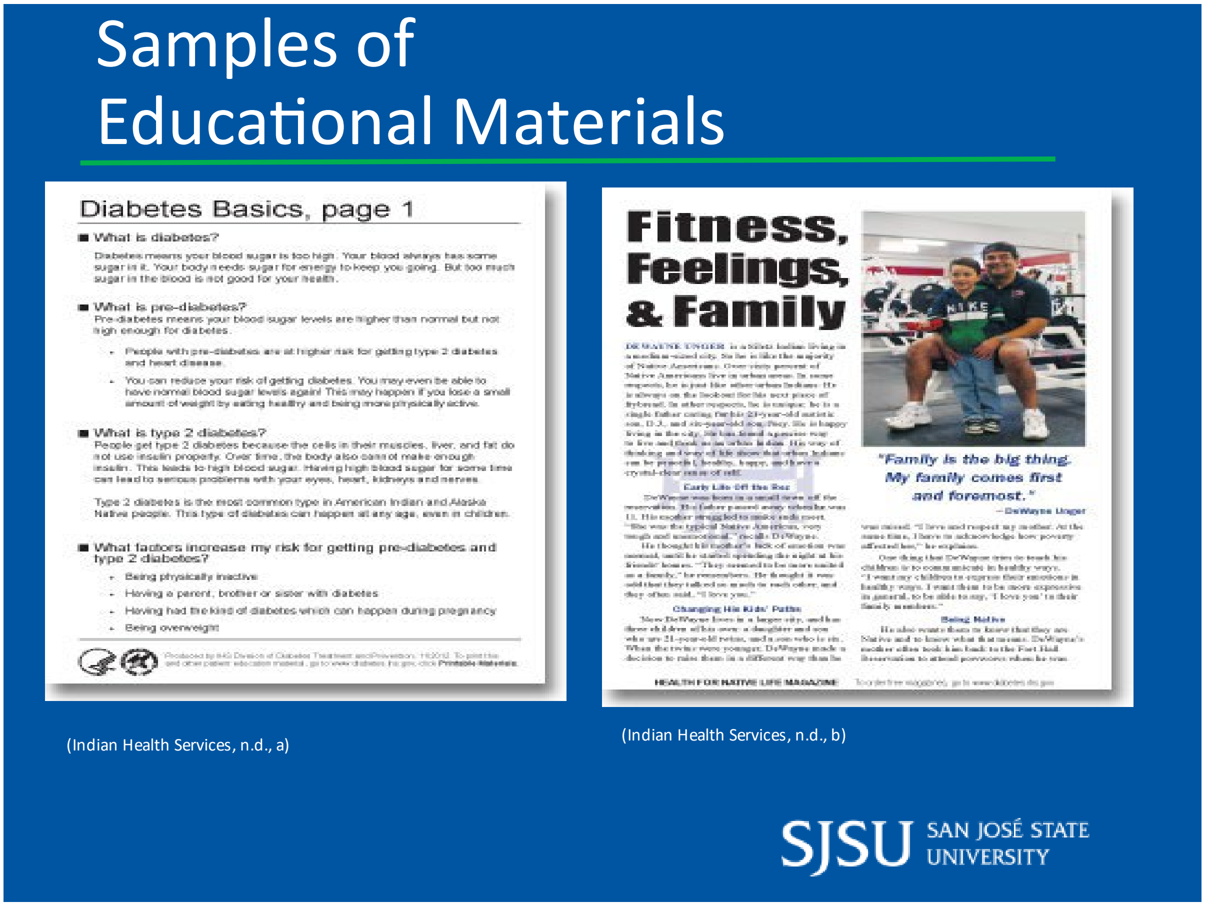


Appendix A

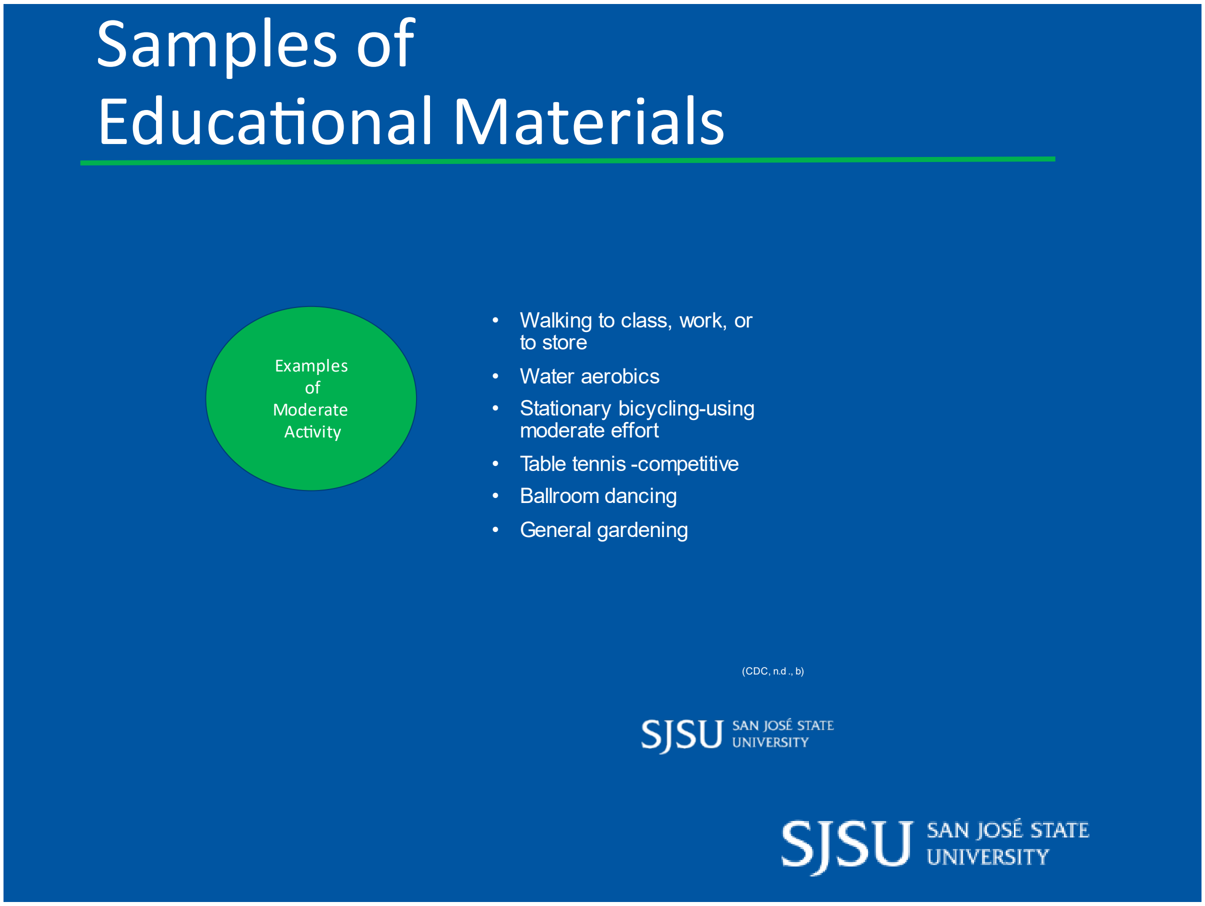
Physical Activity Guidelines

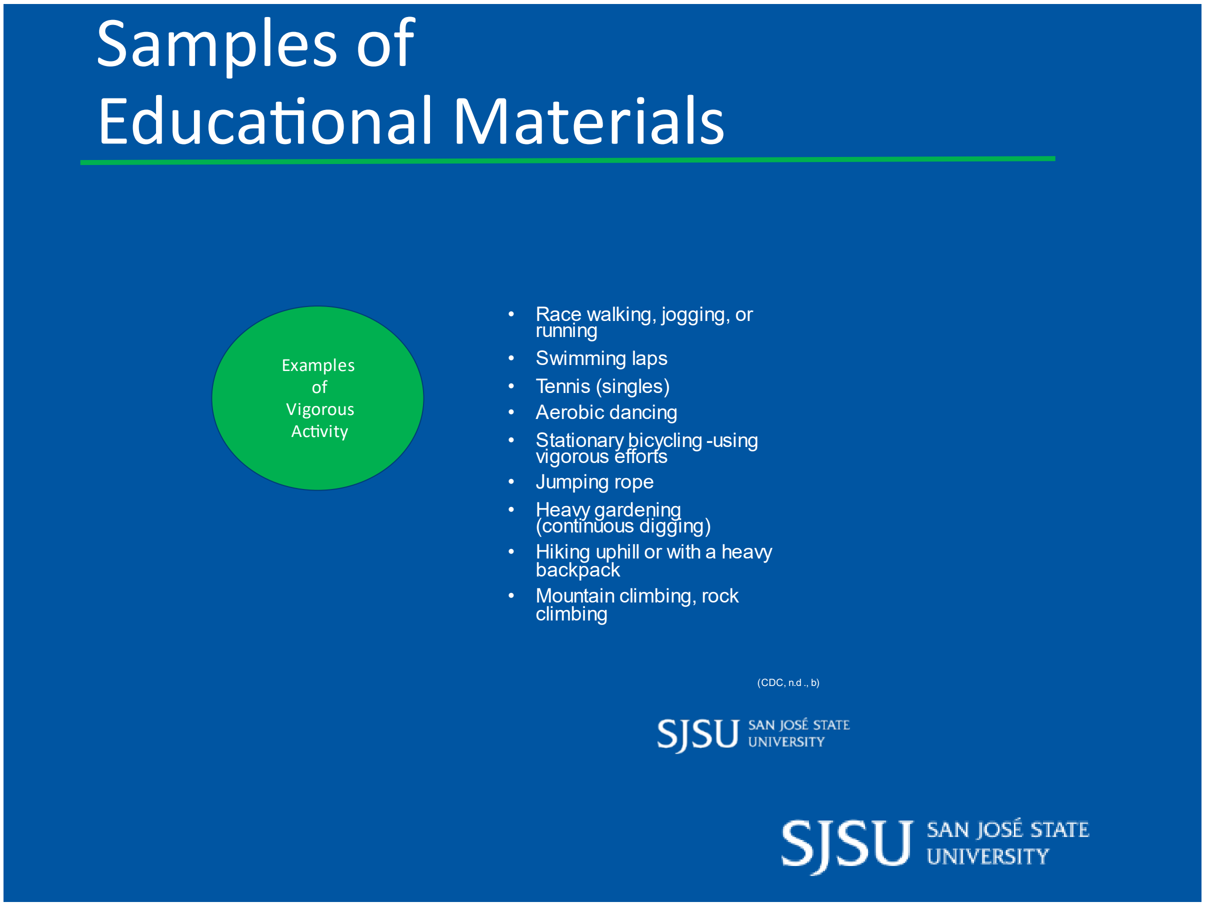
Presentation materials to discuss with the project participants.




Samples of
Educational Materials
Diabetes Basics, page 1
What is diabetes?
Diabetes means your blood sugar is too high. Your blood always has some sugar in it. Your body needs sugar for energy to keep you going. But too much sugar in the blood is not good for your health.
What is pre-diabetes?
Pre-diabetes means your blood sugar levels are higher than normal but not high enough for diabetes.
People with pre-diabetes are at higher risk for getting type 2 diabetes and heart disease.
You can reduce your risk of getting diabetes. You may even be able to have normal blood sugar levels again! This may happen if you lose a small amount of weight by eating healthy and being more physically active.
What is type 2 diabetes?
People get type 2 diabetes because the cells in their muscles, liver, and fat do not use insulin properly. Over time, the body also cannot make enough insulin. This leads to high blood sugar. Having high blood sugar for some time can lead to serious problems with your eyes, heart, kidneys and nerves.
Type 2 diabetes is the most common type in American Indian and Alaska Native people. This type of diabetes can happen at any age, even in children.
What factors increase my risk for getting pre-diabetes and type 2 diabetes?
Being physically inactive
Having a parent, brother or sister with diabetes
Having had the kind of diabetes which can happen during pregnancy
Being overweight
(Indian Health Services, n.d., a)
Fitness, Feelings, & Family
"Family is the big thing. My family comes first and foremost."
—DeWayne Unger
Early Life Off the Rez
Changing His Kids' Paths
Being Native
HEALTH FOR NATIVE LIFE MAGAZINE
(Indian Health Services, n.d., b)
SJSU SAN JOSÉ STATE UNIVERSITY


Samples of
Educational Materials
BENEFITS
OF
PHYSICAL
ACTIVITIES
• Blood sugar control
• Weight management
• Lower blood pressure
• Reduce Vascular Health Risk
• Strengthen muscles, bones
• Reduce anxiety
• Improve overall health
• From: https://www.health.harvard.edu/staying-healthy/
SJSU SAN JOSÉ STATE UNIVERSITY


Samples of
Educational Materials
Examples of Moderate Activity
• Walking to class, work, or to store
• Water aerobics
• Stationary bicycling-using moderate effort
• Table tennis -competitive
• Ballroom dancing
• General gardening
(CDC, n.d., b)
SJSU SAN JOSÉ STATE UNIVERSITY
SJSU SAN JOSÉ STATE UNIVERSITY


Samples of
Educational Materials
Examples of Vigorous Activity
• Race walking, jogging, or running
• Swimming laps
• Tennis (singles)
• Aerobic dancing
• Stationary bicycling -using vigorous efforts
• Jumping rope
• Heavy gardening (continuous digging)
• Hiking uphill or with a heavy backpack
• Mountain climbing, rock climbing
(CDC, n.d., b)
SJSU SAN JOSÉ STATE UNIVERSITY
SJSU SAN JOSÉ STATE UNIVERSITY

Appendix B

https://sites.google.com/site/theipaq/questionnaire_links

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

(August 2002)

SHORT LAST 7 DAYS SELF-ADMINISTERED FORMAT

FOR USE WITH YOUNG AND MIDDLE-AGED ADULTS (15-69 years)

The International Physical Activity Questionnaires (IPAQ) comprises a set of 4 questionnaires. Long (5 activity domains asked independently) and short (4 generic items) versions for use by either telephone or self-administered methods are available. The purpose of the questionnaires is to provide common instruments that can be used to obtain internationally comparable data on health–related physical activity.

Background on IPAQ

The development of an international measure for physical activity commenced in Geneva in 1998 and was followed by extensive reliability and validity testing undertaken across 12 countries (14 sites) during 2000. The final results suggest that these measures have acceptable measurement properties for use in many settings and in different languages and are suitable for national population-based prevalence studies of participation in physical activity.

Using IPAQ

Use of the IPAQ instruments for monitoring and research purposes is encouraged. It is recommended that no changes be made to the order or wording of the questions as this will affect the psychometric properties of the instruments.

Translation from English and Cultural Adaptation

Translation from English is supported to facilitate worldwide use of IPAQ. Information on the availability of IPAQ in different languages can be obtained at www.ipaq.ki.se. If a new translation is undertaken we highly recommend using the prescribed back translation methods available on the IPAQ website. If possible please consider making your translated version of IPAQ available to others by contributing it to the IPAQ website. Further details on translation and cultural adaptation can be downloaded from the website.

Further Developments of IPAQ

International collaboration on IPAQ is on-going and an ***International Physical Activity Prevalence Study*** is in progress. For further information see the IPAQ website.

More Information

More detailed information on the IPAQ process and the research methods used in the development of IPAQ instruments is available at www.ipaq.ki.se and Booth, M.L. (2000). *Assessment of Physical Activity: An International Perspective*. Research Quarterly for Exercise and Sport, 71 (2): s114-20. Other scientific publications and presentations on the use of IPAQ are summarized on the website.

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____ days per week

☐ No vigorous physical activities → ***Skip to question 3***

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐

Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____ **days per week**

☐

No moderate physical activities → ***Skip to question 5***

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐

Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ days per week

☐

No walking → ***Skip to question 7***

6. How much time did you usually spend **walking** on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐

Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ **hours per day**

_____ **minutes per day**

☐

Don't know/Not sure

Appendix C

Recruitment Notice

This flier is to be posted around the clinic building.

Participants Needed

We are conducting a free patient education about benefits of physical activity for diabetes type 2 patients.

Who Is Eligible

Between 18-70 years old and HbA1c > 7.0

Description of the Program

PowerPoint Presentation of benefits of physical activity in reducing HbA1c among the diabetes type 2.
Space is very limited.

Aug. - Nov. Every other Friday, 8:00 AM-10:00 AM

Please call 1-510-347-4620 if you are interested.

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