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A Quantitative Assessment of a Diabetes Self-Management Education Program

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Abstract

A Diabetes Self-Management Education (DSME) program offered in an inner-city health center run by the Cincinnati Health Department, which started in 2014, was created to help those in an underserved population learn how to manage their diabetes. Two key measurements, A1C (glycated hemoglobin) and BMI (body mass index), were taken over time to monitor their progress. In this study, we analyzed quantitatively whether or not there was a significant improvement in their BMI and A1C values over the course of two years since they joined DSME program as any improvement would imply a potentially healthier lifestyle in regards to their diabetes. The analysis was conducted in a number of ways, including (1) comparison of the patients in the DSME program before 2016 versus and those after 2016, and (2) comparisons of the patients who participated in the DSME program at some point during 2014-2018 versus the general population of diabetes patients in same time period. Our analysis suggests that the DSME program may help diabetes patients significantly reduce their individual variations in the BMI values, likely motivating them to maintain a healthier lifestyle.

Introduction

- The DSME program was created to help those in an underserved population learn how to manage their diabetes.
- The participants were from a lower income and an ethnic/cultural minority demographic.
- The program is run by an interdisciplinary team including:
 - Pharmacists, physical therapists, nurses, nutritionists, dentists;
 - Students, acting as individual health coaches for each patient, from the respective university fields.
- The program took place in an urban community health center.

Research Objectives

- Our research objectives include:
 - Whether or not the post-2016 program became more effective than the pre-2016 program;
 - Whether or not there is any statistical evidence that the DSME program helps its participants maintain healthy lifestyles.

Data

- Our data points are between the time the patients started the program to 730 days (2 years) after the program.
- The patients (from the DSME program and general clinic population) had at least four A1C and BMI values in the 730-day period.
- The sample sizes are summarized below.

Sample Size	Pre-2016 (A1C)	Post-2016 (A1C)	Pre-2016 (BMI)	Post-2016 (BMI)
DSME	3	3	6	10
General	7	36	16	59

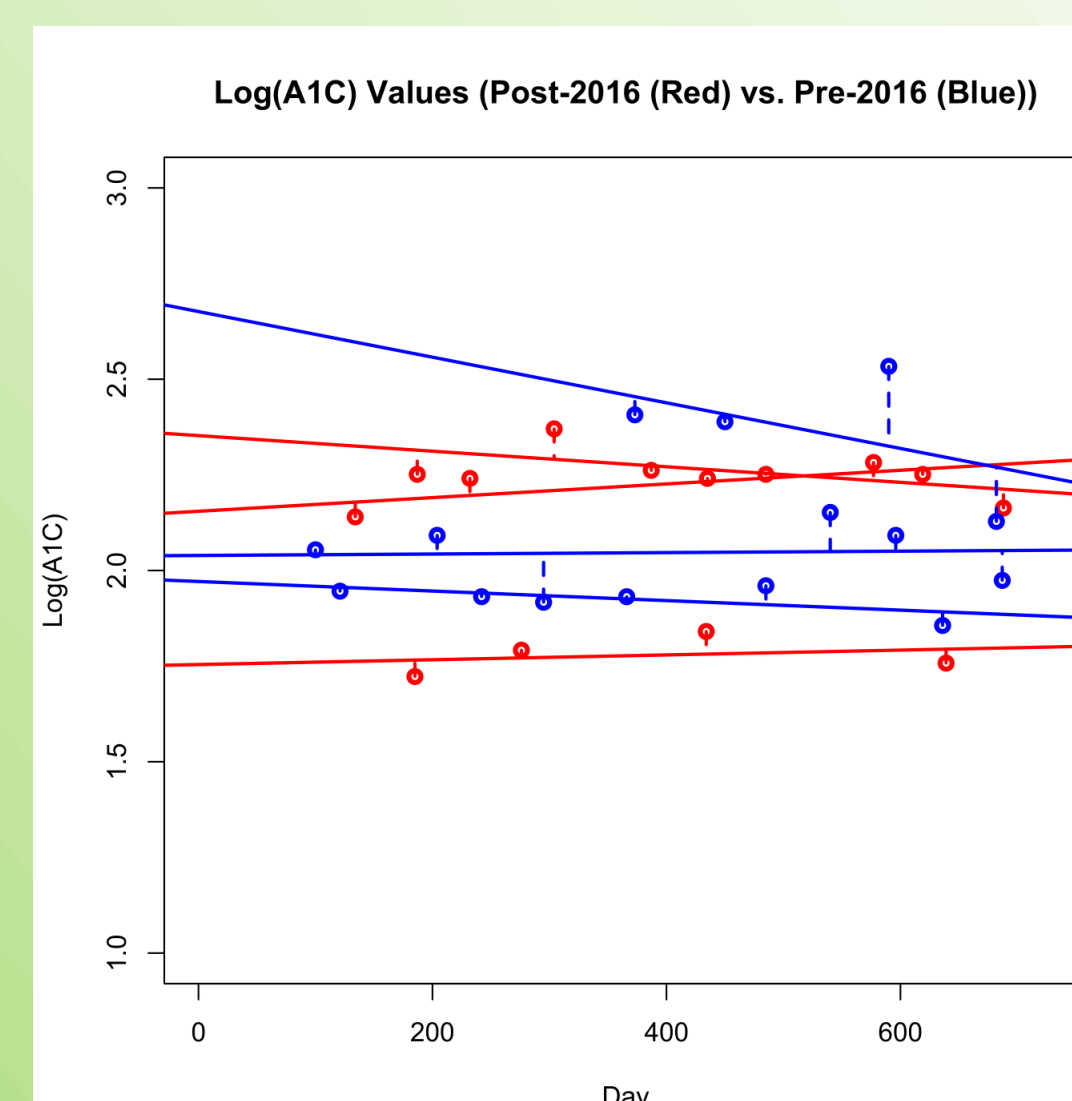
Table 1: Sample sizes of different groups

Methods

- We make the following comparisons using the log(A1C) and log(BMI) values.
 1. Post-2016 DSME Program vs. Pre-2016 DSME Program
 2. Post-2016 General Population vs. Pre-2016 General Population
 3. DSME Program vs. General Population

Statistical Approach

- Each patient is assumed to have a varying y-intercept and slope in a simple linear regression (see right) known as multi-level modeling.
- We applied non-parametric bootstrap-t method to calculate (adjusted) p-values for the overall y-intercept, overall slope, overall variance, and residual variance.



Results

Comparison	1 (A1C)	1 (BMI)	2 (A1C)	2 (BMI)	3 (A1C)	3 (BMI)
Adj. p-value for overall intercept	0.777	0.721	0.881	0.881	0.750	0.986
Adj. p-value for overall slope	0.848	0.626	0.855	0.855	0.341	0.285
Adj. p-value for overall variance	0.952	0.831	0.827	0.827	0.995	0.985
Adj. p-value for overall mean	0.777	0.626	0.855	0.855	0.341	0.285
Adj. p-value for overall structure	0.777	0.626	0.827	0.827	0.341	0.285
P-value for residual variance	0.012	0.002	0.855	< 0.001	0.699	< 0.001

Table 2: (Adjusted) p-values. Overall mean contains overall intercept and overall slope. Overall structure contains overall mean and overall variance. Adjusted p-value calculations follow [1, 2]. Significant results (< 0.05) are indicated in **bold**.

- The p-value for the residual variance for 3 (BMI) gives strong statistical evidence that those in the DSME program had more control over their BMI.
- The p-value for the residual variance for 1 (A1C) suggests that those in the program after 2016 had more control over their A1C than those in the program before 2016. However, due to the small sample sizes, any one patient can greatly affect the results, making the result less reliable.
- Although the p-value for the residual variance for 1 (BMI) is quite small, it cannot be used to conclude anything more about the usefulness of the program as the p-value for the residual variance for 2 (BMI) is also small.
- The overall structures are similar for all the comparisons as their adjusted p-values are high.

Conclusions

- Many of the participants reported after the program they had a higher confidence level on their knowledge of nutrition, which can be a strong attributer to why we see the BMI variance as small for those in the program versus the general population.
- A few of the significant changes that happened from the pre-2016 groups to the post-2016 groups that could be attributed to the reduction of the A1C values were a higher confidence in the team members running the program, adding one-on-one student coaches for the participants, and cutting two classes from the program to keep the focus.

References

- [1] Gabriel, K.R. (1969). Simultaneous test procedures – Some theory of multiple comparisons. *The Annals of Mathematical Statistics* 40(1), 224–250.
- [2] Westfall, P.H. (2011). On using the bootstrap for multiple comparisons. *Journal of Biopharmaceutical Statistics* 21(6), 1187–1205.