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# Correlation between Diabetes Knowledge and Glycemic Control: A Study using the Michigan Diabetes Research and Training Center's Revised Diabetes Knowledge Test

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**Abstract:** ***The purpose of this research is to investigate the correlation between diabetes knowledge and glycemic control among adult patients with Type 1 diabetes mellitus (T1DM) and Type 2 diabetes mellitus (T2DM), following a single session of diabetes self - management education and support (DSMES) focusing on diet. The Michigan Diabetes Research and Training Center's Revised Diabetes Knowledge Test (DKT2) was used to assess patients' general knowledge before and after the DSMES session, and hemoglobin A1C values were measured to evaluate glycemic control. The study found that while the DKT2 scores and A1C values showed overall improvement post - session, the correlation between increased knowledge and glycemic control was weak and not statistically significant. This highlights the need for comprehensive DSMES that includes more than dietary education and suggests multiple sessions for better diabetes management. This study is significant as it provides insights into the effectiveness of DSMES in improving diabetes knowledge and glycemic control, highlighting areas where patient education can be enhanced for better diabetes management outcomes.***

**Keywords:** diabetes knowledge, glycemic control, diabetes education, Type 1 diabetes, Type 2 diabetes

## 1. Introduction

Diabetes mellitus (DM) is a metabolic disease characterized by hyperglycemia resulting from defects in insulin secretion, action, or both.1 The American Diabetes Association (ADA) classifies three main categories of DM: type 1 diabetes mellitus (T1DM) resulting from beta - cell destruction, usually leading to absolute insulin deficiency; type 2 diabetes mellitus (T2DM) ranging from insulin resistance with relative insulin deficiency to an insulin secretory defect with insulin resistance; and gestational diabetes which occurs only during pregnancy.1 The diagnosis of DM is based on glycosylated hemoglobin (A1C) levels, fasting plasma glucose levels, 2 - hour plasma glucose levels during oral glucose tolerance testing, or random glucose levels in an individual with symptoms.1 Most recent estimates report, 34.2 million people, approximately 10.5% of the United States (U. S.) population, have been diagnosed with diabetes mellitus.2

Symptoms of DM are numerous but most commonly include increased thirst, increased urination, increased hunger, and weight loss.3 Glycosylated hemoglobin refers to the permanent attachment of glucose to hemoglobin molecules, reflecting the average plasma glucose exposure over the life of a red blood cell, approximately 120 days, and provides a more accurate measure for monitoring long - term control of blood glucose levels.3 For all types of DM, the main feature is chronic hyperglycemia, a high blood glucose level, resulting from problems with glucose regulation.3 Diabetes mellitus is a chronic metabolic disease affecting glucose regulation and requires lifelong behavioral and lifestyle changes for successful management.3

**Complications of Diabetes**

Diabetes mellitus can cause changes in large blood vessels, macrovascular, and small blood vessels, microvascular, leading to impaired tissue perfusion and cellular death.3 Macrovascular complications include coronary heart disease, cerebrovascular disease, and peripheral vascular disease, while microvascular complications lead to nephropathy (kidney dysfunction), neuropathy (nerve dysfunction), and retinopathy (vision problems).3 Causes of these vascular complications include chronic hyperglycemia, which thickens the basement membranes causing organ damage; glucose toxicity directly or indirectly affecting functional cellular integrity; and chronic ischemia in small blood vessels causing connective tissue hypoxia and microischemia.3 The frequency and severity of these complications are proportional to the duration of the disease and the status of glycemic control.1 Chronic high blood glucose levels are the main cause of all vascular complications related to DM.3

Chronic complications of DM occur over time and are of concern for patients with T1DM and T2DM; however, patients need to be educated on acute diabetes complications too. Three glucose related emergencies that can occur in

patients with diabetes are diabetic ketoacidosis (DKA) caused by lack of insulin; hyperglycemic - hyperosmolar state (HHS) caused by insulin deficiency and profound dehydration; and hypoglycemia from too much insulin or too little glucose.3 All three of these acute complications require immediate emergency treatment and can be fatal if treatment is delayed or incorrect.3 Diabetes complications can also lead to costly emergency room (ER) visits and hospitalizations for these patients. The Centers for Disease Control (CDC) 2020 National Diabetes Statistics Report shows 16 million ER visits occurred in the year 2016 with diabetes listed as a diagnosis, 7.8 million of those visits resulted in hospitalizations with cardiovascular events being the major culprit.4 The total direct and indirect estimated cost of diagnosed diabetes in the United States (U. S.) in the year 2017 was $327 billion (about $1, 000 per person in the US).4 The average medical expenditure for individuals diagnosed with diabetes is about 2.3 times higher than for those without diabetes.5 The complications of DM can be reduced with glycemic control. Glycemic control being defined by the American Diabetes Association (ADA) as an A1C level less than 7% (53 mmol/mol).6 Patients are often asymptomatic for microvascular complications until the disease is advanced (An et al., 2021). Chronic kidney disease (CKD) was the highest of the reported complications at the time of diagnosis among patients with DM.7 With appropriate glycemic control, significant risk reduction for the development of microvascular complications can be achieved.7 Good glycemic control is the cornerstone of treatment and is the difference between a life with verses a life without diabetes - related microvascular complications. Patients, along with the guidance of the healthcare team, can improve outcomes and reduce long - term complications by increasing knowledge of diabetes self - management.

**Diabetes Self - Management Education and Support (DSMES)**

Patient education has been acknowledged as the foundation of effective diabetes self - management.8 Most individuals admit to being frightened and anxious at diagnosis with a sense of helplessness. Education helps individuals diagnosed with DM to feel more in control of their chronic condition and better able to manage their day - to - day responsibilities. Individuals diagnosed with diabetes make several daily decisions regarding nutrition, physical activities, and stress management to achieve a balance between DM and their lifestyle. The goals of diabetes education include providing knowledge and skills, as well as changing the patient's behavior, increasing compliance motivation, improving quality of life, establishing a partnership, preparing the patient for self - care, increasing awareness of complications, and increasing psychological resilience.9

The American Diabetes Association, through its Standards of Medical Care - 2023 and the 2022 National Standards for Diabetes Self - Management Education and Support define DSMES as a collaborative and ongoing process intended to facilitate the development of knowledge, skills, and abilities required for successful self - management of diabetes.2, 10 Furthermore, the ADA recognizes DSMES as an integral part of care for individuals with diabetes. DSMES builds a foundation and is the process of facilitating the knowledge, skill, and ability necessary for individuals diagnosed with diabetes to make a multitude of daily self - management decisions and perform complex care activities.8 Powers et al.8, reports DSMES programs as a design to address patient's health beliefs, cultural needs, current knowledge, physical limitations, emotional concerns, family support, financial status, medical history, health literacy, numeracy, and other factors that influence their ability to meet the challenges of day - to - day self - management. DSMES services have been shown to have a positive impact on participants' lifestyle, eating patterns, and activity level, which in turn, leads to decreased A1C levels and the prevention or delay of diabetes complications, improving quality of life.4 Powers et al.8 reported an A1C average reduction of 0.57% ( - 17.3 mmol/mol) in patients with diabetes who attended DSMES. As stated by Dehkordi and Abdoli, the goal of DSMES is to support informed decision - making, self - care behaviors, problem - solving and active interaction with healthcare providers to improve health status and quality of life for those living with DM.1[1]

This quality improvement project investigated a correlation between diabetes knowledge and glycemic control as evidenced by A1C values. General diabetes knowledge among participants with T1DM and T2DM was assessed before and after DSMES using the Michigan Diabetes Research and Training Center's Revised Diabetes Knowledge Test (DKT2) as a pre - test and post - test. A short - term and long - term goal was established. The short - term goal was to increase diabetes knowledge using DSMES with dietary education. The long - term goal established was to improve glycemic control evidenced by A1C values prior and at least 91 - days post the educational session.

## 2. Methods

***Design***

Initially the primary researcher conducted a needs assessment through a search of a rural primary care health clinic electronic health record using the international classification coding, tenth revision, clinical modification (ICD - 10 - CM) E11.9 which indicates a diagnosis of type 2 diabetes mellitus without complications, and E10.9 indicating a diagnosis of type 1 diabetes mellitus without complications. An A1C change report was generated using the search results for each diagnosis, E11.9 and E10.9. Of the 1, 095 patients with the E11.9 diagnosis code, 796 had a reported A1C lab value within this period in which 467 (58.67%) were greater than or equal to the ADA recommended goal of 7% (53 mmol/mol), indicating poor disease control. Following the needs assessment, the primary researcher determined that a pre - test/post - test quasi experimental design was most appropriate. Stratton[12] determined that a pre - test/post - test research design is useful in determining if an increase in knowledge or positive attitude correlates with higher post - test scores following the intervention. The study design included two measurements of pre - test/post - test. The first measurement was obtained utilizing the "Michigan Diabetes Research and Training Center's Revised Diabetes Knowledge Test". The second measurement was glycemic control. Glycemic control was determined by the collection of A1C values, one prior to the education session they attended and one at least 91 - days later.

***Setting***

The project site was a division of a primary care clinic, referred to as the wellness clinic, located in rural southeast Georgia. The wellness clinic is in a separate building on the same property as the primary care clinic.

***Recruitment***

Local investigational review board (IRB) approval was obtained in accordance with the Declaration of Helsinki. Patients with a known diagnosis of T1DM or T2DM were recruited during a regularly scheduled visit. Patients come to the wellness clinic for treatment with an IV pulsatile insulin infusion, which is given in a small group setting of up to twelve patients per session. Each session lasts two to three hours. During June and July 2019, at their scheduled visit, once infusions had started, patients were asked if they would like to participate in the pre - test, post - test, and educational session by signing a consent form. At the bottom of the consent form it clearly states individuals are welcome to listen to the educational session and not participate in the pre - test or post - test by simply leaving it blank, so no one person will be singled out. No data was collected on anyone that did not complete the pre - test or post - test. Educational sessions were conducted in the group setting during the insulin infusions. The target population included adults 18 years of age or older, with a diagnosis of T1DM or T2DM and a recent A1C value greater than 7% (53 mmol/mol). Participants may be on either oral diabetes medication, insulin, or both. Patients less than 18 years of age and/or recent A1C value less than 7% (53 mmol/mol) were excluded.

***Participants***

The sample consisted of 41 participants that met the inclusion criteria. Of the 41 participants 19 (46.3%) were male gender and 22 (53.7%) female gender as seen in Table 1: Gender. Table 2: Race shows ethnicity distribution: 32 (78.0%) Caucasian and 9 (22.0%) African American. Within the pilot group there was 1 patient diagnosed with T1DM and 40 participants diagnosed with T2DM as seen in Table 3: Diabetes Type.

**Table 1:** Gender

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Male | 19 | 46.3 | 46.3 | 46.3 |
| | Female | 22 | 53.7 | 53.7 | 100.0 |
| | Total | 41 | 100.0 | 100.0 | |

**Table 2:** Race

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Caucasian | 32 | 78.0 | 78.0 | 78.0 |
| | African American | 9 | 22.0 | 22.0 | 100.0 |
| | Total | 41 | 100.0 | 100.0 | |

**Table 3:** Diabetes Type

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | T1DM | 1 | 2.4 | 2.4 | 2.4 |
| | T2DM | 40 | 97.6 | 97.6 | 100.0 |
| | Total | 41 | 100.0 | 100.0 | |

***Data Collection***

The tool used to gather the diabetes knowledge data was a questionnaire titled "Michigan Diabetes Research and Training Center's Revised Diabetes Knowledge Test" (DKT2). Permission for use of the DKT2 was requested from the Michigan Diabetes Research Center and granted. The development of the DKT2 was supported by Grant Number P30DK020572 Michigan Diabetes Research Training Center (MDRC) from the National Institute of Diabetes and Digestive and Kidney Diseases. The DKT2 is a 23 - item questionnaire that was developed by the MDRC and is designed to assess general diabetes knowledge. Fitzgerald et al examined the reliability and validity of the revised Diabetes Knowledge Test (DKT2).1[3] Utilizing analyses of multiple and combined samples, the researchers were able to support the reliability and validity of the revised tool.

Hemoglobin A1C levels were gathered through a chart review. Two A1C values were collected, one prior to the educational session and then again at least 91 - days following the educational session.

All participants were given a booklet of educational material to keep and take home and consent forms and pre - tests were collected. Once consent forms and pre - tests were collected, the education session began and took about 30 minutes to complete. Participants were given the opportunity to interact during the sessions and ask questions. After the educational session, participants again took the same Michigan DKT2 as a post - test to see if scores improved from the pre - test. The pre - test, educational session and post - test all took place during the same session. Eleven educational sessions were held with participant numbers ranging from 4 to 8 in each class. All participants were offered a low carb snack during the sessions, which consisted of pimento cheese, carrots and celery sticks, for a total of less than 5 carbohydrates. Participants expressed their appreciation for the education and appeared eager to learn more about how to eat healthy and manage their diabetes.

***Data Analysis***

Pre - test and post - test scores from the Michigan DKT2, as well as a chart review for demographic information (age, gender, race), A1C lab values, number of years diagnosed, type of insurance (private, Medicare, self - pay), diabetes medications, number of daily blood glucose (BG) checks, and co - morbidities were collected. A hand - written spreadsheet was generated listing all information collected. Participants were assigned a number for the spreadsheet; no patient names appeared. Data collected was input into the Statistical Package for the Social Sciences (SPSS) for analysis. SPSS is one of the oldest and most established software products for analyzing data using conventional statistical methods.1[4] SPSS analysis performed was descriptive statistics using frequencies and correlations of the variables collected and sample t - test analysis. Participants' pre - test and post - test answers were transferred from the Michigan DKT2 worksheet to scantron answer sheets for further analysis of answer options and test scores. Scantrons were scanned using a datalink 1200 test scanner by Apperson for analysis of each question - and - answer option on the Michigan DKT2.

## 3. Results

***Michigan Diabetes Knowledge Test* Scores**

The average pre - test score for all participants was 65.54%, with 95.65% being the highest and 30.43% being the lowest score reported. The most missed question on the DKT2 pre - test was #15, "Signs of ketoacidosis (DKA) include: " with 75.6% of participants answering incorrectly. The number one chosen answer for #15 was "d. low blood sugar". Most participants expressed that they did not know what ketoacidosis meant or what it was, let alone the signs of DKA. The second most missed question on the DKT2 pre - test was #3, "Which of the following is highest in fat?" 70.7% of participants missed question 3. Nearly half of participants, 48.8%, felt "c. corn" was highest in fat; correct choice was "a. low fat (2%) milk. " The two questions that most participants answered correctly on the DKT2 pre - test were questions 11 and 14. Question 11 "The best way to take care of your feet is to: " "a. look at and wash them each day"; and 14 "Which of the following is usually not associated with diabetes: " "d. lung problems". The DKT2 post - test did show an overall improvement in scores, 80.38% was the average, 100% highest score and 43.48% lowest score. The two most missed questions were the same on the DKT2 post - test as the DKT2 pre - test, questions 3 and 15. There was one question that all participants answered correctly on the DKT2 post - test and that was question 6. "Which is the best method of home glucose testing?", "b. blood testing". Table 4: Michigan DKT2 displays low, high, and score means for the pre - test and post - test.

**Table 4:** Michigan DKT2

| | | Pretest Score | Posttest Score |
|---|---|---|---|
| N | Valid | 41 | 41 |
| | Missing | 0 | 0 |
| Mean | | 65.5463 | 80.3854 |
| Std. Deviation | | 16.49270 | 15.55719 |
| Minimum | | 30.40 | 43.50 |
| Maximum | | 95.70 | 100.00 |

***Hemoglobin A1C Values***

Glycosylated hemoglobin lab values were analyzed using SPSS. The mean A1C value collected prior to the DSMES sessions was (n=41) 8.9% (73.8 mmol/mol), with the lowest value 7.10% (54.1 mmol/mol) and highest 14.0% (129.5 mmol/mol). A second chart review was conducted in October 2019 for collection of 91 - day repeat A1C values. The repeat A1C lab values collected at least 91 - days from the prior are noted as "A1C Post". The mean A1C value collected after the DSMES was (n=36) 8.4% (68.3 mmol/mol), the lowest 6.5% (47.5 mmol/mol) and highest 13.0% (118.6 mmol/mol). There were 5 participants who did not have a repeat A1C lab value and therefore were excluded from all data points. Table 5: A1C Values display the SPSS analysis results.

**Table 5:** A1C Values

| | | A1C Prior | A1C Post |
|---|---|---|---|
| N | Valid | 41 | 36 |
| | Missing | 0 | 5 |
| Mean | | 8.9610 | 8.4806 |
| Std. Deviation | | 1.91532 | 1.65042 |
| Minimum | | 7.10 | 6.50 |
| Maximum | | 14.00 | 13.00 |

***Comparison of Michigan Diabetes Knowledge Test Scores and Hemoglobin A1C Values***

A paired - samples *t* test was calculated to compare the mean pre - test score to the mean post - test score. The mean on the pretest was 65.55 (*sd* = 16.49), and the mean on the post - test was 80.39 (*sd* = 15.56). A significant increase from pre - test scores to post - test scores was found ($t$ (40) = - 4.921, $p$ <.001). Another paired - samples *t* test was calculated to compare the mean A1C lab values prior to DSMES to the mean A1C lab values at least 91 - days post DSMES. The mean on the A1C prior was 8.9% (73.8 mmol/mol), (*sd* = 1.89), and the mean on the A1C post was 8.4% (68.3 mmol/mol), (*sd* = 1.65). A significant decrease from A1C prior to A1C post was found ($t$ (35) = 2.155, $p$ <.05). Tables 6 - A: Paired Samples Statistics, 6 - B: Paired Samples Correlations, and 6 - C: Paired Samples T - Test display the above results.

**Table 6 (A):** Paired Samples Statistics

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Pair 1 | Pretest_Score | 65.5463 | 41 | 16.49270 | 2.57573 |
| | Posttest_Score | 80.3854 | 41 | 15.55719 | 2.42963 |
| Pair 2 | A1C_Prior | 8.9583 | 36 | 1.89290 | .31548 |
| | A1C_Post | 8.4806 | 36 | 1.65042 | .27507 |

**Table 6 (B):** Paired Samples Correlations

| | | N | Correlation | Sig. |
|---|---|---|---|---|
| Pair 1 | Pretest_Score & Posttest_Score | 41 | .275 | .082 |
| Pair 2 | A1C_Prior & A1C_Post | 36 | .726 | .000 |

**Table 6 (C):** Paired Samples T - Test

| | | Paired Differences | | | | | T | df | Sig. (2 - tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | | | |
| | | | | | Lower | Upper | | | |
| Pair 1 | Pretest_Score - Posttest_Score | 14.83902 | 19.30930 | 3.01561 | - 20.93379 | - 8.74426 | - 4.921 | 40 | .000 |
| Pair 2 | A1C_Prior – A1C_ Post | .47778 | 1.33054 | .22176 | .02759 | .92797 | 2.155 | 35 | .038 |

A Pearson correlation was calculated examining the relationship between the Michigan DKT2 pre - test scores and A1C lab values prior to the DSMES. A weak correlation that was not significant was found ($r$ (39) =.117, $p$ >.05). The Michigan DKT2 pre - test scores are not related to the A1C lab values collected prior to the DSMES. Tables 7 - A: Pre - test and A1C Prior Descriptive Statistics and 7 - B: Pre - test and A1C Prior Correlations display the above results. Another

Pearson correlation was calculated examining the relationship between the Michigan DKT2 post - test scores and A1C lab values at least 91 - days post the DSMES. A weak correlation that was not significant was found ($r$ (35) = - .004, $p$ >.05). Tables 8 - A: Post - test and A1C Post Descriptive Statistics, 8 - B: Post - test and A1C Post Correlations display the above results.

**Table 7 (A):** Pre - test and A1C Prior Descriptive Statistics

| | Mean | Std. Deviation | N |
|---|---|---|---|
| Pretest_Score | 65.5463 | 16.49270 | 41 |
| A1C_Prior | 8.9610 | 1.91532 | 41 |

**Table 7 (B):** Pre - test and A1C Prior Correlations

| | | Pretest_Score | A1C_Prior |
|---|---|---|---|
| Pretest_Score | Pearson Correlation | 1 | .177 |
| | Sig. (2 - tailed) | | .267 |
| | N | 41 | 41 |
| A1C_Prior | Pearson Correlation | .177 | 1 |
| | Sig. (2 - tailed) | .267 | |
| | N | 41 | 41 |

**Table 8 (A):** Post - test and A1C Post Descriptive Statistics

| | Mean | Std. Deviation | N |
|---|---|---|---|
| Posttest_Score | 80.3854 | 15.55719 | 41 |
| A1C_Post | 8.4806 | 1.65042 | 36 |

**Table 8 (B):** Post - test and A1C Post Correlations

| | | Posttest_Score | A1C_Post |
|---|---|---|---|
| Posttest_Score | Pearson Correlation | 1 | - .004 |
| | Sig. (2 - tailed) | | .981 |
| | N | 41 | 36 |
| A1C_Post | Pearson Correlation | - .004 | 1 |
| | Sig. (2 - tailed) | .981 | |
| | N | 36 | 36 |

## 4. Discussion

This quality improvement project identified knowledge deficits among patients with T1DM and T2DM in a rural southeast Georgia primary care office setting. The Michigan DKT2 was the validated tool used for measuring general diabetes knowledge among this pilot group. Glycemic control was evaluated using A1C lab values, collected prior to DSMES and at least 91 - days post DSMES.

The short - term goal was to increase patient knowledge related to DSMES with a dietary focus. At the time this research was conducted, this goal aligned with the Healthy People 2020 and now the current updated Healthy People 2030 outcome for patients with diabetes, D - 06: Increase the proportion of persons with diabetes who receive formal diabetes education.1[5] The primary researcher saw no evidence that the patients at the rural southeast Georgia primary care clinic had received any type of formal diabetes education between the EHR search parameters, January 1, 2018, through June 1, 2019. A total of 59 patients came into the clinic during the three - week intervention period and consented to receive DSMES with dietary education. Forty - two of the 59 met all inclusion criteria. One patient expired before the completion of the project, leaving 41 total participants for the pilot group (n=41). By July 15, 2019, all participants had received DSMES with dietary education and had taken the Michigan DKT2 pre - test and post - test.

The long - term goal for this project was to improve glycemic control in patients diagnosed with T1DM and T2DM. This goal aligned with the Healthy People 2020 outcome goal, D - 5: Improve glycemic control among persons with diabetes and correlates with the current Healthy People 2030 outcome goal, D - 3: Reduce the proportion of adults with diabetes who have an A1C value above 9% (74.9 mmol/mol).1[5] The collection of A1C lab values before DSMES for all participants was completed by July 15, 2019. A second chart review for the collection of repeat A1C lab values at least 91 - days from prior was conducted and completed by October 31, 2019.

Diabetes mellitus is a life altering and progressive disease that affects many individuals. Primary care providers are challenged when managing this deadly disease because for optimal patient care outcomes it takes coordination of care including the provider and the patient, themselves. Patients must learn to be proactive in managing their diagnosis. Diabetes Self - Management Education can help to empower these patients with the knowledge and skills to take an active part in managing their diabetes.

This quality improvement project set out to establish the correlation between diabetes knowledge and glycemic control using the Michigan DKT2 as an assessment tool and A1C lab values as evidence of improved outcomes. Although the cohort post - test average demonstrated increased knowledge of diabetes self - management, not all participants achieved an increased score on their individual post - test and therefore, adjustments were made during the intervention period. For example, during some of the post - testing sessions the primary researcher read aloud the questions and the participants answered the questions as a group. The intention of this intervention was that knowledge would then be gained through group collaboration. As with the Michigan DKT2, not all participants demonstrated an improvement in A1C lab values, however the cohort experienced an overall lower A1C lab value average. Despite improvement in test scores and A1C values, an SPSS analysis revealed a weak correlation that was not significant between the two variables.

## 5. Limitations

Limitations to this quality improvement project are acknowledged. The small cohort size (n=41), three - week intervention period and number of participants having a repeat 91 - day A1C (n=36) were all limitations. The amount of information covered in the DSMES sessions was considered extensive for the 20 - 30 minutes allowed. It was challenging to present in the timeframe allotted and difficult for some participants to grasp all the material in one setting. This was evident by some participants' post - test scores on the Michigan DKT2 not showing much improvement. Participants lacked education in more areas than just dietary. Diagnosis, medications, and complications of DM were also identified as areas of weakness. As evidenced by one participant stating, "I thought once you started taking insulin you then had type 1 diabetes" (personal communication, 2019). Another participant stated, "What are carbohydrates, what foods contain carbohydrates" (personal communication, 2019).

## Future Research

Considerations for future research would include a larger cohort size with more educational sessions than just the one and a longer intervention period. These modifications could reveal results closer to those found in the review of literature showing an improvement in A1C lab values from DSMES. Davis et al.2 reported greater A1C reductions are associated with 10 or more contact hours of DSMES services. DSMES interventions should be person centered and can be delivered in individual and/or group sessions through in - person, virtual, telehealth, telephone, text messaging, and/or web - based/mobile applications.2 Regarding longer intervention periods, ongoing DSMES is more effective at achieving A1C goals and glycemic control. Davis et al.2 reports that improvements in outcomes have been shown to diminish in as little as six months following the initial DSMES. This highlights the need for more comprehensive and repeated educational sessions to cover all aspects of diabetes care to achieve better glycemic control. Future implementations of DSMES should consider these factors to enhance the overall effectiveness of diabetes self - management education.

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