



## Research Article

# The Association between Type of Diabetes Education and Chronic Limitation for Diabetes Participants

Starr Seip\*

*Penn State (Schuylkill Campus), Department of Health Science, Schuylkill Haven, Pennsylvania, USA*

### Abstract

Diabetes is an epidemic that has started to capture political attention in the United States because of the devastating health care costs associated with the disease. Researchers in other studies have concluded that additional education Face-To-Face (FTF) and FTF with alternative forms of diabetes nutrition communication (FTF plus) have been beneficial. However, there is very little information on the comparison of the two groups as mentioned above when comparing chronic limitations, as circumscribed by specific demographic population. This study was an investigation of the above variables and explored how specific demographic characteristics (age, gender, educational level, and race/ethnic background) may have an identifiable association with each diabetes nutrition education type, either FTF or FTF plus. This quantitative, cross-sectional study used secondary data from the 2016 National Health Interview Survey for analysis. A logistical regression was used for chronic limitations, while controlling for demographics for all the variables. The study revealed FTF plus had an association with chronic limitations with race and education level, but age was not significant. After controlling for

**\*Corresponding author:** Starr Seip, Penn State (Schuylkill Campus), Department of Health Science, Schuylkill Haven, Pennsylvania, USA, Tel: +1 5706173650; E-mail: starr8795@comcast.net

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demographics, a person who has FTF plus has decreased odds of having chronic limitations, in comparison to someone who receives only FTF. The results from this study may aid formulation of future healthcare policies that focus on how to refer patients to multiple forums of diabetes education, while reducing healthcare costs.

### Introduction

Diabetes is a serious epidemic in the United States. According to the Centers for Disease Control and Prevention [1], over 29.1 million people in the United States have diabetes, which is about 9.3% of the population. About 8.1 million of them are undiagnosed. Type 2 Diabetes Mellitus (T2DM) requires early intensive management to keep patients' Glycated Hemoglobin (A1C) levels below 7%, which prevents the onset of diabetes related complications [1]. These complications could be minimized by educating the patient about managing their diabetes [2,3]. The best way for a participant to manage his or her diabetes is to meet with a Health Care Provider (HCP) and an educator regularly [2].

### Background of the Study

#### Diabetes prevalence

According to the [1], from 1980 to 2012, the number of people diagnosed with diabetes in the United States quadrupled. The numbers went from five and a half million diagnosed with diabetes to 21.3 million diagnosed with diabetes [1]. Every year there are nearly two million new cases of diabetes among the adult population. The [1], estimated that if the trend continued by the year 2050, 1 out of 3 adults in the United States would have diabetes.

There are about 200,000 deaths that occur among the people with diabetes in the United States. In the year 2013, diabetes was the seventh leading cause of death. The [1], also stated there were an additional 86 million USA adults who have pre diabetes. It was important to identify people with pre diabetes because they were at an increased risk for developing T2DM, stroke, and heart disease.

Rates of pre diabetes and T2DM are increasing because of the rates of obesity, unhealthy diet, lack of physical activity, and low socioeconomic factors are also rising [1]. T2DM is associated with poor blood sugar control, elevated blood cholesterol, and elevated blood pressure. Longer life spans, obesity, and diabetes have combined to increase the risk of diabetes by 40% among USA adults over the last 20 years [1]. Non-Hispanic Black women and Hispanic men and women are predicted to develop the disease, 50% more than non-Hispanic White individuals [1].

An essential ingredient of better patient health outcomes is early education for diabetes management. Yet, there were several barriers that prevent the HCP (Health Care Provider) from placing the referral. Some HCPs specifically cited "feelings of fragmented diabetes care" [4]. These HCPs were concerned that if they refer their patient to an endocrinologist or CDE, the patient's treatment plan may not be shared with the primary care physician [4]. Another common reason

is “frustration and insecurity regarding their role in diabetes care” [4]; meaning, time constraints may not allow the HCP to keep up on all the medications and treatment pathways for diabetes care. The last cited reason was, “the need for time to reassure that the program respects their role and added value to care” [4]. This shows that HCP perceptions, of their additional time with patients, may not always be welcomed or appreciated by the patients themselves all of these participant’s concerns may create significant barriers to quality diabetes education.

### Complications of diabetes decrease quality of life

QOL for people who have diabetes will always be a challenge due to the potential complications that may set in over the course of the disease. A1C levels above 7% are associated with several microvascular and macrovascular complications, such as renal failure, amputations, cardiovascular disease, blindness, and neuropathy [5]. Complications of T2DM may be decreased with more self-management, but first the HCP may have to look at different ways at getting the information to the patient promptly by circumventing some of the aforementioned barriers [2]. The HCP should find more cost-effective methods to close the gap for the benefit of their patients’ health outcomes. One study demonstrated this suggestion by designing a self-care program with multimedia software support and comparing it to a control group [6]. Abumasoudi et al. [6], specifically evaluated lectures with multimedia software content about diabetes self-care and how it might impact QOL. The authors found no significant difference in QOL scores between the intervention group (the group using the self-care program with multimedia software support) and the control group [6]. The QOL inventory questionnaire was used to measure differences in QOL [7]. This questionnaire measured 13 domains of QOL regarding employment, ease of mobility, enjoying food, satisfaction with one’s social life, sex life, family life, and future worries about one’s health [7]. Given these results, it might be worth HCPs’ efforts to supplement their services with alternative forms of communication, such as multimedia software made for low-literacy audiences.

### Barriers to Diabetes Education

#### Decrease in health care professionals

Alternative forms of diabetes education, such as telemedicine, telehealth, and web-based platforms have been assessed in rural areas, which made a significant impact on behavioral and psychosocial outcomes, as well as patient satisfaction [8]. Diabetes self-management support, using a diabetes specialist team, is challenging in rural areas. In this team approach, more than one type of HCP provides education to the patient; the team typically includes a CDE, registered dietitian, physician, physical therapist, and pharmacist. One community utilized this approach in a program called Telemedicine for Reach, Education, Access, and Treatment (TREAT) by pairing an endocrinologist from an urban environment with a CDE from a rural environment [8]. In fact, there is quite a shortage of HCPs in rural areas. There are only 33 primary care physicians per 100,000 residents, and there are about 5 million rural citizens in the United States [9]. Due to this shortage, underserved areas may have less access to diabetes education.

A T2DM patient’s biggest challenge is being seen by an HCP FTF without a long waiting time. Thus, the patient’s diabetes management skills may be compromised. For instance, hypoglycemia may result,

and the patient must have the skills to take care of it immediately or risk a negative outcome [3]. Since there is a decreased number of HCPs to treat and educate patients with diabetes, a diabetes patient needs to master numerous lifestyle management skills, including how to manage hypoglycemia reactions. The patient may lack an understanding of the signs and symptoms of a reaction (shaking, sweating, and dizziness), and how to respond to it when it does happen [3]. Hypoglycemia reactions, in particular, have the tendency to decrease QOL for patients with T2DM. Thus, understanding these must be a high priority for these patients [10].

Likewise, it is essential for blood sugar control to execute physical activity daily, which is one of the central self-management behaviors. Patients should plan the timing, frequency, and duration of such activity to help manage their blood sugar levels [3]. Increasing physical activity has been shown to improve QOL by reducing or delaying the onset of physiological complications, such as reduced life expectancy, microvascular damage, and microvascular complications [11]. Management of physical activity needs to be understood, in conjunction with tracking carbohydrates and meal planning, in order to decrease the risks of hypoglycemia and ensure proper blood sugar management. HCPs can recommend individualized physical activity plans to match each patient’s current health care plan.

Finally, healthy eating is vital for T2DM patients to understand and manage to keep their blood sugars under tight control. An individual dietary plan may be helpful in meeting multiple nutritional needs at the same time, such as restrictions on sodium, fat, cholesterol, and targets for protein or potassium (for patients with renal issues; [3]). The majority of Americans lack knowledge on how to prepare healthy meals due to time constraints or lack of prior education at home or in school [12]. One of the ways to gauge if a patient has quality food is by seeing if the patient spends enough time on food preparation. If a patient does spend much time on food preparation, there is a good chance the patient may be spending money on more convenient but less nutritious food [12]. Food preparation has significantly declined since 1960; Americans now only spend about 33 minutes per day on food preparation and clean up [12]. There is a great advantage to seeing a registered dietitian CDE to get an individualized plan, yet most T2DM patients do not know how to eat healthier. These poor eating habits may have contributed to the development of T2DM.

#### Different customs and cultures

The social environment also impacted the participant’s behavior, and it may be offered for different support across customs and cultures. Important social factors included family support and resources in the workplace to facilitate diabetes management. Depending on their cultures, individual patients may have had significantly different values, norms, and perspectives [13]. Thus, diabetes education must be culturally and linguistically appropriate to serve people with diabetes or those at risk of developing diabetes. Several organizations’ websites already provided this service: The ADA [3], the USA Department of Health and Human Services Office of Minority Health, and the National Diabetes Education Program [13].

#### Technology

As T2DM patients are typically older than Type 1 Diabetes Management (T1DM) patients, it would be useful to study if T2DM patients above the age of 50 could adapt to a mobile device to help

manage their disease process [14]. According to [15], out of 32 participants (T2DM) in their study, only 15 participants understood apps (47%), and two participants used a diabetes app (6%) for therapy. The reasons that the participants did not use apps included the lack of additional benefits compared to current therapy management; they did not gain any amusement while using the app; and they expressed a lack of compatibility with other devices [15]. Some of the operating tests revealed that the font sizes were too small, and the touch screens were difficult to operate due to press-sensitive areas. The most important aspect of implementing the app was having a technical support person available to answer questions [15]. The researchers in this study offered T2DM patients alternate diabetes information and a chance for better self-management, but evidently the app development and implementation needed more work.

### Lack of health insurance

The lack of health insurance or inadequate insurance coverage may be another barrier to see an HCP or CDE, due to the cost of office visits. Although diabetes education from a diabetes educator had the strongest correlation, with persistently good glycemic control, not all insurance covered the cost of the education [16]. Patients may need to decrease visits with an HCP/CDE due to cost. In the absence of physical visits with an HCP/CDE, patients may try to access information about diabetes through other forms of communication. For example, in one study, participants of a free web-intervention diabetes education was proven to make a significant difference in improving QOL, social support, and measures of depression, compared to a control group [17]. Having no health insurance or poor health insurance is often challenging for people with diabetes. Therefore, alternative ways of providing diabetes education at low cost would be a positive development. Researchers stated that only 22% of their participants had health insurance [17]. These participants had the motivation to seek more information about their disease by logging onto web-based diabetes applications, and this study did show statistically significant improvements in A1C, total cholesterol, Low-Density Lipoprotein (LDL) cholesterol, and triglyceride levels [18].

Participant's reimbursement rates from health insurance were a particular barrier that patients explain why they do not consult with HCPs or Certified Diabetes Educators (CDEs) [19]. Globally, T2DM has made a significant impact on insurance reimbursement and did have a negative impact on the USA economy. A study in China found that even though there was an increase in maximum reimbursement for outpatient visits, there remained an increase in out-of-pocket costs for T2DM patients [20]. In other studies' researchers looked at the feasibility of alternate ways of developing Diabetes Self-Management Education (DSME), such as telephone and secure messaging [21]. Greenwood et al. [21], stated there were no significant differences in health outcomes (A1C and diabetes complications). Prescribers might not have accomplished significant interaction with a patient and might not have studied 16 participants over a significant period of time.

### Attendance to classes

Other contributing factors to a lack of a DSME attendance include patients' work schedules and related challenges with childcare and transportation [19]. Pereira et al. [22], found that Internet DSME improved patients' eating habits and helped them keep more of their appointments. Only 23% to 66% of the United States receives diabetes

education services over the course of the diabetes journey [22]. Based on these studies, it was apparent that alternate methods for obtaining information about diabetes needed to take place for a better QOL.

Another study found a great need for better communication with patients who have diabetes and comorbidities with long-term conditions, and a similar need for better access to appointments [23]. To manage patients better, health care systems should develop better data management systems to help share care plans among a multidisciplinary team [24]. Participants with diabetes may have unmet health-care needs, and they often need personalized care plans to gain a sense of control of their disease [25,26]. The lack of access to reliable and timely education, physician referrals, and the lack of sharing patient information among health care providers may influence the need for alternative forms of communication and education.

### Quality diabetes education

Another barrier that inhibited patients from receiving accurate information, about diabetes management, was when their main HCPs referred them to external education programs, which was due to the HCP lacking time or knowledge to deliver the appropriate education [19]. Bootie et al. [24], mentioned multiple educational and informational resources, and they confirmed that the main form of diabetes education was through FTF meetings with an HCP. The authors expressed that all the participants found diabetes education sessions helpful; unfortunately, only about 50% of diabetes patients attended those sessions [24]. Another theme that Bootie and Skovlund addressed was poor access to quality diabetes care. In addition, training and support for HCPs was limited, and Bootie and Skovlund suggested that HCPs needed better communication skills to facilitate better diabetes self-management education. Finally, access to technology is needed to enhance support for patient education, especially for family support [24]. Overall, participant's barriers, such as cost, lack of transportation, lack of referrals, and poor time management, may indicate the need for more communication between the HCP and patient, no matter what avenue that communication takes.

The identification and development of communication tools have to be effective because Bootie et al. [24], stated that healthcare provisions outside FTF interactions were impactful. Paddison et al. [27], addressed a similar question: Should nurses be aware of pre diabetes and should they educate patients about it? When a nurse must perform an impromptu education session, often it is inadequate and may need to be supplemented with more reliable resources. Paddison et al. [27], stated that 61.2% of nurses educated patients for less than 5 minutes. This brief impromptu education may be the only education the patient receives due to numerous barriers to receiving more formal education.

### Certified Diabetes Educators (CDE)

The standard for diabetes education would be to refer the patient to a CDE [28]. A CDE may be a pharmacist, registered dietitian, or registered nurse. The CDE credential requires performing a minimum number of training hours with diabetes patients, passing a national certification test, and remaining current with 75 continuing education credits every 5 years [28].

There was limited literature that addressed alternative avenues of discovering credible diabetes education online. Many articles showed how conventional diabetes education sessions impacted QOL for

diabetes patients [3], and explained why HCPs did not refer patients, even though a referral to a CDE would be ideal for patient education. For instance, some HCPs did not refer patients if the patient's insurance did not cover the cost of the education [28], or if other barriers existed to the patient attending the class [14,29].

## Research Method

The purpose of this quantitative, cross-sectional study was to explore the possibility of an association of chronic limitations among participants with diabetes. The comparison was based on their current method of receiving diabetes communication. Educational communications were examined to determine whether there was a difference in health outcomes and perceptions. Specifically, health outcomes and perceptions were examined for participants who received FTF educational communication only and those who received FTF communication, as well as using chat rooms, health information on the Internet, and emails (alternative forms of diabetes communication). The data were collected from a secondary source: The 2016 National Health Interview Survey (NHIS). An analysis was completed on the above variables to identify any significant relationships. The other surveyed factors included demographics of age, gender, race/ethnic background, and education.

The research methods includes a discussion on the research design and rationale, methodology (including population, sampling, and sampling procedures), procedures for archival data, instrumentation and operationalization of constructs, the data analysis plan, threats to validity, ethical considerations, and summarization. To test these research questions, I presented the independent, dependent, and covariate variables. I also presented how the research data were collected from an archival source and analyzed it to understand the relationships between the dependent and independent variables.

## Research Design and Rationale

In this quantitative, cross-sectional study, I used secondary data from a 2016 questionnaire administered by the NHIS. The surveyed population participants included diagnosis of diabetes, ages 18-80, and non-institutionized.

### Dependent variables

The dependent variables for this study included the participant's chronic limitations.

### Independent variables

There was one independent variable: Type of educational communication. The first level of the variable was FTF educational communication received directly from an HCP. The second level of the variable was FTF with alternative forms of educational communication, which was determined by whether the participant received their diabetes education/communication via the Internet, email, or phone in addition to FTF.

### Covariate variables

The covariates for this study included age, sex, race/ethnic background, and education. The demographics ranged from 18-80 years old. The race included white, black and other. The education level included none to post graduate level.

## Research Design

I used a quantitative cross-sectional design for this study. The primary source of data was secondary data extracted from the 2016 NHIS. The advantages of using a cross-sectional design included the data being analyzed using the same group of participants with diabetes, yet using different statistics to show a relationship between two groups [30]. The cross-sectional design takes a snapshot in time, where multiple variables may be analyzed at one time [31]. The main constraint in utilizing secondary data would be if a researcher would repeat the study in a future year; hence, the participants might not be the same [31]. I explored the connection between diabetes chronic limitations, diabetes participants between covariates, and analyzed how the variables might relate between the two groups.

My cross sectional quantitative study, utilizing NHIS secondary data, might have limitations, but this survey was chosen due to its large sample size and the fact that all the interviewers were trained to give the survey. This design fit my financial constraints. The NHIS survey has been conducted every year since 1957; the NHIS survey is a cross-sectional household survey by the CDC [32], and the NCHS [20]. I chose the 2016 NHIS survey because its data were easy to access, and its multiple variables are effective in answering the research questions. Finally, experts in the public health field have classified the NHIS survey as reliable data [33].

The NHIS data set has a very clear definition for diabetes diagnosis. The interviews clarified the diabetes status of participants in the following responses. The NHIS identified participants with diabetes during interviews with adult respondents. The participants stated whether or not they had been diagnosed with diabetes by an HCP. Women with gestational diabetes were excluded from the sample [32]. The NHIS had specific parameters for how long a participant needed to have been diagnosed with diabetes, which eliminated any ambiguous self-reported diabetes responses [32]. The official diagnosis of diabetes has three criteria to be met. The first one is HbA1C (A1C) has to be greater than 6.5%. The second criterion was a fasting blood sugar greater than 126mg/dl, more than twice. The third criterion is the blood sugar being greater than 200mg/dl with a sign or symptom of high blood sugars (polydipsia, polyphagia, or polyuria; [3,32]). The diagnosis criteria were used in the NHIS data collection.

For this study, I used a quantitative, nonexperimental cross-sectional design. The dependent variable was chronic limitations. The independent variable was classified into two contrasting groups: FTF and FTF with alternative forms of educational communication. The researchers made a comparison assessment of the relationship between the independent variable and each of the dependent variables. The demographic variables also helped identify specific groups of participants who might be influenced by the different variables in the two groups. Demographic variables were included in the analysis to determine the impact on the association between the primary variables of interest.

## Research Question and Hypotheses

In this study, the following research questions guided the null and alternate hypothesis:

- Research Question (RQ): Is there an association between the type of diabetes education communication and chronic limitations among adults diagnosed with diabetes?

- Null Hypothesis ( $H_0$ ): There is no association between the type of diabetes education communication and chronic limitations among adults diagnosed with diabetes
- Alternative Hypothesis ( $H_a$ ): There is an association between the type of diabetes education communication and chronic limitations among adults diagnosed with diabetes

The research model always influences the outcome of the research study [32]. There are numerous quantitative research designs, but most researchers opt to compare or find the correlation between two or more variables between two groups. I chose to explore the correlation between FTF diabetes educational communication and FTF with alternative forms of educational communication among the dependent variable of chronic limitations. I used the 2016 NHIS data set.

The research method was the quantitative, cross-sectional method. The purpose of this method is to test objective theories by explaining the relationships among variables [34]. I did not choose either a qualitative or a mixed-methods approach because the purpose of the qualitative method is to use an inductive style of collecting data, based on exploring a human problem relating to social interaction, as suggested by Creswell et al. [34]. A mixed research method is based on both the quantitative and qualitative methods. Thus, because qualitative methods were not appropriate for this study, a mixed methods approach was also not appropriate.

Due to my decision to use quantitative methods for the research, the study involved an analysis to determine if there was an association between the dependent variables compared to the independent variables. The NHIS used a multistage stratified method of sampling. The method of data collection was by using structured questionnaires completed through an interview process. I used the data from the 2016 NHIS data set. The information collected was used to generalize from the population sample.

I did not choose the experimental design because the purpose of this study was not to show how an intervention may influence the outcome. Experimental research may be best used for a longitudinal study, which consists of surveying or observing the same set of individuals with the same variables over long periods of time, sometimes even decades. Due to the dissertation process and the fact that the NHIS did not survey the same individuals every year, I did not choose a longitudinal approach, and instead opted for a nonexperimental cross-sectional method.

## NHIS

USA Census Bureau interviewers conduct an annual multistage probability sample survey in households. Known as the NHIS, the survey is conducted by the Centers for Disease Control and Prevention's NCHS. The Researchers for the NHIS used approximately 750 interviewers (i.e., field representatives) to conduct the 2016 NHIS interviews [35]. The USA Census Bureau's Performance and Data Analysis Program (PANDA) system trained and supervised the interviewers. Every question asked by the interviewers was a part of this study's variables.

Under the simple random design, the NHIS knew in advance that some ethnic groups, such as Black Hispanic, and Asian populations, would not be sampled sufficiently. As such, the NHIS made adjustments in order to meet its stated survey objectives. Besides the other

issues addressed in the research, the primary goals in the sample design were to improve the reliability of the statistics for economic, ethnic, racial, and geographic domains [36,37]. Due to survey resource constraints, the survey methods included clustering, stratification, and over-sampling of the unique population's subgroups. Based on the concentration of Black, Asian, and Hispanic persons, the U.S. Census Bureau partitioned each selected Non-Self-Representing (NSR) or Self-Representing (SR) Primary Sampling Units (PSU) into substrata of census blocks or combined blocks [33]. The race and ethnicity density substrates were defined according to the population concentration from the 2000 Decennial Census. This census included new housing, within a PSU, as its substation to produce the most current sample of households.

One component of the NHIS sample was assigned to be screened prior to interviewing. The screening process is an interviewing procedure to determine which households meet minimum specified criteria [38]. For example, a household without civilian Black, Asian, or Hispanic members might not be given a chance to take the full-length interview. The preselection of interviewees was calculated in a NHIS screening process [38]. This process should be initiated in the beginning of the interview before the household composition is determined [32]. The NHIS interview proceeded through the collection of household rosters for this sample. The interview continued only if the household roster contained one or more Black Asian, or Hispanic persons. Otherwise, the interviewer terminated the interview, and the household was deemed screened out.

When selecting participants for the sampling, one concern was to ensure that each participant could satisfy disclosure constraints. The disclosure limitations included collecting statistical data while protecting the individual identification and release of data to other research sources [39]. The original design of the interview was withheld from the public, which included the substrate, strata, Secondary Sampling Units (SSUs), hypothetical substrata sampling parameters made up of clusters of Housing units in a multiple of four-and PSUs, by applying the cluster technique, collapsing, mixing, and partitioning the original design variables. These simplified design structures were not designed to support geographical analysis below the census region level. The disclosure consent became essential to file, due to the sampling and the potential for the design variables to be influenced by the sampling method.

## Cross-sectional design

Cross-sectional research is a type of observational study that collects data from a population or subset of the population at a specific period of time [40]. This study involved the use of data from the 2016 NHIS survey because this was the most recent data available. In 2014, the institute added questions about Internet, chat rooms, and email usage to the questionnaire. Cross-sectional research had the advantage of studying several variables at the same time. The one disadvantage of choosing this study design was that the results might not pinpoint a definite cause-and-effect relationship. These results only demonstrated a snapshot of a moment in time and not looked at what happened before and after the survey. The research questions might only be considered accurate at the time the participant answered the questionnaire. Nevertheless, this study was appropriate because it enabled me to estimate the sample's prevalence of chronic limitations, self-perceived health status, and healthcare satisfaction while on insulin or oral medication.

## Methodology

### Population

The target population for the 2016 NHIS was all non-institutionalized individuals, over the age of 18-years-old, living in the United States. Non-institutionalized is defined as persons who currently reside in the United States or the District of Columbia and do not live in any institutions, including mental facilities, prisons, or facilities for the aged [33]. The second criterion would be that the person was not currently active in the United States Armed Services.

### Sampling and sampling procedures

The 2016 NHIS conducted the initial survey in-person with some telephone follow-up. The interviewers were trained USA Census employees with computer-assisted personal interviewing software. The NHIS conducts this survey annually and repeats for cross-sectional estimates [33]. The original NHIS sample design began in 1995 with an updated design in 2006. The institute introduced the most recent sample design in 2016. When the NHIS designed the parameters for sampling, their primary focus was to interview 47,000 American households per year [33]. Households are defined by three or more individuals living in a dwelling at one time [38]. Thus, my targeted sample population utilized a multi-step method, partitioned into several affiliated levels of strata and clusters for the massive number of interviews accomplished.

**2016 NHIS with diabetes current study sample:** I obtained sampling procedures from the 2016 NHIS and utilized the data to answer research questions. In 2016, of the 33,028 individuals interviewed, 3,540 were diagnosed with diabetes [35]. The researchers for NHIS used the following procedure to gather the sample. They divided the number of people interviewed over the total number of people who were eligible to participate in the survey (interviewed sample adults/eligible sample adults). They calculated the final sample by response rate of interviewed sample adults/eligible sample adults from interviewed families multiplied by the final family response rate [33].

In 2016, 40,220 households had a total of 97,169 persons in 40,875 families with 33,028 sample adults and 11,107 children [33]. There were approximately 511 proxy cases, a knowledgeable proxy answered for the sample adult. By dividing the adults interviewed (33,028) by the eligible individuals (40,848), the institute calculated an 80.9% response rate. Dividing the number of adults with diabetes (3,540) by the adults interviewed (33,028), the NHIS determined a 10.7% eligibility rate.

**Sample size for RQ:** I began analysis for RQ1 by calculating descriptive statistics on the dependent variable (chronic limitations), independent variables (FTF and FTF with alternative diabetes communications), and control variables (demographic characteristics: Sex, age, race/ethnic background, and education background). The analysis continued with a multivariate logistic regression to test the association between type of interaction and odds of reporting a chronic limitation, while controlling for each of the demographic variables. The sample size was calculated for logistic regression.

### Operationalization of the variables

The following table, table 1, shows the proposed research question, dependent variables, and independent variables, as well as the categorical/numerical unit of measurement. The research questions

were illustrated right beside the associated variable(s). The diabetes variable was used to restrict the dataset so that only those with diabetes were included. The NHIS asked the question: Have you ever been told by a doctor or other professional that you had diabetes (DIABETICEV)? The interviewer coded the choices as 1=yes, 2=no, 7=refused, 8=not ascertained, and 9=don't know. For the purposes of this study, the researcher only used yes and no answers. The current study excluded refused, not ascertained, and don't know from the analysis. For the purpose of this study, having diabetes was a simple filter for the participants to be the sample. The dependent variable included chronic limitations. The two independent variables included the form of communication variables: FTF educational communication or FTF with alternative forms of educational communication. The last part of this table displays the demographic variables: Education, age, gender, and race/ethnic background.

Research Variable	Variable Questions	Categorical/Numerical Unit of Measurement	Statistical Test
Chronic limitations	Chronic State of limiting Diabetes (CLIMDIABETIC)	0=NIU 1=Chronic	Frequency and means, Logistic Regression, R value, R <sup>2</sup> , Sig change, β, Sig
	Chronic status of functionality limiting diabetes (FLDIABETIC)	0=NIU 1=Chronic	
FTF with HCP	SAW/talked to general doctor in the past 12 months (SAWGEN)	1=Yes 2=No	
Alternative forms of communication	Did you communicate with HCP via email? (PCEMAILHPYR)	1=Yes 2=No	
	Did you make a phone call to a doctor or medical professional? (IRMEDPCDOC)	1=Yes 2=No	
	Did you ever look up health information in the last year? (PCLOOKHELYR)	1=Yes 2=No	
	Did you ever participate in a health chat in the last year? (PCCHATHELYR)	1=Yes 2=No	
Sex			
Age	What is your age?		
Race/ethnic background	What ethnic background best describes you? (RACEA)	1=White 2=Black/African American	
Education background	What level of education did you achieve? (EDUC)	1 =No high school diploma 2=High School Graduate 3=Some College, no degree 4=2 year degree 5=4 year degree 6=Graduate degree	

**Table 1:** Quantitative research question 1: Is there an association between the type of diabetes education communication and chronic limitations among adults diagnosed with diabetes?

### Study variable codes

In this the study, the variables that were used for chronic limitations were chronic status of limiting diabetes (LHAL10T; CLIMDIABETIC) and chronic status of functionality of limiting diabetes (FLDIABETIC).

All the instruments for each dependent variable were analyzed between each independent group. The FTF group used the following variable: Saw/talked to a general doctor in the past 12 months (SAWGEN). The alternative educational communication group used the following: Did you make a phone call to a doctor or medical professional? (IRMEDPCPOC); have you communicated with a HCP using email in the past 12 months? (PCEMAILHPYR); did you ever participate in a health chat in the last year? (PCCHATHELYR); and did you ever look up health information on the Internet in the last year? (PCLOOKHEYR). In the questions above, a yes or a no was the response to the question. If the person responds yes to the question, the participant used an alternative method.

### Demographics

**Education:** For educational information (EDUCATION), the following categories were used: 1=No education/Kindergarten, 2=Grades 1-6, 3=Grades 7-12, 4=High School diploma/GED, 5=Some College, and 6=College graduate or higher.

**Race/ethnicity:** For race/ethnic (RACE) background, the following categories were used: White American, Black or African American, or others.

**Age:** For age (AGE), the following categories were used: 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, and 80+ over. For the purpose of this study, I referred to the variable names (variable questions) to explain the study analysis.

**Sex:** For Sex (SEX), the categories were used: 1=Male and 2=Female.

Table 1 was addressing this research question by highlighting the exact research variable. The variable questions that were asked to the participant (including demographics) are in the following table. The third column reflected the unit of measurement and the last column was statistical tests performed on each question.

The 2016 NHIS database was a reliable secondary dataset to conduct the analysis. The public has access to the dataset website without limitation. I began the analysis with frequency and means tests on dependent variables: Chronic limitations, healthcare satisfaction, and health status, the independent variables (FTF and FTF with alternative diabetes communications), and demographics (sex, age, race/ethnic background, and education background). The frequency test and means highlighted the sample size and the mean within each variable.

The analysis continued with a simple regression utilizing R-value, R-squared, significant change, beta, and significance. Beta and significance were tested on interaction type (the FTF with alternative forms of communication). A logistical regression was performed on research question 1's chronic limitations due to the binary answer to the question. The beta was also calculated. Then, a significant change and significance were tested to this chronic limitation. The demographic variables were also used in this study.

The next and last two tests were the beta test and the significance test. This test was set up with all the dependent variables and control for demographic (sex, age, race/ethnic background, and educational level) with the second group (FTF with alternative forms of communication). The beta calculation indicated if the sample data could project to the population. The last test significance might have indicated among the dependent variables if there were different association between the groups and if the demographics have indicated a bigger significance.

A logistic regression was tested on research question one (chronic limitations) because it was binary. In addition, the linear regression quantified the association between the predictor and the outcome that might be unique to the predictor and how that might impact the other variables in the model [41]. Statistical analyses were completed on SPSS statistics 24 and began with univariate descriptions of each variable, including measures of central tendency and variation, to understand the composition of the sample under investigation.

### Analyses for RQ

I began analysis for RQ1 by calculating descriptive statistics on the dependent variable (chronic limitations), independent variables (FTF and FTF with alternative diabetes communications), and control variables (demographic characteristics: Sex, age, race/ethnic background, and education background). The analysis continued with a multivariate logistic regression to test the association between type of interaction and odds of reporting a chronic limitation while controlling for each of the demographic variables.

### Summary

The secondary data from the NHIS was used in this cross-sectional quantitative study. I used SPSS Statistics 24 to test the hypotheses, bivariate comparison, descriptive linear analysis, and regression analysis. I explored any potential association between chronic limitations.

This was a quantitative cross-sectional study that used secondary data from the 2016 NHIS with a sample size of 33,028 civilian non-institutional subjects, in which they found 3,540 individuals who reported having a diabetes mellitus diagnosis [35]. Before starting the data analysis, I sought and gained approval from the Walden University Institutional Review Board.

This chapter summarized the planned research study and methodology to examine the possible relationship between the different communication avenues with an HCP and how these impact multiple demographic variables. In particular, the examination included the multiple forms of communication with an HCP analyzed variables, such as health care satisfaction insulin dependent and non-insulin participants with diabetes, self-perception health status, and chronic limitations. Chapter 4 presented the results of the data analysis. Chapter 5 followed, including a discussion of implications and recommendations for future research.

### Demographic Characteristics

I used secondary data collected from the 2016 NHIS for this study. The variables from this dataset were selected based on the research questions. The demographic variables used in the analysis included: Age, sex, education background, race/ethnicity, and they were told they had diabetes. Age was categorized by less than 30 years of age, 30-39, 40-49, 50-59, 60-69, 70-79, and 80+. Sex was defined as 0 or 1 (male=0; females=1). The three racial groups included for analysis were: White, black and another racial group. Other racial groups included American Indian and Asians. These racial groups were chosen because there is significant difference in diagnosis rate between whites and other races.

The categories for education were narrowed to the following: Non-high school graduate, high school graduate, some college, no degree, 2-year degree, 4-year degree, and graduate degree. For educational attainment, 28.1% completed high school (n=994), 11.5%

completed a 2-year degree (n=407), 13.1% completed a 4-year degree (n=464), and 7.7% have graduate degrees (n=273). To examine type of provider communication, two groups were identified: FTF and FTF with alternatives interaction. FTF plus alternatives included participants who have FTF communication with their providers but also had other forms of communication including chat room, email, or phone call.

The majority of the respondents in the sample were over 60 years old (n=2268, 64%). Most of the sample participants (77.6%, n=2,747) identified as White, 15.7% (n=556) identified as Black, and 6.7% (n=237) identified as another racial group. In terms of interaction type, the majority indicated they have FTF communications (n=2169, 61.3%). Descriptive statistics for age, sex, education level, race/ethnicity, and forms of communication are shown below in table 2.

		Frequency	Percent
Sex	Male	1,692	47.8
	Female	1,848	52.2
Age	30>	81	2.3
	30-39	172	4.9
	40-49	308	8.7
	50-59	711	20.1
	60-69	1,106	31.2
	70-79	785	22.2
	80<	377	10.6
Education* *Level	Non-HS-graduate	726	20.5
	HS graduate	994	28.1
	Some college	661	18.7
	Two year degree	407	11.5
	Four year degree	464	13.1
	Graduate degree	273	7.7
Race/Ethnicity	White	2,747	77.6
	Black	557	15.7
	Other	236	6.7
Interaction Type	Face-to-face	2,169	61.3
	Face-to-face plus interaction	1,371	38.7

**Table 2:** Frequencies and percentages of demographic characteristics (N=3,540).  
 Note: \*15 Responses were missing for education variable (N=3,525).

### QOL (chronic limitations)

The QOL dependent variable was identified as chronic limitation due to diabetes. When the data was analyzed, the data was represented by the following answers: 0=NIU, 1=not chronic, 2=chronic, and 9=unknown. The data collected was placed into two categories. I discarded the NIU (Not in Universe) responses then determined that unknown responses would be treated as not chronic and then recoded the data so that 0=chronic and 1=not chronic. I excluded these cases because it would not have been real distinction on the chronic limitation variable. Due to the ambiguous definition of NIU, the researchers for this research study determined it would not provide reliable data for this variable.

The universe referred to the participants in the population at risk for a response for the variable in question. The labeled cases as “NIU” are known as outside the universe for that particular variable question

response. (CDC and Prevention and USA Department of Health and Human Services [35]).

The definition of chronic limitations was based on how the questions were asked to the participants by NHIS. The definition was based on the following: A person that was at least 18 years or older with at least one activity limitation, while being diagnosed with diabetes and reported having a limitation caused by the following defined condition. The people with a chronic limitation may be defined by having a condition for at least 3 months or longer and was at least diagnosed with the condition at least three months prior to the interview. Those conditions that have not persisted for 3 months are considered acute. The researchers for NHIS noted that some conditions are considered chronic by definition, regardless of the length of time since diagnosis (CDC and Prevention and USA Department of Health and Human Services [35]). For example, the participant may have had the chronic condition for a long time (5 years) without being diagnosed. The participant had numbness in their feet and was not able to walk long distances.

The descriptive statistics of QOL. Based on the summary statistics, the percentage was at .815 (SD=0.388) which indicated that participant responses were leaning toward not chronic. This indicates that majority of the responses (n=2885, 81.5%) were not chronic.

### Research question: Modeling chronic limitations

I asked research question, is there an association between the type of diabetes education communication and chronic limitations among individuals diagnosed with diabetes? A logistic regression was performed to answer research question in order to determine if there was a significant relationship between the type of diabetes education communication (FTF versus FTF plus alternatives) and chronic limitations (chronic vs. non-chronic) among adults diagnosed with diabetes while controlling for age, sex, race/ethnic background and education level. The logistic regression model was statistically significant,  $\chi^2(4)=93.626$ ,  $p<0.001$  and a non-significant Hosmer and Lemeshow test verified that the model was well fitting,  $\chi^2(8)=5.13$ ,  $p=0.744$ . In the first regression model, the covariates age category, sex, race/ethnicity and education level were added to control for the effect of these variables on QOL. In the second model, the interaction type was entered. The dependent variable was “Chronic status of functionally limiting diabetes,” where 1=non-chronic and 0=chronic. The first model (Table 3), including only the control variables and the dependent variable, had three statistically significant variables: Race ( $p=0.011$ ), age ( $p=0.021$ ), and education level ( $p<0.01$ ). A person who is white had decreased odds of having chronic limitations compared to a black person ( $B=-0.002$ ,  $p\text{-value}=0.011$ ). A person with a higher level of education had a decreased chance of having chronic limitations ( $B=0.265$ ,  $p\text{-value}<0.01$ ). An older person also has increased chance of having chronic limitations ( $B=-0.077$ ,  $p\text{-value}=0.021$ ).

Model 2 (Table 4) included the control variables as well as the type of diabetes education communication. In the full model, race/ethnic background, education level, and interaction type were found to be statistically significant, but age was no longer significant. A person who is White has decreased odds of having chronic limitations ( $B=-0.002$ ,  $p=0.026$ ) compared to a person who is black or another race. A person who is higher educated has decreased odds of having chronic limitations ( $B=0.228$ ,  $p<0.01$ ). After controlling for age, race/ethnic background, and education, a person who has FTF plus

alternative interaction has decreased odds of having chronic limitations (B=0.335, p=0.002) when compared with someone who receives only FTF communication. Therefore, there is sufficient evidence to reject the null hypothesis that states there was no association between the type of diabetes education communication and chronic limitations among adults diagnosed with diabetes. The logistic regression models are presented in tables 3 and 4.

		B	SE	Wald	Df	Sig	Exp (B)
Step 1 <sup>a</sup>	Age	-0.077	0.033	5.300	1	0.021	0.926
	Sex	-0.090	0.091	0.985	1	0.321	0.914
	Race	-0.002	0.001	6.389	1	0.011	0.998
	Education	0.265	0.032	68.623	1	0.000	1.303
	Constant	1.532	0.265	33.388	1	0.000	4.628

**Table 3:** Variables in the equation for model 1: Chronic limitations as dependent variable (N=3540).

**Note:** a Variable(s) entered on Step 1: Age, Sex, Race, Education and Constant.

		B	SE	Wald	Df	Sig	Exp (B)
Step 1 <sup>a</sup>	Age	-0.051	0.034	2.167	1	0.141	0.951
	Sex	-0.099	0.091	1.182	1	0.277	0.906
	Race	-0.002	0.001	4.943	1	0.026	0.998
	Education	0.228	0.034	44.948	1	0.000	1.256
	Interaction	0.335	0.108	9.540	1	0.002	1.398
	Constant	1.373	0.269	26.036	1	0.000	3.947

**Table 4:** Variables in the equation for model 2: Chronic limitations as dependent variable.

**Note:** a Variable(s) entered on Step 1: Interaction.

The research question investigated if there was a significant relationship between the type of diabetes education communication (FTF versus FTF plus alternatives) and chronic limitations (chronic vs. non-chronic) among adults diagnosed with diabetes while controlling for age, sex, education level and race/ethnicity. The logistic regression model was statistically significant. The first model, including only the control variables, had three statistically significant variables: Race/ethnicity, age, and education level. A person who was white had decreased odds of having chronic limitations compared to a person of a different race. A person with a higher level of education had a decreased chance of having chronic limitations. An older person also has increased chance of having chronic limitations. Model 2 included both the control variables as well as the type of diabetes education communication. Race, education level, and interaction type were found to be statistically significant. A person who was white has decreased odds of having chronic limitations. A person who had higher education has decreased odds of having chronic limitations and a person who has FTF plus alternative interaction has decreased odds of having chronic limitations. There was sufficient evidence to reject the null hypothesis that stated there was no association between the type of diabetes education communication and chronic limitations among adults diagnosed with diabetes.

Results on the tests was completed to identify the relationship between the type of diabetes education communication and chronic

limitations among adults diagnosed with diabetes, while controlling for age, sex, education level, and race, indicated there were significant variables. Race (p=0.011), age (p=0.021), and education level (p<0.01) were significant variables in relation to chronic limitations. A person who was White or had a high level of education had a decreased change of living with chronic limitations, but an older adult had an increased chance of having chronic limitations. When including the type of education communication, race (p=0.026), education level (p<0.01), and education communication type (p=0.002) were found to be statistically significant.

### Communication and chronic limitations among adults diagnosed with diabetes?

Based on the findings, race/ethnic background, age, and education were significant variables. A person who was white had lower chances of living with a chronic limitation. Similarly, those with higher levels of education had lower likelihood of living with chronic limitations, but those participants who were older had more chronic limitations. Results also showed that the type of education was significant, resulting in rejection of the null hypothesis, and accepting the alternative hypothesis. There was an association between the type of diabetes education communication and chronic limitations among adults diagnosed with diabetes.

Some previous studies showed results that were consistent with the findings identified in the current study. Siminerio et al. [8], found that alternative forms of diabetes education, such as telemedicine, telehealth, and web-based platforms, were effective in rural areas. Results showed that these alternative forms significantly influenced the behavioral and psychological outcomes and patient satisfaction of participants. Diabetes self-management support using a diabetes specialist team is challenging in rural areas. In this team approach, more than one type of HCP provides education to the patient; the team typically includes a CDE, registered dietitian, physician, physical therapist, and pharmacist.

Researchers have studied Internet-based diabetes self-management education [22], but there were limited free sites offering diabetes resources, communication, and webinars. Welch et al. [42], compared two platforms for diabetes management by focusing on urban Latino populations. The group using Internet-based platforms had lower A1C levels compared to the traditional diabetes care group, and they had lower diabetes distress and lower social distress during the follow-up [42].

Diabetes health education might be a vital factor in helping create positive behavioral changes in diabetes management [42]. Internet-based tools need more investigation as different avenues to change behavior. Particularly, using these tools may have a considerable impact on more vulnerable populations (such as those with low Diabetes Care conducted a review of computer-based interventions to improve self-management in adults with T2DM [43]. Based on the Diabetes Care studies, there was little benefit to computerized interventions regarding glycemic control, as measured by A1C, but the mobile phone-based interventions showed a larger numerical effect [43]. This analysis of the individual studies confirmed that using alternative forms of education and communication might improve blood sugar control, health status, and satisfaction with healthcare [44].

However, Greenwood et al. [21], found a different result. In Greenwood et al. [21], study on the alternate ways of developing

diabetes self-management education, such as telephone and secure messaging, they found no significant differences in the health outcomes of patients. Contrary to what was identified in the Greenwood et al. [21], study changing the type of education did not influence health outcomes.

Researchers have identified race as a significant factor contributing to the outcomes of patients. Jack et al. [13], explained that different support across customs and cultures influenced behavior. Depending on the culture, individual patients might have significantly different values, norms, and perspectives [13]. As such, diabetes education should be culturally appropriate to serve people with diabetes or those at risk of developing diabetes.

Socioeconomic status, people who live in rural areas, and individuals with languages other than English) with diabetes. The impact on health outcomes may be more substantial for this population because numerous barriers may be applied to these groups of people. The need for more quality communication with their HCPs can help them obtain higher treatment satisfaction and lower medication non adherence [45].

## Conclusion

Diabetes is one of greatest epidemics today in the world. There has been a dramatic increase in the number of individuals with diabetes from 1980 to 2012. If the trend continues, 1 out of 5 adults in the United States will have diabetes by 2050. Self-education is vital for people diagnosed with diabetes, so they can manage their conditions and prevent these from further developing. There are many barriers resulting in individuals with diabetes receiving limited education about the disease. To address these barriers, alternative forms of education are being explored and suggested. However, there is limited study on using alternative forms to supplement FTF education.

The findings of the study are beneficial to individuals with diabetes and HCPs. The results may help HCPs create and explore a tailored fit education program depending on the preferences of individuals with diabetes, as well as in association to their demographics to chronic limitations. One of the areas that future researchers can explore involves expanding the study to use a mixed method approach to understand the perceptions of individuals with diabetes.

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