RESEARCH ARTICLE

EXPLORING SELF-CARE STRATEGIES IN INDIVIDUALS WITH LOW LITERACY, TYPE 2 DIABETES AND EUGLYCEMIA

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ABSTRACT:

Purpose

This qualitative study utilizes the health belief model to explore how individuals with type 2 diabetes mellitus and low diabetes numeracy achieve and maintain good glycemic control.

Methods

Participants (n=10) participated in semi-structured interviews and completed the Patient Diabetes Knowledge Questionnaire, the Health Belief Questionnaire, and the Social Support Assessment Tool.

Results

Results indicate that participants had low levels of diabetes knowledge, high levels of perceived social support and strong self-efficacy related to type 2 diabetes management, despite low numeracy. Self-designed routines mitigated potential educational, socioeconomic, and knowledge barriers. Self-efficacy and social support were strong protective factors.

Conclusions

The healthcare team can help high-risk patients manage their type 2 diabetes by improving self-efficacy and identifying social support. Diabetes self-management education should encourage activities that promote higher levels of self-reflection and critical thinking.

INTRODUCTION

Improving health outcomes for individuals with diabetes mellitus is of increasing concern to healthcare professionals and community leaders. It is estimated that 34 million Americans have diabetes and another 88 million individuals are at risk of developing the disease.[1] Diabetes is a complex chronic disease that is largely self-managed, and diabetes self-management education (DSME) and support are central to diabetes care.[2] Despite the importance of DSME, only 5% of Medicare patients receive timely, formal diabetes education during their first year of diagnosis.[3]

Review of Relevant Literature

Because diabetes is largely self-managed, effective diabetes self-care is critical to short- and long-term health outcomes. Individuals with diabetes employ numeracy skills every day during self-care activities, such as interpreting blood glucose readings, calculating carbohydrate intake and adjusting medications. Low general literacy—including document literacy, prose literacy, and numeracy—and low health literacy can be barriers to successful self-care.[4] Specifically, low numeracy skills may be

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a barrier to effective self-care in the management of diabetes mellitus. Studies demonstrate that many patients with diabetes have difficulty determining what values are within the normal blood glucose range, counting carbohydrates and calculating an insulin dose.[5] One randomized controlled trial found that low Diabetes Numeracy Test (DNT) scores were associated with lower perceived self-efficacy, fewer self-management behaviors and possibly poorer glycemic control.[5] More recently, another study demonstrated a higher level of diabetes medication adherence and lower HbA1c in participants with higher numeracy skills and medication self-efficacy.[4]

It is estimated that 43 million adults in the United States have low literacy skills, and more than 62 million have limited numeracy skills.[6,7] These challenges often go unrecognized; however, many individuals with limited literacy and numeracy skills can still successfully maintain good control of their diabetes,[8-9] but research explaining why and how this occurs sparsely. This study focuses on that subgroup of individuals: those patients with type 2 diabetes mellitus and limited numeracy skills, multiple barriers and risk factors for poor self-care, yet who have maintained target glucose control. Understanding how individuals with limited diabetes numeracy successfully manage their diabetes will help inform educational and clinical interventions. In addition, as patient-centered approaches to diabetes management increasingly emphasize building on patients' existing strategies and skills, it is important to understand the scope of those strategies. Ultimately, this information can help diabetes educators and healthcare providers work with patients to successfully manage their diabetes, improve their blood glucose control and reduce rates of diabetes complications.

There is a large body of research on the risk factors associated with diabetes and its complications. For example, low income and low educational attainment have been associated with poor health outcomes.[1] Low socioeconomic status is associated with poor health literacy, which can be a barrier to effective self-care.[4] Individuals living in impoverished neighborhoods tend to be less physically active[10] and experience higher rates of food insecurity, resulting in reduced access and consumption of fruit and vegetables.[11,12]

Previous research has also shown a correlation between social support—including emotional and tangible support from family,[13] involvement in community organizations and online social networks— and positive diabetes management.[14] Individuals with diabetes rely on experimentation[15] and "self-initiated strategies"[14] including taking ownership of medication-related needs and integrating taking medicine into daily routines.[14]

However, health education alone is not sufficient to change behavior in patients with chronic disease. Many health behavior theories have been proposed over the past several decades.[16] The Health Belief Model (HBM)[12,17] has been used to explore self-care behaviors in patients with diabetes mellitus. There are six main constructs of the HBM that influence people's decisions about whether to take action to control illness. According to HBM, people will engage in health behaviors if they: (1) believe they are susceptible to the illness (perceived susceptibility), (2) believe there are serious consequences if they acquire the illness (perceived severity), 3) believe taking action would reduce their susceptibility to the illness or its severity (perceived benefits), 4) believe any barriers to taking action (perceived barriers) are outweighed by the benefits, (5) are exposed to factors that prompt action (cue to action), and 6) are confident in their ability to perform an action (self-efficacy) successfully. Health motivation is the central focus of the HBM, making it a good fit for addressing problem behaviors that evoke health concerns.[12,18]

This study investigates the psychosocial protective factors via HBM to better understand how individuals with limited numeracy skills successfully manage their diabetes. In this context, HBM theorizes that an individual's self-care behaviors are based on their perceived susceptibility to developing diabetes mellitus, perceived severity associated with the impact of diabetes mellitus on one's physical and mental wellbeing, perceived benefits of and perceived barriers to engaging in self-care behaviors,[18] cues to action to encourage that behavioral engagement[19] and self-efficacy to successfully complete self-care behaviors.[12] Recently, demographic variables, including age, sex, education and income, have been added to the model as modifying factors, resulting in an expanded HBM framework.[20] Few studies have investigated the influence of demographic or environmental variables within this expanded HBM.[20]

In this study, we were interested in applying the expanded HBM (including demographic and environmental factors) as a descriptive instead of an explanatory or predictive framework to understand better how individuals with limited diabetes numeracy skills and limited diabetes knowledge successfully managed type 2 diabetes. To address the limitations of the HBM, we included broad interview questions and applied an open coding process during the analysis to allow related findings to emerge. We also included assessments for diabetes knowledge, health beliefs and perceived social support.

METHODS

Design

Qualitative studies, which can be described as naturalistic and interpretive, are well-suited to understanding the complexity of chronic diseases. Therefore, a qualitative collective case study design[21] was chosen to successfully understand the various strategies individuals with low literacy used to navigate type 2 diabetes successfully. Collective case studies are designed to study the phenomenon in different contexts and allow for comparison within and between cases.[22] To standardize the measurement of diabetes knowledge, health beliefs and perceived social support across participants, quantitative assessments were used to supplement this qualitative approach. The Institutional Review Boards at Ohio University and Touro University California approved this study.

Sample

Eligible participants were patients of a county family health services primary care clinic (federally qualified health center) with type 2 diabetes who scored 5 or below on the DNT-15 and had a current HbA1C < 8.0 mg/dL. Eligible participants were introduced

to the study during their clinical care. Those interested were given consent information and called by research assistants to schedule a time for a consent visit. Those who were eligible were contacted by phone, and if still interested, were scheduled for a consent visit.

The sample was a diverse group of 10 participants, all with very low or no income, reflective of the population served by the county family health services (Table 1).

TABLE 1.

Demographics of participants

PART. CODE	AGE	RACE	SEX	DURATION OF DISEASE	DIABETES KNOWLEDGE (% CORRECT)	MEDS (#SMBG/TIME)*
Alice	54	African American	Female	30 yrs.	90	none (0)
Beth	69	Caucasian	Female	15 yrs.	70	metformin (1x/day, lately "hit or miss")
Chris	60	Caucasian	Male	Newly diagnosed	40	insulin, victoza (4x/day)
Dolly	78	African American	Female	> 50 yrs.	33	insulin (2x/day)
Ed	63	Haitian	Male	4 yrs.	38	none (1x/3-4days)
Frank	85	Filipino	Male	7 yrs.	71	metformin, glipizide (3x/day)
Georgia	59	African American	Female	> 20 yrs.	38	none (0)
Hannah	50	African American	Female	1.5 yrs.	50	none (0)
Isaac	56	African American	Male	2 yrs.	70	glipizide (1x/day)
James	62	Hispanic	Male	5 yrs.	70	metformin

There is no formal threshold for low numeracy on the DNT-15; a score of 5 is generally agreed as "low literacy." It was used to screen patients for this study.
*SMBG – self monitoring of blood glucose

The participants in the study ranged in age from 50–85 years of age, with a mean age of 63.6±10.9. Five participants were female and five male. All were English speaking. Four of the participants had been diagnosed with type 2 diabetes within the last five years and the other six had been diagnosed 15 or more years ago. Many of the participants had comorbidities, with hypertension and arthritis being the most common. Four participants were on oral medications for diabetes and two were on injectable insulin. Four of the participants were not taking any medications for their diabetes. The mean A1C was 6.7 % (50 mmol/mol).

Data Collection

The principal investigator reviewed the consent form with each participant at the time of the interview. Interview questions focused on the strategies, resources and assets that the individuals use to manage their diabetes and their barriers to managing their diabetes. Interviews lasted approximately 45 minutes. Before the interview, the following questionnaires were administered verbally to all participants: (a) Patient Diabetes Knowledge Questionnaire (PDK)[23] a 24-item, true/false knowledge assessment, (b) The Health Belief Questionnaire (HBQ)[24] to explore beliefs about diabetes self-management and (c) Social Support Assessment Tool (SSAT),[25] which utilizes a five-point Likert scale to explore levels of social support in various aspects of their lives.

Analysis

Interviews were transcribed and loaded into ATLAS Ti qualitative data analysis software.[26] Utilizing the process of thematic analysis,[27] an initial cycle of open coding[28] was completed on the first three interviews as a team, resulting in a codebook. We applied the codebook to the remaining interviews. We met to reconcile emergent codes. The principal investigator completed the second cycle of coding to ensure that all new codes were applied accurately across all interviews. After coding was completed, we met to complete the analysis and interpretation, grouping codes into categories and reviewing the cases for patterns and themes within and across cases.[29] This approach further allowed a comprehensive set of factors to emerge.[30]

The questionnaires were scored and means calculated for the overall group of participants. Once scored, associations between average scores on the survey instruments and the qualitative responses were triangulated and explicated for each participant in a case report developed for each participant. Thus, combining qualitative and quantitative methods, and focusing on the convergence of results, can "elucidate complementary aspects of the same phenomenon."[31] The following presents the results of this cross-case analysis.

RESULTS

Five themes emerged from the cross-case analysis: (1) I Know How Food Affects My Body, (2) I am Responsible for My Health, (3) I am an Active Participant in Maintaining My Health, and(4) TABLE 1. Demographics of participants, and (5) My Family Supports Me in Staying Healthy. Each triangulated finding is framed around the constructs of the health belief model and is presented below. (Table 2)

TABLE 2.

Themes with exemplar quotations

	THEME NAME	TOPIC/STRATEGY	EXEMPLAR QUOTE
Theme 1	**I Know How Food Affects My Body**	How food affects their blood glucose	I experimented with myself. To learn. That's how I learn more than if I go and sit. Because half the stuff I hear, I forget. *(Alice)*
		How eating large amounts of carbohydrates can impact their weight and blood glucose	I might have to cut out a lot of the fruits. Because a lot of the food is good, but they carry so much sugar. I didn't know that. *(Hannah)*
			But the danger is in the uh… you also have to watch your carbohydrates, not only the sugar intake… My concern is more for the carbohydrates, the sodium, and So, and I look at the sugars, and the carbohydrates, and the sodium. *(Alice)*
Theme 2	**I Am Responsible for My Health**	Motivation to maintain their healthy habits	I wanna live. I have grandkids. I wanna live long enough to see my grandkids have kids *(Alice)*
			My main motivation is the gift of life. Motivation is staying alive…. grandchildren, I wanna live, for them. Because I love them so much, they take good care of me. And the more I think about them, like this morning, I said I need the will to lose more weight, to take better care of myself because I want to live more years... *(Hannah)*
		Managing DM on their own	Actually myself. Me. Cuz my dad wasn't doin' it. My mom wasn't you know, doin' it. So I had to learn for myself *(Alice)*
			And so, I had said to myself the other day, I said, if I don't do it, no one else is gonna do it for myself. I'm starting to, take time and do it. *(Isaac)*
			I've been following that, what kinda food I have to eat. You know, what kinda vegetable, stuff like that... Nobody help me do that. I figured that by myself. *(Ed)*
		Strict adherence to routines	I think I'm the only one in the family that learned the discipline. And that's what it takes, discipline … Sometimes I get a cravin' and I don't know if it's my sugars or if it's, you know, if it's something wrong or. So I'll drink some water, more water, I'll drink some more water if I still have it, and then I'm like, okay, I'll just take a little piece. And then I take a little piece and then… I check my sugars first …and then I eat a piece of candy or I chew a piece of gum or something like that.*(Alice)*
			I got a measure(ing) cup, one cup, I measure it. *(Ed)*

	THEME NAME	TOPIC/STRATEGY	EXEMPLAR QUOTE
Theme 2		Acceptance of their condition	You just live with it. I mean. First you have to accept it. (Laughter)… the key thing about diabetes is that you have to believe that it can happen to you. It's more of a positive attitude. Because, it's nothin' you can do about it. *(Alice)*
Theme 3	**I am an active participant in maintaining my health**	Checking their blood glucose more frequently	Don't beat yourself up. Don't be hurt that you was diagnosed. Life goes on. And find something constructive that makes you feel happy, that you know, and be around people that can help you make your diabetes feel better…And so only thing now is just managing it. You know, and taking better care of your health. *(Hannah)*
		Eliminating and replacing food items	I substitute my protein shakes for my meal replacement. So instead of having bacon, eggs, and the greasy food that I shouldn't eat, I just substitute half of a banana. And I sometimes put…I use soy milk, and I maybe scramble half an egg replacement…*(Hannah)*
			I eat full meals and I love vegetables. I love vegetables more than I love fruit. Cuz even natural fruit make my sugars high. *(Alice)*
		Eating less	…but when it's somethin' like rice or noodles or something like that I eat a smaller portion of it. *(Chris)*
			It's not that you can't eat what you want to eat, you just can't eat as much of it. *(Isaac)*
		Reading food labels and avoiding sugar and sodium	My daughter taught me how to read the labels. *(James)*
			I'm learning to read the back, the labels, to find out what consists of *(Isaac)*
		Commitment to a regular physical activity	I just walk, you know, walk about 30, 40 minutes every day. *(Chris)*
			And sometimes I walk for 45, 50 minutes... No, not every day, if I do it today, next day I don't do it. Another day I do it… (Every other day) *(Ed)*
			I usually walk around 45 minutes to an hour (everyday). *(Frank)*
Theme 4	**My Healthcare Provider is My Trusted Partner in Maintaining my Health**	Support from their healthcare providers is meaningful	Cuz I see her [provider]. It's like her voice be in my ear like, "Oh you know you don't need that, girl!" Cuz that's – she just bring a smile to my face all the time. *(Hannah)*
			Oh yeah, I trust my doctor. I love my doctor, both of them. I love my doctor. They help me a lot. *(Ed)*
Theme 5	**My Family Supports Me in Staying Healthy**	Support from siblings, children and partners in managing their diabetes	[My partner] always say you want to make sure you see your kids get grown don't ya? ... your grandkids? I say well yeah, of course. He said well come on, let's walk. You know, and so he the one really encourage me to you know to get out there and walk. *(Georgia)*
			You know, and when – I'll tell – my brother. Cuz if it wasn't for him, I wouldn't have my diabetes under control the way I do. (tearing up) I wouldn't. Like I said, he scared the crap outta me. *(James)*

Perceived Barriers

HBM indicates that individuals are motivated to take action when the benefits outweigh the perceived barriers to taking action; as noted earlier, diabetes is a disease that requires self-management. The complicated routines and time-consuming self-management activities were not perceived barriers for these participants. Most of the participants who have lived with diabetes for 15 years or more had integrated diabetes management into their daily routines.

Theme 1: I Know How Food Affects My Body

Many participants discussed their regular schedules for serum glucose self-monitoring. The number of checks varied with providing advice, but many kept medication logs and knew the numbers that constituted "high" or "low" values, and used it to help guide their medication, exercise and food intake.

Some of the participants described eliminating and replacing food items they felt they should not eat, including sugar and foods high in fat (including fast foods) and adding more vegetables into their diets. Most of the participants stated that they cook their own meals. Other participants described just eating less. They have learned to read food labels and avoid sugar and sodium. All of the participants described a commitment to regular physical activity, reporting about 30–45 minutes every day or every other day, some even despite complications making exercise difficult. Some of the participants who had dogs reported that the dogs were their exercise companions and a source of motivation. Participants talked about the need to accept their condition and stated they did not want to worry and concern about the daily self-care behavior to overwhelm them. All of the participants reported finding a positive way to deal with the daily stress they are confronted with in managing their diabetes.

Theme 2: I Am Responsible for My Health

When asked who assists them in managing their diabetes, almost all of the participants responded, with a sense of pride and accomplishment, that this was something they have been managing on their own. In addition, the participants described strict adherence to self-developed routines, whether to their food preparation, eating habits (limiting sugars or serving sizes), checking their blood glucose, or exercise habits, describing this discipline as a critical factor in the successful management of their diabetes. Furthermore, as measured by the HBQ, 80% of the participants disagreed/strongly disagreed with the statements *Taking my medication interferes with my normal daily activities and I would have to change too many habits to take my medication.*

Self-developed routines seemed to mitigate knowledge and education as potential barriers. Despite having low educational levels, low scores overall on the diabetes knowledge assessment and having overall low literacy levels (as measured by the DNT), the participants strongly disagreed with the statements *I am confused by all the medication the doctor has given me, and It has been difficult following the diet the doctor ordered for me.*

Cues to Action

HBM theorizes that cues to action trigger an individual's self-care behaviors. Cues to action can be internal (e.g., physical discomfort, pain) or external (e.g., advice from others, a call from a physician).

Theme 3: I Am an Active Participant in Maintaining My Health

Only two participants had attended diabetes education classes. Rather, personal life experiences generated valuable knowledge about the risks and severity of the disease. The participants described a personal understanding of how food affects their blood glucose. They knew through self-experimentation how their bodies would react to particular foods. In addition to understanding how certain foods affect their blood glucose, participants expressed an understanding of how eating large amounts of carbohydrates can impact their weight and blood glucose. Some participants described checking their blood glucose more frequently than recommended by their physicians to understand better how their blood glucose fluctuates with food and exercise.

Theme 4: My Healthcare Provider is a Trusted Partner in Maintaining my Health

The participants revealed the significance of the guidance from their healthcare providers, stating that their advice stayed with the patients long after they left the office. For example, one respondent described her provider's voice being "in her ear" (a clear cue to action), helping her make healthy choices.

Self-Efficacy

HBM posits that self-efficacy is an important driver of health-related behavior, particularly related to long-term health behaviors such as chronic disease management. As measured by the HBQ, most participants had a positive perception of their ability to manage their diabetes (self-efficacy). Most agreed with the statement: My diabetes is well-controlled. As described earlier (Theme 3: I Am An Active Participant in Maintaining My Health), most of the participants developed lifestyle habits that enable successful glycemic control. The strong positive response to the statement that diet will help "them feel better" coupled with strong disagreement that following the diet has been difficult suggests a strong degree of self-efficacy in using diet to manage their diabetes.

Perceived Benefits

HBM indicates that health-related behaviors are influenced by how individuals perceive the value or benefit of engaging in health behaviors. The participants understood the benefits of medication and lifestyle modifications in controlling their diabetes. They discovered the benefits through self-experimentation and paying close attention to how their bodies respond to medication, dietary and lifestyle changes *(Theme 1: I Know How Food Affects My Body)*. All of the participants agreed with the following statements: *In general, I believe that my diet for diabetes will help me to feel better; Following a prescribed diet is something a person must do no matter how hard it is; I believe that my medication will control my diabetes; and I believe that my medication for diabetes will help me to feel better.* Interestingly,

despite having strong diet and exercise routines, almost half the participants incorrectly answered the false statement, *Medication is more important than diet and exercise to control my diabetes.*

Diabetes Knowledge

Participants scored an average of 57% on the PDK assessment, indicating a low level of diabetes knowledge overall as measured by this assessment, with wide variation in the group. As a group, the participants scored highest on PDK questions having to do with self-care management of their diabetes and complications of diabetes, including those related to food preparation and foot care. All participants correctly answered the questions related to kidney damage and loss of feeling in hands and feet. Nearly all participants were able to correctly identify that a "fasting blood sugar of 210 is too high."

Perceived Severity and Perceived Susceptibility

HBM predicts that individuals who perceive themselves to be more susceptible to a particular health problem are more likely to engage in health-promoting behaviors. Additionally, those who perceive a particular disease or condition, or the complications from it as serious, are more likely to take preventative action. Participants were keenly aware of the severity of the complications of diabetes. Most of the participants agreed/strongly agreed that they must follow a prescribed diet and take medication "no matter how hard it is." On the diabetes knowledge assessment, participants scored high on questions regarding complications of type 2 diabetes. Many participants described someone in their life who did not manage their type 2 diabetes well and their resultant complications.

PERCEIVED SOCIAL SUPPORT

Theme 5: My Family Supports Me in Staying Healthy

While most participants felt they were responsible for their success in managing their diabetes, some of the participants reported that their siblings, children, and partners were supportive of them in managing their diabetes. As stated earlier, most participants reported managing their diabetes on their own. Despite this, the participants reported a high level of perceived social support on the SSAT. Participants felt they have supportive family members who help support type 2 diabetes management, particularly with their diet. Every participant had an important relationship in their lives that they cited as motivation to control their diabetes. As noted in the previous section, participants indicated that their physician and family members were the most supportive individuals in their diabetes management, followed by a paid helper, spouse, and God. One participant responded "no one" when asked this question.

Discussion and Implications

In this patient population with euglycemia and low numeracy, the PDK assessment demonstrated a low general knowledge about type 2 diabetes. Yet, interviews revealed a relatively high functional knowledge of diabetes management and complications. The participants showed high levels of knowledge related to daily disease management strategies. This could be attributed to their practice in maintaining good glucose control.

Only two participants had attended diabetes education classes, reflecting that only 20% of patients with diabetes receive formal diabetes education.[32] Rather, personal life experiences generated valuable knowledge about the risks and severity of the disease. The diabetes educator must understand what the patient understands. The etiology of type 2 diabetes, the relative efficacy and importance of medication versus lifestyle changes in long-term management and the home treatment of wounds, especially on the lower extremity, are worthy of focus in DSME. Other topics regarding the responsibility of the kidneys in diabetes or the pancreas' role in insulin production may be relatively less important in the context of day-to-day management.

There were some inconsistencies between interview and survey responses. Discussion with participants about their experiences with hypoglycemia and how they treated it suggested that participants understood the topic and its implications. Most participants, however, answered the PDK questions on hypoglycemia incorrectly. Specifically, many participants switched the symptoms of high and low blood glucose on the questionnaire, although when given the opportunity to self-treat shakiness and diaphoresis (hypoglycemic episode), most had an appropriate plan. This highlights that although some participants cannot name these symptoms as "hypoglycemia," they know what to do in an emergency. This discrepancy between questionnaire knowledge and interview responses further exemplifies the problematic nature of relying on only one source of information to understand patient knowledge. Some individuals may be better able to express their (correct) understanding of a concept through dialogue and conversation (interview) than via a multiple-choice or true/false assessment.

Many participants incorrectly answered the false statement, *Medication is more important than diet and exercise to control my diabetes.* This highlights another important teaching point: the need to emphasize the lifestyle modification necessary for glucose control and the secondary role of medication, especially with those who present with pre-diabetes and signs of insulin resistance. This may reflect the lack of focus their providers have placed on therapeutic lifestyle change. Team-based care may provide the best support for habit/behavior change but requires access to certified diabetes educators (CDE), nutritionists and exercise physiologists to help individualize nutrition and physical activity plans.

Many participants discussed their regular schedules for serum glucose self-monitoring. Previous research demonstrates patients poorly predicted their blood glucose levels[4], so the trend of regular glucose checks in the participant group may be an important factor in their successful glucose management. Further evidence of this was the insight of the importance of blood glucose checks before self-treating hypoglycemia.

Participants did not perceive their management routines as barriers that interfere with or compromise their daily activities. On the contrary, they believed that daily disease management is important and manageable within their daily schedules. Research has shown that self-efficacy is associated with glycemic control.[4] High levels of self-efficacy, coupled with an internal locus of control over type 2 diabetes symptoms and disease, may contribute to their ability to manage their diabetes effectively.

Participants reported high levels of emotional support from family. On the other hand, the participants reported low levels of support in daily chores and friendship (e.g., "someone to do something enjoyable with"). The survey results suggest that social support from family members is a potential protective factor and not a barrier to diabetes self-management for these participants.

Strengths and Limitations

A strength of this study is the triangulation of qualitative and quantitative results across participant cases. While patients had low scores on the DNT-15 and PDK indicating low diabetes numeracy and low diabetes knowledge, their interviews demonstrated they could manage a complex chronic disease such as type 2 diabetes. This overarching finding would not have emerged without analyzing and comparing data collected using multiple methods.

The cross-sectional nature of the study limits the conclusions that can be drawn. This study relied on only a single A1C reading as a measure of glucose control. The patient's long-term diabetes control may or may not reflect this sole A1C reading. Furthermore, validated questionnaires were challenging for some of these low-literacy participants to understand. For example, if a question about insulin dosing were asked on the DNT survey, many participants would initially state they are not on insulin.

CONCLUSION

Participants had high levels of risk (low income, older, low levels of numeracy, low diabetes knowledge as measured by PDK) yet maintained good glycemic control. They demonstrated self-efficacy, self-knowledge, and discipline and reported strong social support. Self-care routines were not perceived as barriers. The benefits of careful and diligent self-care routines were clear to the participants and outweighed any inconvenience. Cues to action were based on personal experiences and self-awareness developed from experimentation, not from formal diabetes educational experiences.

Recognizing low numeracy can help patients with individualized care plans that may contribute to their successful glycemic control. To develop knowledge and understanding, educators and providers need to build upon existing patients' knowledge when introducing new information. By activating background knowledge and starting from what patients know, understanding, and experiencing several things that can promote successful type 2 diabetes self-management: 1) builds relationships and increases perceived social support, 2) develops self-reflection and critical thinking and 3) builds a framework for new knowledge.

The social support provided by family members was a significant protective factor for the participants in this study. Future diabetes care interventions should consider expanding the role of the family in diabetes control. There is a strong genetic link in type 2 diabetes. Increased involvement of families may result in better patient outcomes and broader community effects due to lifestyle changes in families with family-based interventions. Future studies could approach diabetes and other chronic diseases from a family or social support standpoint. Exploring social networks as a decision unit may provide new insights to helping people cope and better manage chronic disease self-care.

Jay H. Shubrook, DO, FACOFP, is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

AUTHOR DISCLOSURES:

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