

# Thinking About Cognitive Function

## Perceptions of Cognitive Changes in People With Type 2 Diabetes

Heather E. Cuevas, PhD, RN, ACNS-BC

Alexa K. Stuijbergen, PhD, RN, FAAN

Sharon A. Brown, PhD, RN, FAAN

Jamie L. Rock, MSN, RN

From School of Nursing, The University of Texas at Austin, Austin, Texas (Dr Cuevas, Dr Stuijbergen, Dr Brown, Ms Rock).

Correspondence to Heather E. Cuevas, PhD, RN, ACNS-BC, School of Nursing, The University of Texas at Austin, 1710 Red River, Austin, TX 78701, USA (hcuevas@mail.nur.utexas.edu).

*Funding:* This work was supported by the Center for Transdisciplinary Collaborative Research in Self-Management Science at The University of Texas at Austin School of Nursing (TCRSS; P30, NR015335: PI Kim).

*Acknowledgments:* Editorial support with manuscript development was provided by the Cain Center for Nursing Research and the Center for Transdisciplinary Collaborative Research in Self-management Science (P30, NR015335) at The University of Texas at Austin School of Nursing.

DOI: 10.1177/0145721717729806

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### Purpose

The purpose of this study is 2-fold: (1) to explore how people with diabetes view diabetes-related cognitive problems and (2) to examine participants' ideas on a cognitive rehabilitation intervention to adapt it for persons diagnosed with type 2 diabetes (T2DM).

### Methods

A qualitative descriptive study based on narrative interviews was conducted with adults ( $n = 10$ ) with T2DM. The interview data were analyzed using content analysis.

### Results

The interviews reflected 4 major themes: search for advice regarding cognitive complaints, cognitive symptoms, impact of perceived cognitive dysfunction on diabetes self-management, and maintenance of cognitive health. Specific areas of interest for an intervention included the following: understanding how cognitive function relates to diabetes, dealing with cognitive barriers to self-management, and learning how to incorporate a "brain healthy" lifestyle into daily activities.

### Conclusions

Findings showed that perceived cognitive impairment impacted self-management and suggested that cognitive rehabilitation interventions have potential utility for

people with T2DM. Existing successful interventions can be tailored to meet the needs of those whose diabetes self-management is impacted by cognitive problems.

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**D**iabetes affects all areas of cognitive function, and its negative effects on memory and executive function are prominent and well documented.<sup>1</sup> The brain is an end-organ of type 2 diabetes (T2DM), and cognitive dysfunction is strongly associated with poor metabolic control and longer duration of the disease due to hyperglycemia-related neurotoxicity, changes in amyloid metabolism, and increased inflammation.<sup>2</sup> Recent guidelines therefore recommend annual screening for cognitive dysfunction at age 65 in people with T2DM.<sup>3-5</sup> However, symptoms of cognitive problems in diabetes and a decline in scores on neuropsychological tests begin at an earlier age in those with diabetes compared to those without.<sup>6,7</sup> The presence of midlife cognitive complaints also indicates a risk for dementia, but few studies have examined individuals' perspective of cognitive complaints, and none have done so within the context of diabetes.<sup>8</sup> Cognitive concerns (eg, memory difficulty, attention deficits) are complex, and it is difficult to assess the effects of slight cognitive changes on daily life with standard neuropsychological tests.<sup>8</sup>

Even when cognitive problems have been identified, there are few interventions designed specifically for those with diabetes. Intensive glycemic control with medications has not been shown to improve cognition and in fact may worsen it.<sup>9</sup> Exercise and a Mediterranean-style diet may improve cognitive function or prevent or at least delay cognitive decline.<sup>10</sup> Computer-based cognitive rehabilitation interventions designed for individuals with other chronic conditions such as multiple sclerosis have been shown to improve performance on neuropsychological tests and improve quality of life in those who have objective evidence of cognitive problems or subjective concerns.<sup>11-13</sup> Camp et al<sup>14</sup> have tested a memory intervention involving spaced retrieval in 18 participants with T2DM to enhance medication adherence; A1C levels declined initially after treatment but returned to baseline levels after 6 months. The authors concluded that future studies should involve booster sessions after initial training, with maintenance of contact over a longer period. One intervention that has fulfilled these criteria for other conditions and improved verbal memory and

the use of compensatory cognitive strategies is a combination of weekly group sessions and home-based computer-assisted cognitive rehabilitation.<sup>12</sup> Participants in these types of interventions have shown improvement on neuropsychological tests and reported that the intervention's cognitive strategies improved their ability to function in daily life. For example, some of the participants reduced distractions when focusing on new information—a memory strategy that they learned in one of their group sessions.<sup>12</sup> Interventions of this type have been adapted for other chronic conditions, such as cognitive dysfunction following chemotherapy (“chemo brain”), and show promise as a treatment that merits investigation in T2DM.<sup>13</sup> The purpose of the present study reported here was 2-fold: (1) to explore the perceptions of people with T2DM regarding cognitive changes they have experienced and (2) to examine informants' recommendations for modifications of existing cognitive rehabilitation interventions (in-person classes and online training) to adapt them for use with those who have T2DM.

## Research Design

This was an exploratory qualitative descriptive study based on narrative interviews and qualitative content analysis. Because to date no studies have examined the perceptions of cognitive function in people with T2DM, a qualitative descriptive method was especially appropriate because it provided a useful first stage in our investigation.<sup>15</sup> Such inductive research enables the identification of unexpected themes, with the goal of a clear description of participants' experiences that can (1) be understood by a variety of groups including lay people, researchers, and health care professionals and (2) supply information about ways to improve care.<sup>16</sup> This was the first part of a 2-phase project to develop and adapt an intervention for diabetes, approved by the Institutional Review Board of The University of Texas at Austin. Written informed consent was obtained prior to the interviews. The consolidated criteria for reporting qualitative research (COREQ) checklist was used for reporting the data.<sup>17</sup> The COREQ is a 32-item checklist used to improve rigor, comprehensiveness, and reliability in studies using qualitative methods.<sup>17</sup> The checklist includes criteria in 3 domains: (1) research team and reflexivity, (2) study design, and (3) analysis and findings. Each domain consists of questions such as “What experience or training did the researcher have?,” “Was data saturation discussed?,” and

“Were themes identified in advance or derived from the data?” Researchers can use these criteria not only to guide reporting of study results but also promote transparency and reproducibility.<sup>17</sup>

## Setting, Recruitment, and Participants

The study was undertaken in central Texas. Participants were recruited from a local multisite endocrinology clinic known to the research team using purposive sampling. The clinic oversees the health care of over 2000 patients per month, about 60% of whom have T2DM. Most patients at these clinic sites access lab reports through a “patient portal” that requires Internet access, which meant that participants could also access a computer-based training program.

For inclusion, participants were required to have been diagnosed with T2DM for at least 2 years to ensure that they had the experience of living with the disease and its requirements for self-management. Further, participants’ age range was set at 40 to 70 years, owing to the higher prevalence of T2DM in mid to late middle age and the likelihood of differences in intervention preferences and responses between younger and older adults with T2DM. Participants also had to express subjective concerns about their cognitive functioning. To determine this, potential participants were given the Perceived Deficits Questionnaire.<sup>18</sup> This instrument assesses domains of cognitive function that are often affected in T2DM: attention, retrospective memory, prospective memory, planning, and organization.<sup>18</sup> Those scoring a score of at least 10, indicating subjective complaints, were eligible to participate. Additional inclusion criteria were that participants: (1) be able to speak, read, and respond in English and (2) have access to transportation and telephone and Internet services. Exclusion criteria were having: (1) limitations that precluded study activities such as severe dementia or (2) other medical causes of dementia or disorders that might affect cognition, such as self-reported depression. People who were patients of one of the interviewers (first author) were excluded to avoid conflicts of interest in participant recruitment. Each participant was given a \$20 grocery store gift card for participation.

## Methodology

Data collection took place from November 2016 to January 2017. Data were collected via narrative interviews with participants. The interviews were held in private areas

of the clinic or at a site of each participant’s choosing. Two trained interviewers conducted and audio-recorded the interviews, which included questions regarding how participants managed their diabetes, how they felt diabetes did or did not affect their cognitive function, and how they felt cognitive function affected their diabetes self-management, as well as questions to obtain comments on the structure and topics of a cognitive rehabilitation intervention (Tables 1 and 2). Additional probing questions were used as needed to clarify responses, and participants were allowed time to reflect on their comments as well as clarify their responses if needed. Care was taken to ask participants about their individual experiences with diabetes and perceived cognitive problems instead of cognitive problems in general. All study participants completed a demographic questionnaire that included gender, age, ethnicity, educational level, and self-reported most recent A1C level. The principal investigator kept a journal to document all research project decisions for continued tracking, all of the researchers’ preconceptions, and all project decisions.

## Data Analysis

The first author transcribed the audio-recorded interviews verbatim. The transcripts were then reviewed and coded, using Miles et al’s<sup>19</sup> recommendations. In such an analysis, the codes and themes are derived from the data rather than a theoretical framework. First, the data were read repeatedly to obtain a sense of the whole; next, the data were read word-for-word, highlighting text that appeared to capture key thoughts and concepts; codes were then derived from the key concepts; and the codes were categorized according to their relationships and linked and grouped into meaningful clusters. To ensure reliability of this process, a second reviewer separately coded the transcripts using the themes developed in the initial coding. The level of agreement between the coders was 88%. To achieve total consensus, when differences were found, discussion ensued, and the section of text in question was assigned to a different code or a new code was generated from similar themes. Member checks were not used because of their potential inherent problems.<sup>20,21</sup> For example, member checking may lead to participant confusion; participants may change their minds about an issue or may have forgotten what they said.<sup>20</sup>

All research team members were experienced in qualitative methods. The first author was also experienced as an advanced clinician managing patients with T2DM. Two members of the research team were experienced in

Table 1

## Interview Questions

Diabetes Self-Management	Cognitive Function	Intervention
<p>What should someone know about having diabetes?</p> <ul style="list-style-type: none"> <li>• What advice do you have for someone with diabetes?</li> <li>• What do you wish someone had told you about diabetes?</li> </ul>	<p>Cognitive function describes how we use memory and how we think about things.</p> <p>What, if any, problems have you noticed with your cognitive functioning since your diagnosis with diabetes?</p>	<p>We are planning 8 weekly sessions. Take a look at the list of topics.</p> <ul style="list-style-type: none"> <li>• How do these topics relate to your life?</li> <li>• Are we missing any topics?</li> <li>• Is there anything we should leave out?</li> </ul>
<p>What is your biggest barrier to caring for your diabetes?</p>	<p>When did you first notice changes in your cognitive functioning?</p>	<p>In what ways are you more likely to participate in a diabetes class?</p> <ul style="list-style-type: none"> <li>• What time of day?</li> <li>• Who leads it?</li> <li>• How do you feel about homework?</li> </ul>
<p>What would people be surprised to know about having diabetes?</p>	<p>What, if any, impact have these changes had on your:</p> <ul style="list-style-type: none"> <li>• Work</li> <li>• Activities</li> <li>• Daily functioning</li> </ul> <p>What, if any, impact did these changes have on how you manage your diabetes?</p> <p>What, if anything, did your health care provider do to address your perceived cognitive impairment?</p> <p>Would you be interested in a program that would teach you strategies to improve your cognition/memory?</p>	<p>Would you be open to doing a 45-minute activity?</p> <p>Do you have computer access at home?</p> <p>What is your opinion about learning in a small group setting?</p> <p>If you were in this study, what would keep you coming back to a class? What would prevent you from attending?</p> <p>What are some things the class leader can do to keep you engaged in each lesson?</p>

developing and testing interventions in people with chronic conditions; one was the developer an existing cognitive rehabilitation intervention.

## Results

Sixteen people were approach by members of the team in person or via phone and asked to participate. Ten people agreed to participate in the interviews; sample characteristics are presented in Table 3. All participants had at least a high school education, and their average age was 55 years (range, 44-70 years). Their average length of time with diabetes was 8.1 years, and their self-reported average A1C was 7.5% (58 mmol/mol). The interviews lasted for an average of 45 minutes (range, 35-80 minutes). The participants' comments suggested 4 major themes: search for advice about cognitive complaints,

cognitive symptoms they experienced, impact of perceived cognitive dysfunction on diabetes self-management, and maintenance of cognitive health.

## Search for Advice About Cognitive Complaints

The most common theme expressed among the participants was the desire for knowledge about potential effects of diabetes on cognitive function. None of the participants reported that a health care provider had talked with them about the impact of diabetes on cognition. All but one said that they were unaware of potential cognitive problems related to diabetes. As one woman noted, for example, "I never knew that diabetes was related to memory . . . that's surprising." Another "never knew" that diabetes was "related to memory or cognitive stuff." Many discussed

Table 2

## Proposed Topics for Cognition Class Sessions for People With Type 2 Diabetes (T2DM)

	Elements of the MAPSS-MS Intervention	T2DM Adapted Content
<b>Week 1</b>	<ul style="list-style-type: none"> <li>Maximizing cognitive functioning and orientation to computer training</li> </ul>	<ul style="list-style-type: none"> <li>Understanding T2DM, symptoms, complications, and medications</li> <li>Understanding how cognitive function is related to T2DM</li> </ul>
<b>Week 2</b>	<ul style="list-style-type: none"> <li>Attention and processing speed</li> </ul>	<ul style="list-style-type: none"> <li>Addressing ADA dietary recommendations</li> <li>Discussion of favorite recipes, more healthy food preparation, eating out, and emphasis on portion control</li> </ul>
<b>Week 3</b>	<ul style="list-style-type: none"> <li>Memory and language</li> </ul>	<ul style="list-style-type: none"> <li>Enlisting family and friends to assist with self-care activities</li> <li>Discussing effective strategies to facilitate better communication with health care providers</li> </ul>
<b>Week 4</b>	<ul style="list-style-type: none"> <li>Executive functioning and visuospatial skills</li> </ul>	<ul style="list-style-type: none"> <li>Diabetes medications and the need for adherence</li> <li>Blood glucose self-monitoring skills</li> </ul>
<b>Week 5</b>	<ul style="list-style-type: none"> <li>Lifestyle adjustments to maximize cognitive health</li> </ul>	<ul style="list-style-type: none"> <li>Addressing misunderstandings of T2DM self-management and symptoms/complications</li> </ul>
<b>Week 6</b>	<ul style="list-style-type: none"> <li>Stress management</li> </ul>	<ul style="list-style-type: none"> <li>Acknowledging and appreciating stress associated with diabetes</li> <li>Providing resources for mental health care services</li> </ul>
<b>Week 7</b>	<ul style="list-style-type: none"> <li>Engaging in exercise and physical activity</li> </ul>	<ul style="list-style-type: none"> <li>Addressing ADA activity recommendations</li> <li>Discussion of practical ways to increase activity</li> </ul>
<b>Week 8</b>	<ul style="list-style-type: none"> <li>Maximizing cognitive functioning—pulling it all together</li> </ul>	<ul style="list-style-type: none"> <li>Improving self-management skills including blood glucose monitoring, medication adherence, diet, and exercise by addressing resources as well as barriers</li> </ul>

Abbreviation: MAPSS-MS, Memory, Attention, and Problem-Solving Skills for Persons with Multiple Sclerosis.

the need to have information about cognitive impairment as a potential diabetes complication at the time of diagnosis: “It’s important to know so you can be prepared and you can not think you’re going crazy.”

Some participants had a rudimentary understanding of the pathophysiology of cognitive changes in diabetes related to acute episodes of hypoglycemia but wanted to know more: “But as the glucose changes there is a mis-firing of neurons in the brain because there’s not enough sugar bouncing around up there. So somebody could be talking in the background and you may have heard it, but you won’t remember.”

One participant had searched the Internet on his own and said that when he subsequently asked his physician about diabetes and cognitive function, his question was “pushed off to the side.” Others wanted to investigate the potential contributions of diabetes to cognitive problems: “I need to read up and some doctors don’t say anything. I need to learn. And you know with diabetes there are some things you can get like neuropathy and so any type of change in your memory it’s probably related to the diabetes.”

## Cognitive Symptoms

Participants in this study reported that they had experienced cognitive problems, particularly a worsening in memory ability—for example,

I think short-term memory to be more specific. It’s the fact that I will try to do something, but I will say no I’ll do it in a minute and then I’ll forget and I’ll say wait, what’s happening. So I would classify it as short-term memory. Sometimes and this is something. I’m trying to think of a specific fact, for example, the name of an actor. Eventually I’ll get it, but it’s seems like it’s harder now that, well since I was diagnosed. It’s frustrating because it’s not at my fingertips.

As another said, “Well, I can remember when I used to drive for [bus company] one time I couldn’t even remember where I was at. I forgot. Wrong turns and stuff like that.” Memory issues tended to have worsened since diabetes diagnosis: “I think I can’t remember certain things that used to be easier. Especially before I had diabetes.”

Table 3

## Participant Characteristics

Variable	Frequency	Mean	Range
Age (y)		55	44-70
Gender	Male	5	
	Female	5	
Ethnicity	Hispanic	4	
	African American	2	
	Non-Hispanic white	4	
Marital status	Single	1	
	Married	6	
	Divorced	3	
Education level	High school	1	
	Some college	2	
	Completed undergraduate degree	5	
	Graduate degree	2	
Length of time with diabetes (y)		8.1	2-16
Self-reported A1C % (mmol/mol)		7.5 (58)	5.9-9.2 (41-77)

In fact, most participants believed that their cognitive changes had worsened or that they were made more aware of their cognitive problems after their diabetes was diagnosed. However, none had actually attributed those changes to diabetes. Despite the relatively young age of the sample, most attributed their perceived problems to “normal aging.” Most stated that these cognitive issues had not improved but instead worsened over time.

### Impact of Perceived Cognitive Dysfunction on Diabetes Self-Management

Most participants reported that cognitive problems had some impact on their diabetes self-management. Remembering to take medications and planning ahead were prominent areas of diabetes self-management affected by cognitive issues:

I think I have problems remembering to take my medications, but it does not benefit me to mark on calendars or anything like that. I even have a pill that I have to take an hour after I eat and I'll remember it past the hour and it's too late.

Others mentioned issues with diet: “Planning what to eat is hard . . . I always have to think ahead about what am I gonna eat. And am I going to eat this or that or when. And a lot of times I don't think ahead.”

### Maintaining Cognitive Health

Some participants were already using different cognitive strategies to try to stay “sharp”: “When I was still working and I was at the register at the pharmacy. And I would look around the store and I would get a word and see how many words I could make out of that one. I would write it on a piece of paper.” Others kept up with hobbies, such as cross-stitching and cooking, that they felt kept their “brains going.” One woman put it thus:

It would be very easy for the person who has a memory problem not to remember what those terms [for sewing] are. But with practicing it brings in not only the kinetic of doing something with your hands, but then the mental piece too. It needs to be repetitive stuff. So if you make a potholder you're going to learn to make three.

Others mentioned trying stay social (eg, going to church, family activities) or reading more as other ways to maintain

cognitive health. None mentioned exercise as a strategy to maintain or improve cognitive health, and only one mentioned, “I need to eat less junk food to get rid of the brain fog.”

## Cognitive Rehabilitation Intervention Specifics

None of the participants had ever tried formal “brain games” or cognitive training to improve cognitive function. All participants liked the combination of online training and in-person classes, particularly the social support offered by the classes. Nine of 10 individuals who were interviewed said that they would be interested in class sessions to improve memory, attention, and other cognitive domains, with the hope that this would help improve their diabetes self-management. As one participant put it, “I need a diet for diabetes and maybe it will help my brain. I think I could learn that in a class.” Specific areas of interest for intervention class content included the following: understanding how cognitive function relates to diabetes, dealing with cognitive barriers to diabetes self-management, discussing how stress associated with diabetes is related to cognitive function, and learning how to incorporate a “brain healthy” lifestyle, particularly related to diet, into daily activities. All participants said that they would be willing to commit to an intervention of 4 to 6 weeks in length; they thought they would be able to adhere to a 45-minute, 3 times per week online game schedule. Ease of use of online games, accessibility, and convenient scheduling of group sessions were mentioned as important aspects of an intervention. Potential barriers to participation included travel to group sessions and timing of the classes (ie, interference with work hours).

## Discussion

The ultimate goal of this project was to determine how best to adapt a cognitive rehabilitation intervention for people with T2DM. Ten adults with T2DM were interviewed and questioned about cognitive function, including how they felt it affected their diabetes self-management and strategies that they used to deal with cognitive difficulties. The themes that emerged included search for advice about cognitive complaints, cognitive symptoms, the impact of perceived cognitive dysfunction on diabetes self-management, and maintenance of cognitive health. For these participants, memory was the prominent concern. This study builds on

the existing evidence regarding changes in cognitive function after a diagnosis of diabetes, but it is the first study to address participants’ perceptions of changes in cognitive function. Other qualitative research has investigated perceived cognitive problems related to chemotherapy, chronic pain, and mild cognitive impairment, but this issue has not been addressed for diabetes.<sup>22-24</sup> This study introduces the effects of perceived cognitive impairment on diabetes self-management.

Subjective reports like these can be useful in the assessment of cognitive impairment in diabetes because patients’ reports and complaints are an important part of evaluation. Prior studies have shown that health care providers are unaware of cognitive impairment in 40% of their patients with cognitive dysfunction.<sup>25</sup> The US Preventive Services Task Force recommended that “although the overall evidence on routine screening is insufficient, clinicians should remain alert to early signs or symptoms of cognitive impairment (for example, problems with memory or language) and evaluate as appropriate.”<sup>26</sup> This is noteworthy because failure to evaluate cognitive complaints can present issues of safety and may delay treatment of underlying conditions.<sup>5</sup> In diabetes, cognitive changes may manifest as problems in adherence to recommendations for self-management.<sup>1,27,28</sup> Unless they are prompted, patients may not necessarily mention that they have cognitive problems, linking their symptoms to aging rather than to diabetes; or when they report cognitive problems to health care providers, their concerns may be dismissed, as they were for one person in this sample. Improving self-management behaviors can be achieved by developing or adapting educational programs that take into account the impact of cognitive changes on diabetes self-management. This type of support and validation is essential for coping with cognitive changes.<sup>23,29</sup>

Cognitive problems were reported in domains found to be affected by diabetes in previous studies using neuropsychological tests, including executive functioning and memory.<sup>30</sup> Healthy older adults primarily report cognitive problems for memory.<sup>31</sup> This was also true in the present study. Furthermore, participants reported that cognitive problems affected their work and diabetes self-management. Evaluating how perceived cognitive functioning impacts daily life is increasingly important. Neuropsychological tests may not be accurate predictors of daily functioning, and the impact of perceived cognitive impairments on a person’s ability to perform diabetes self-management

tasks is critical.<sup>1</sup> Qualitative studies have examined only a small part of these real-world outcomes, indicating a need for more comprehensive measurement of the impact of cognitive impairments on daily functioning in patients with diabetes. By extension, gathering information about how patients cope with or compensate for such difficulties is also important. In addition, understanding the trajectory of cognitive changes is valuable because it can inform personalized services for patients. Although resources exist to help improve cognitive function, they may not be tailored to the specific challenges that people with diabetes face. A deeper understanding of how perceived cognitive issues impact the daily lives of persons with T2DM and their diabetes self-management is needed to inform and improve interventions. Current approaches in this population could be altered to include discussions with patients about their feelings of control over cognitive changes.

Only one intervention study that has been published to date was designed to specifically help people with diabetes and cognitive impairments.<sup>14</sup> However, studies have investigated cognitive interventions in other chronic illnesses, including multiple sclerosis and Parkinson's. Current approaches in these populations include sharing knowledge about cognitive changes, training in cognitive strategies, and promoting "brain healthy" lifestyles.<sup>12,32</sup> Other cognitive rehabilitation interventions, which include those components, have been effective in improving cognitive functioning in a variety of disease processes as well as in increasing self-efficacy in the use of cognitive strategies.<sup>12</sup> When asked about the components of a cognitive rehabilitation intervention, participants responded positively and indicated that they wanted to know more about mitigating diabetes' effects on cognitive function. Participants also had a desire to increase social activities. This finding is encouraging because evidence shows that those with perceived or objective memory problems withdraw from social interactions and leisure activities.<sup>33</sup> Other studies have underscored the need to help people increase their engagement in leisure and social activities. For example, a qualitative study of patients with mild cognitive impairment demonstrated that participants benefitted from interventions that helped normalize the experience of memory changes by increasing feelings of control and self-efficacy over memory functions.<sup>32</sup>

The interview method used in this study has some limitations. Levels of perception, cooperation, and articulation varied among individuals. The specificity of participants' described experiences of perceived cognitive

problems and diabetes self-management varied as well. Additionally, the principal investigator was a clinician in the endocrinology clinic where these participants were recruited, which may have resulted in more socially desirable answers. This group also had good access to care and relatively controlled glucose levels. Therefore, this sample was somewhat biased toward a higher educated, better controlled group of persons with diabetes. Conversely, this could be considered a strength as these individuals could be considered "experts" in diabetes self-management and represent some of the best sources of information to inform the design of future interventions. As in most qualitative studies, the interview findings should be seen as exemplifications rather than a representation of an entire population. There may be more issues that did not arise in participants' answers.

## Conclusion

To our knowledge, this is the first study to examine the perceptions that people with T2DM have regarding their cognitive function in the context of diabetes. The findings show that perceived cognitive impairment impacts self-reported diabetes self-management decisions and activities. The findings also suggest that a cognitive rehabilitation intervention can be developed and modified for testing in people with T2DM and that it can provide valuable data for further study. Participants indicated that interventions were desirable and should include interactions with others who are experiencing similar problems.

This study brings to light the need to educate health care providers regarding discussions of cognitive problems with patients, partially because patients may be reluctant to initiate discussions about cognitive issues due to fear of not being taken seriously or losing independence. In fact, participants in this study were anxious to learn more about cognitive issues, which is an important facilitator to change. There may be some benefit to screening patients on a more consistent basis for cognitive problems to promote lifestyle change, but care should be taken to avoid creating fear in patients, which may lead to hypervigilance regarding cognitive problems. Additionally, existing interventions may need to be tailored to meet the needs of those whose diabetes self-management is impacted by perceived cognitive problems. Longitudinal research is needed to examine the effects of interventions because there are few guidelines to direct care. Future research should focus on multiple

dimensions of cognition as cognitive function includes much more than memory ability.

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