

# Assessment of Cognitive Function in Type 2 Diabetes

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## ABSTRACT

If health care is ultimately to reduce morbidity and mortality, all forms of cognitive dysfunction must be decreased, whether mild cognitive impairment, dementia, or Alzheimer's; to do this, health care providers must consider evaluations of cognitive function in people with type 2 diabetes (T2DM), as the condition is associated with a higher risk for cognitive dysfunction. This report addresses cognitive assessment in T2DM and invites advanced practice nurses to review the current data on assessing and making recommendations to individuals with T2DM.

**Keywords:** cognitive dysfunction, screening, type 2 diabetes

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## INTRODUCTION

The complications of type 2 diabetes (T2DM) discussed most often with patients include cardiovascular disease, neuropathy, and retinopathy. Cognitive dysfunction, however, is also closely associated with T2DM, and evidence suggests that it should be addressed by health care providers. In a meta-analysis of 14 studies that together examined 100,000 cases of dementia, T2DM was found to be associated with a 60% risk for dementia.<sup>1</sup> In addition, having T2DM in midlife is associated with a 19% greater decline in cognitive function over 20 years than for those without T2DM.<sup>2</sup> Indeed, the incidence of dementia and cognitive decline may begin early in T2DM's development. Some studies have found changes in brain structure and brain activation patterns with obesity, insulin resistance, and/or metabolic syndrome before development of overt T2DM.<sup>3</sup> This is unfortunate, as many individuals with T2DM are unable to adhere to self-management recommendations such as home glucose monitoring or specific diet and exercise regimens, thus contributing to cognitive dysfunction that leads to poorer glycemic control.<sup>4</sup> Moreover, lack of glycemic control is linked to the development and progression of cognitive dysfunction.<sup>5</sup>

In primary care, we therefore have a major opportunity to advocate for cognitive screening in patients with T2DM who are at risk for cognitive dysfunction and to implement simple assessments of

cognitive function during an annual exam as well as make necessary referrals. All forms of cognitive dysfunction must be decreased, whether mild cognitive impairment, dementia, or Alzheimer's, if morbidity and mortality are to be reduced. Thus, health care providers must consider evaluations of cognitive function in people with T2DM, along with insulin resistance, obesity, and metabolic syndrome. Once cognitive dysfunction is detected and diagnosed, health care providers can implement guideline-based T2DM care that addresses the potential impact of patients' cognitive impairment on their self-care.<sup>6</sup> Therefore, advanced practice nurses need to be familiar with the guidelines and simple screening tools for treatment of cognitive deficits.

## SCREENING GUIDELINES

The Affordable Care Act stipulates that clinicians must assess individuals aged  $\geq 65$  for cognitive impairment as part of their annual wellness visit ([www.healthcare.gov/law/full/index.html](http://www.healthcare.gov/law/full/index.html)). The United States Preventive Services Task Force recommends that clinicians use the Dementia Screening Indicator to help identify those who may benefit from cognitive impairment screening. Potential predictive factors on the screening form include depressive symptoms, body mass index  $< 18.5$ , functional difficulties, and T2DM.<sup>7</sup> Recent guidelines from the American Geriatrics Society (AGS) and the American Diabetes Association also

recommend assessment of cognitive function as a standard of care in older adults with T2DM.<sup>8,9</sup> The AGS states that clinicians should assess all older adults with T2DM in an initial visit for cognitive impairment. Any increased difficulty in self-care (eg, missed appointments, multiple medication errors, or inability to perform skills they were proficient at in the past, such as self-glucose monitoring) should be considered as a change that requires additional assessment. Screening for other factors that can affect cognitive function, such as B<sub>12</sub> deficiency, depression, and hypothyroidism, are also part of the AGS guidelines. However, assessment for cognitive impairment in T2DM may not be fully implemented in the outpatient setting and recommendations have not been made at all for screening patients age < 65, despite the risks associated with a longer duration of T2DM.<sup>8-10</sup>

**ASSESSMENT TOOLS**

Asking patients about changes in cognitive function is important, but, beyond that, structured assessments are necessary.<sup>11</sup> For general assessment of cognitive function in T2DM, several quick and sensitive assessments have been utilized in outpatient settings. Table 1 provides brief descriptions of 3 such tools. The Montreal Cognitive Assessment (MoCA) is recommended by both the American Diabetes Association and the AGS.<sup>8,9</sup> The MoCA, a pen/paper test specifically developed by a neurologist for use in clinics with a high volume of patients, is precise in measuring cognitive impairment, sensitive to early stages of neurodegenerative conditions, and easy to administer (it takes approximately 10 minutes).<sup>16</sup> This instrument assesses memory, visuospatial ability, executive function, attention, language, and orientation. In a review of tools used to assess cognitive function in primary care, the MoCA, in combination with the Digit Symbol Substitution Test, was found to be more sensitive in detecting mild cognitive deficits in those with T2DM than the commonly used Mini-Mental Status Examination (MMSE).<sup>16,17</sup> The MMSE does not measure executive function, a domain that shows deficits in T2DM.<sup>13</sup> Some clinicians have argued that the clock drawing test alone is sufficient for detecting cognitive problems, but comparative studies have yet to confirm this

**Table 1. Cognitive Screening Tool Characteristics**

Test	Advantages <sup>10</sup>	Disadvantages <sup>10</sup>	Time to Administer	Specificity and Sensitivity	Reliability
Montreal Cognitive Assessment (MoCA)	<ul style="list-style-type: none"> <li>Versions for multiple languages and visual impairment</li> <li>Assesses many separate cognitive domains</li> <li>Sensitive to early cognitive impairment</li> </ul>	<ul style="list-style-type: none"> <li>Administration time &gt;10 minutes</li> <li>Education bias (&lt; 12 years)</li> <li>Requires training before administration</li> </ul>	10-15 minutes <sup>12</sup>	93/67 <sup>13</sup>	alpha = 0.91 <sup>16</sup>
Mini-Cog	<ul style="list-style-type: none"> <li>Versions for multiple languages</li> <li>No education bias</li> <li>Administration time is relatively short</li> </ul>	<ul style="list-style-type: none"> <li>Word lists will vary and may affect scores</li> </ul>	3-5 minutes <sup>14</sup>	87/90 <sup>13</sup>	Cohen's kappa = 0.949 <sup>14</sup>
Mini-Mental Status Examination (MMSE)	<ul style="list-style-type: none"> <li>Widely used and studied</li> <li>Reference point for comparison with other cognitive tests</li> <li>Required for some insurance reimbursements</li> </ul>	<ul style="list-style-type: none"> <li>Controlled by copyright</li> <li>Language bias</li> <li>Highly educated impaired subject pass (ceiling effect)</li> </ul>	7-10 minutes <sup>15</sup>	93/13 <sup>15</sup>	alpha = 0.877 <sup>15</sup>

observation.<sup>12,15</sup> The MoCA does require clinicians to be trained in its use. The Mini-Cog, another short assessment tool well validated in people with T2DM, does not require training and is recommended by the Alzheimer's Association.<sup>14</sup>

### STRATEGIES FOR PATIENT CARE

Counseling should be provided before and after any cognitive assessment.<sup>10</sup> Studies have shown that, even in the absence of direct treatment options such as medication to improve cognitive function, patients appreciate diagnostic information for other reasons, such as planning for the future and prioritizing other health-related goals.<sup>18</sup> Also, although no one particular treatment exists to reduce or prevent T2DM-associated cognitive dysfunction, the discussion of perceived or actual cognitive problems can help clinicians tailor T2DM treatment to patients to reduce medication errors, prevent hypoglycemia, and coordinate support for self-management activities.<sup>18</sup>

Several strategies for teaching patients about cognitive function in the context of T2DM have been recommended.<sup>19</sup> Health care providers are encouraged to adopt a holistic approach to treatment and address the comprehensive range of modifiable risk factors for cognitive impairment.<sup>20</sup> Initially, patients should be asked about any cognitive

complaints and how these complaints may or may not affect routine day-to-day activities. The clinician assesses and discusses other potential contributors to cognitive changes, such as sleep disorders (eg, sleep apnea, which is common in obesity/T2DM), hypertension, and hyperlipidemia and obesity-associated inflammation (see Table 2).<sup>10</sup> Mood disturbances, which can interfere with cognitive function, are particularly important, because T2DM is strongly correlated with depression.<sup>23</sup> Depression screening instruments such as the Patient Health Questionnaire, which measures the frequency of depressive symptoms, are useful.<sup>24</sup> In addition, the Problem Areas in Diabetes Scale, which assesses emotional responses to aspects of life with T2DM, can supplement cognitive assessment in the absence of major depression.<sup>24</sup> These tools can help the clinician determine the extent to which depressive symptoms affect specific areas of T2DM management.

Discussion of the relationship between cognitive dysfunction and glycemic control is also relevant, although findings for medications used to treat T2DM have been varied with regard to their effect on cognitive function. A review of 27 studies found that intensive medication treatment yielded no benefit for cognitive function and may lead to more

**Table 2. Strategies to Reduce Cognitive Dysfunction in Diabetes**

Assessment Findings	Strategies	Resources
Cognitive screening results	<ul style="list-style-type: none"> <li>In-depth neuropsychological testing or referral</li> </ul>	<ul style="list-style-type: none"> <li>Alzheimer's Association Wellness Visit Algorithm<sup>10</sup></li> <li>National Institute on Aging guide for primary care<sup>21</sup></li> </ul>
Lack of glycemic control	<ul style="list-style-type: none"> <li>Comprehensive diabetes education, medical management and monitoring, avoidance of hypoglycemia</li> </ul>	<ul style="list-style-type: none"> <li>American Diabetes Association guidelines for management of diabetes<sup>8</sup></li> </ul>
Hypertension	<ul style="list-style-type: none"> <li>Monitor BP</li> </ul>	<ul style="list-style-type: none"> <li>The Eighth Joint National Committee (JNC 8) guidelines for blood pressure management</li> </ul>
Hyperlipidemia	<ul style="list-style-type: none"> <li>Quarterly lipid panels</li> </ul>	<ul style="list-style-type: none"> <li>American Diabetes Association guidelines for management of hyperlipidemia in diabetes<sup>8</sup></li> </ul>
Obesity	<ul style="list-style-type: none"> <li>Mediterranean diet</li> <li>Physical activity</li> </ul>	<ul style="list-style-type: none"> <li>Dietician referral, MIND diet<sup>22</sup></li> <li>American Diabetes Association guidelines for exercise in diabetes<sup>8</sup></li> </ul>

hypoglycemia, which could impair cognitive function further.<sup>25</sup> The most significant improvements in cognitive function were found in working memory scores in participants taking metformin plus rosiglitazone or metformin and glyburide, but scores on other cognitive tasks did not improve.<sup>25</sup> Although large-scale, randomized, controlled trials did not indicate or demonstrate any cognitive benefit from intensive glucose control and patients should be cautioned regarding hypoglycemia, there is an area of glucose management that falls between neglect and intensive or aggressive management.<sup>26,27</sup>

Diet, especially the Mediterranean diet, has been shown to have some benefit on cognitive function.<sup>22,28</sup> Exercise is a low-risk activity that also has been shown to improve cognitive function in the general population.<sup>29</sup> Both the National Institute on Aging and the American Diabetes Association provide guidelines to help people with T2DM start and maintain an exercise regimen.<sup>21,30</sup> Discussion of the effects of T2DM on cognitive function may also motivate individuals to adhere to better self-management of diet and exercise.

A referral to a clinical neuropsychologist or neurologist may be required based on cognitive screening tests or the patient's statement of symptoms.<sup>19</sup> Assessment findings that would trigger concerns include Mini-Cog scores  $\leq 3$ , MoCA scores  $< 26$ , and MMSE score  $< 27$ ; persistent deficits after correction of precipitating factors (eg, treating hypothyroidism); rapid progression ( $< 6$  months) of deficits or depression; or isolated cognitive deficits.<sup>31</sup>

## CONCLUSION

Considering the high risk and prevalence of cognitive impairment in T2DM, strategies should focus on detecting cognitive deficits, because they are likely to have implications for daily function and T2DM self-management. Resources in the form of support and monitoring can then be appropriately directed to the more susceptible patients. Given the increasing number of patients with T2DM, the need for knowledge about the best approach for determining cognitive impairment is increasingly urgent and relevant, particularly in the context of T2DM, where

unrecognized cognitive dysfunction can, apart from affecting many other aspects of life, affect T2DM self-management with potentially serious results.<sup>18</sup> Assessment for cognitive problems in people with T2DM, combined with appropriate T2DM management, can lead to improved care and quality of life. **JNP**

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1555-4155/17/\$ see front matter  
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<http://dx.doi.org/10.1016/j.nurpra.2017.04.026>