Review Article

Management of Cognitively Impaired Older Diabetic Patients

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ABSTRACT

One of the demanding situations of handling older adults with diabetes is the individualization of care in human beings with more than one comorbid situation. Although macrovascular and microvascular headaches of diabetes are nicely recognized, there may be a lack of understanding concerning different situations consisting of cognitive disorder, depression, and bodily disabilities. Cognitive disorder is of specific significance due to its effect on self-care and first-class of life. The review concluded for successful management of diabetes; it is important to identify the degree of cognitive impairment among diabetic patients must be conducted in order to provide optimal patient care.

Keywords: Older adult, diabetes, cognitive impairment, management.

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INTRODUCTION

Although affected person-centric manage strategies are advocated for everyone, some age-related conditions aren't nicely understood and their effect on diabetes control with inside the ageing populace continues to be evolving. Diabetes is a systemic disease as it affects various body systems to some extent. For instance, diabetes can disrupt proper function in cardiovascular, gastrointestinal, immune and nervous systems. Adverse effects of diabetes on cognitive system and memory disorders have been noticed by researchers for a long time. Thus, the presence of cognitive disorder (additionally generally called cognitive impairment), is a vital situation to apprehend because it interferes with affected person's participation of their diabetes control. Cognitive disorder is a huge time period that consists of many domains, consisting of memory, learning, intellectual flexibility, attention, and govt feature. In addition, sufferers with cognitive disorder may be on a spectrum that extends from a moderate cognitive impairment (described as cognitive disorder without issue appearing each day sports) to extreme disorder (generally called dementia). Mild cognitive disorder might not reason issue in self-control sports in lots of sufferers, development of this situation desires to be cautiously observed. Mild cognitive impairment additionally places the affected person at chance for delirium. For patients with cognitive impairment capabilities, consisting of perception, problem-solving, judgment, preventing or converting antique habits, and beginning new habits are all difficult. All of those behaviours are vital while diabetic with cognitive impairment is requested to do complicated obligations consisting of matching insulin dose with carbohydrate content, predicting the effect of bodily pastime on blood glucose, or maybe spotting and treating hypoglycaemia appropriately. In this Perspective, I will speak vital elements of handling diabetes with inside the older populace with coexisting cognitive disorder [1].

IS DIABETES ASSOCIATED WITH COGNITIVE DYSFUNCTION IN OLDER ADULTS?

Although cognitive dysfunction is associated with both kind 1 and kind 2diabetes, Patients having kind 1diabetes are much more likely to have faded intellectual flexibility and slowing of intellectual speed[2]. Patients having kind 2 diabetes display decline in reminiscence, gaining knowledge of, attention, and psychomotor efficiency [3, 4].

Researchers prove sufferers with kind 2 diabetes are predisposed to each vascular and Alzheimer varieties of dementia. Aging additionally has an effect on sufferers with diabetes. A longitudinal look at asymptomatic sufferers over the duration of 6 years suggests accelerated mind extent loss which could be much higher in diabetic patients[7]. It seems that the danger of cognitive disorder in kind 2diabetes can be stimulated through glycaemic control, hypoglycaemia, depression, and macro- and micro vascular pathology [8]. In sufferers with kind 1 diabetes, it seems though diabetes has a lesser effect on cognitive disorder than the ones sufferers with kind 2diabetes. Patients with kind 1 diabetes performed lower than age-matched manipulate subjects; the test outcomes showed that the cognitive test values' remained with the ordinary range [9]. Thus, the cognitive decline in sufferers with kind 1diabetes can be moderate and might not intrude with their capability till later years.

HOW DOES COGNITIVE DYSFUNCTION IMPACT DIABETES?

The presence of cognitive disorder has an impact on the risk of every hypoglycaemia and hyperglycaemias in patients with diabetes.

Hypoglycaemia

There is a bidirectional relationship between dementia and the threat of hypoglycemia. In a potential populace, sufferers with any hypoglycaemic episode had a twofold better risk of growing dementia [10]. Similarly, sufferers with dementia had a three times better threat of getting subsequent hypoglycaemic episodes. The association between cognitive disorder and the risk of hypoglycaemia is visible in sufferers with each kind 1 and 2diabetes. In a evaluation of a huge potential cohort Action to Control Cardiovascular Risk in Diabetes-Memory in Diabetes (ACCORD-MIND) trial, cognitive decline was related to an multiplied risk of hypoglycaemia in patients with kind 2 diabetes[11.] Other cross-sectional populace based studies' in sufferers with kind 2 diabetes have additionally proven records of excessive hypoglycaemia and poor cognitive feature in later life [12, 13]. However, latest studies have proven a better occurrence of cognitive disorder in older sufferers (60years of age) with kind 1 diabetes. The presence of cognitive dysfunction has an impact on the risk of both hypoglycaemia and hyperglycaemias in patients with diabetes [5].

Hyperglycaemia

There have been a few proofs to suggest a bidirectional courting among the hyper glycaemia and cognitive disorder. Presence of cognitive disorder is related with poor glycaemic control [15]. As described in the preceding section, that is possibly due to the patient's lack of ability to carry out diverse additives of self-management. On the alternative hand, hyperglycaemia mediated superior glycosylated cease product and oxidative stresses are the elements which could damage neurons and vascular endothelium main to cognitive disorder [16]. However, extra researchers are wanted to identify the effect of glycemic and nonglycaemic factors related to diabetes on the progression of cognitive disorder. Patients with kind 1diabetes enrolled in the DCCT trial had been reassessed after18 years and this evaluation showed that long-time period negative metabolic control was related to cognitive decline [17]. Small studies have additionally evaluated the effect of glucose on cognitive function and discovered an affiliation among the postprandial elevation of glucose with a cognitive decline [21, 22].

HOW DO WE RECOGNIZE COGNITIVE DYSFUNCTION?

As the growing older affected person gets medically more complicated, the time constraints appear to worsen for the clinicians stressful to treat them inside the clinics. Studies suggest that the health practitioner need to carry out a few form of cognitive evaluation in all over sixty five years of age as a part of medical visit. In medical practice, moderate-to-excessive decline in cognition is commonly identified through the use of aid. Mild cognitive illness in hundreds of oldsters who are on a clean diabetes regimen might also additionally needed to be recognized as it may interfere with treatment. However, moderate or diffused dysfunctions in patients who are on complicated insulin regimens are much more likely to interfere with their functionality to carry out self-management. Thus, interest need to be paid and cognitive function need to be assessed with the populace on a complicated habitual who are having problem dealing with their diabetes [24, 25]. It's difficult for critical thinking in diabetic with cognitive impairment. Thus, it's far essential to discover illness earlier than prescribing a complex insulin regimen. Various brief screening tests, on the aspect of Montreal Cognitive Assessment (MOCA), Mini-Cog, or Mini-Mental State Examination (MMSE), are beneficial to assess overall cognition [24, 26]. The Mini-Cog is also a brief screening tool that is placed to be beneficial in a hectic clinical practice to reveal for cognitive illness [26].

Table 1: Clinical shows of patients with polygenic disease and psychological features and techniques for management

Affected behaviour	Impact on polygenic disease self-care	Methods to boost management
Memory loss	• Forget to monitor glucose • Forget to take medications • Forget to eat on time • Forget to take insulin injection • Forget to eat before exercise • Forget to attend clinic visit	• Decrease frequency of self-monitoring, check when caregivers are available • Pillboxes, alarm • Decrease number of insulin injection • Long-acting formulation to decrease frequency of pills/day • Involve caregivers • Choose supervised exercise program • More than one clinic visit reminders
Problem solving difficulty	• Seems to remember instructions but unable to integrate into practice • Unable to recognize or treat hypoglycaemia	• Repeated education and instructions at each visit • Avoid labels such as "noncompliant" • Make small changes at a time

		• Avoid complex regimen
Difficulty stopping old behaviour and starting behaviour	• Seems to be "stubborn" • Refuses any new therapy • Errors occurs when old routine are changed	• Avoid changes if possible • Ask for help from caregivers with reminder when behaviour is being changed May need to restrict access to insulin (especially in type 1 patient)if too much insulin is taken due to old habits
Difficulty with mental flexibility	• Feel anxious regarding "falling "the treatment plans • Too much focus on diabetes management	• Avoid difficulty tasks such as sliding scales • Simplify regimen • Decrease the need for frequent snacks or monitoring

MANAGEMENT

Management of diabetes involves a high degree of patient involvement and daily performance of many self-care tasks. These include monitoring of blood glucose; eating healthy meals; engaging in physical activity; taking medications as directed; recognizing and managing hypoglycaemia; performing proper hygiene, including foot and dental care; attending medical appointments; and understanding sick-day management. Pharmacological therapy, particularly when insulin is needed, can be complex. Social, physical, and mental health challenges may hinder self-care and are associated with increased diabetes complications and poor quality of life [27].

CLINICIAN APPROACH

At present, it isn't clear whether or not enhancing glycaemic manage or the use of specific therapeutic dealers can enhance the risk of cognitive decline. A examine of a middle-elderly population showed that the control of prediabetes and diabetes with tight glycaemic control at some point of the midlife might also additionally protect against cognitive decline [3]. On the other hand, there's clean proof that the extensive manage of blood glucose, blood pressure, or levels of cholesterol within the older population isn't useful in preventing cognitive decline [19, 34]. Intensive remedy regimens require diligent self-care and perception into insulin characteristic and its relationship with carbohydrates and physical activity. If sufferers' coping talents are limited, the complicated regimens may cause remedy failure and hypoglycaemia, which in flip will increase the risk of cognitive decline.

It is important to define the appropriate glycemic goals in these patients

Recently, there can be a developing pain with the use of A1C as a sole parameter to define glycaemic goals with the older population. Studies have validated that A1C values with the older population may not reflect the same predicted mean glucose as with the younger population

Table 2: Simplification strategies for older patient with diabetes

Difficulty with regimen	Possible strategies
Forget to take mealtime insulin	Use basal insulin once daily to control fasting glucose. Replace mealtime insulin with once daily noninsulin agents to control postprandial hyperglycaemia (e.g., long –acting formulation of metformin or sulfonylurea, pioglitazone, once-a-day GLP-1Analog, dipeptidyl peptidase 4 inhibitors, sodium-glucose > co transporter 2 inhibitor).
Make errors in insulin scale	Avoid insulin sliding scale, Replace with fixed insulin dose before meals. If scale is not available, use simple one-or-two-dose scale. For example, glucose >250mg/dl, use two units; glucose >350mg/dl, use four units.
Hypoglycaemia at fasting but high glucose during the day time	Use basal insulin in the morning and titrate the dose up to get fasting glucose control the next morning. Combine insulin with noninsulin agents as described above for postprandial glucose control during the day.
Need caregiver for insulin injections	Choose strategies with less frequent insulin administration. For example, use basal insulin in the morning to titrate for fasting glucose control. At the same time, use long acting oral agents or mixed insulin in the morning to control postprandial glucose during the daytime. Coordinate with caregivers to see when they are available to assist the patient.
Forget to take medication-scheduled several times/ day	Use pillbox Try long acting formulations once daily

Treatment Strategies

When choosing a treatment strategy, interest of cognitive function, caregiver support, and coexisting co morbidities are crucial. Using drugs with a lower risk of hypoglycaemias one easy method to hassle in patients with type 2 diabetes. Contraindications because of exceptional co morbidities, which consist of renal and hepatic dysfunction and the immoderate rate of new classes of drugs, are barriers to this method. When drugs with a low risk of hypoglycaemia are not an option, insulin can be used successfully at each age in patients. However, insulin additionally may be dangerous medication, particularly in older patients with cognitive dysfunction who may make unrecognized errors in doses, timing of injections, or timing and content material fabric of meals. These errors can lead to massive glucose excursions, with an immoderate risk of hypoglycaemic unawareness. However, insulin can be used safely in appropriate settings, if caregivers are available or if the patient is in a supervised care facility[35].

The out of place opportunity to simplify regimens is possibly due to the lack of algorithm that directs no specialist clinicians who care for these frail older patients with diabetes. The use of basal insulin to lower the baseline and use of noninsulin agents to control post meal hyperglycaemia is an effective way to govern diabetes and reduce the risk of hypoglycaemia and glucose excursions. The makes use of extended-launch formulations for oral or noninsulin injectable stores are also useful and decrease the frequency of dosing, resulting in a discounted chance of missing doses. Some clinically beneficial techniques for sufferers with advancing cognitive disorder are validated. . It is vital to recollect that such techniques aren't going to bring about awesome glycaemic manage. It is meant to avoid severe hypo- and hyperglycaemic episodes and to beautify strain and quality of life in patients who are now no longer capable of cope with complex regimens.

There are subtle versions in how management issues observed in patients with type 1versus type 2diabetes with cognitive decline. Patients with type 1 diabetes are normally proactive in their disease management and pretty disciplined. Cognitive disease in the ones patients creates vast distress for the first time in their lives; they suddenly feel a "lack of control" over the sickness they have managed for masses decades. The addition of autonomic disease, gastropathy, or neuropathy might also cease end result in wider glucose excursions. These patients are usually more afraid of hyperglycaemia than hypoglycaemia every of which they've got managed for many years. However, cognitive dysfunction in older adults with type 1 diabetes has been decided to be associated with hypoglycaemic unawareness and glucose variability [42], which in turn increases the risk of intense hypoglycaemia [41] .The need for purpose adjustments to avoid hypoglycaemia and receive some hyperglycaemia, can be very difficult for masses of these patients. Family people and caregivers concern to be important for supervision to avoid errors in insulin dosing and to avoid intense hypoglycaemia with falls and unconsciousness. With extra current advances in technology, the careful use of non-prevent glucose monitoring and Bluetooth-enabled insulin pens might also help patients with type 1diabetes manipulate their sickness successfully. Finally, it is crucial to remember that diabetes and its self-care requirement have an impact on excellent of life in all age-groups. However, the presence of cognitive disease extensively decreases the excellent of life because of the difficulty in taking part in self-care and other behavioural adjustments that frequently accompany this sickness. Management plans that weigh down patients physically, emotionally, or financially should be carefully avoided.

Table 3: Role of health care professionals in supporting the needs of people with diabetic and cognitive impairment

Health care professionals and Services
Diabetes medical providers: 1. Screen sufferers for cognitive impairment, decide etiology of cognitive decline, and/or check with a strong point company (neurologist or neuropsychologist) for in addition assessment and offer for remedy of cognitive impairments, as indicated; screening may consist of the usage of the Montreal Cognitive Assessment, asking sufferers approximately cognitive changes, and asking own circle of relatives approximately cognitive changes 2. Make suitable referrals for ongoing diabetes care control to a: a. Nurse for domestic care desires together with medicine control, glucose tracking or wound care b. Dietician for dietary desires c. Physical therapist to deal with mobility and stability issues d. Occupational therapist to deal with domestic protection desires e. Diabetes educators to deal with academic desires of the patient, own circle of relatives, and different caregivers f. Podiatrist for foot care g. Mental fitness company or social employee to deal with psychosocial desires h. Pharmacist for coordination of drugs desires and fill up control I. Specialty care company (e.g., cardiologist, neurologist, optometrist, ophthalmologist, dentist, nephrologists, or endocrinologist), as needed 3. Foster a collaborative courting amongst sufferers, their own circle of relatives individuals, and different individuals of the fitness care group 4. Seek possibilities to simplify regimens 5. Adjust clinical regimens to limit hypoglycaemia and symptomatic hyperglycaemia
Registered nurses: 1. Discuss with sufferers (and families) their worries and options on the subject of their diabetes and circulate to comprise nursing care to satisfy these, as suitable

2. Help sufferers (and/or their caregivers) who carry out SMBG to interpret consequences and inspire self sustaining decision-making wherein possible

3. Provide commands in simplified terms

4. Obtain assistive gadgets together with an automated tablet dispenser, as needed

Registered dieticians:

1. Ascertain and hold sufferers' dietary desires and meals options

2. Review nutrition, setting up sensible carbohydrate, protein, and caloric goals

3. Provide sensible meal plans

4. Refer to outdoor organizations as needed (e.g., Meals on Wheels)

Physical therapists, occupational therapists, and speech therapists:

1. Assess sufferers' practical skills and limitations

2. Establish a secure interest regimen

3. Establish a secure domestic environment

4. Recommend assistive gadgets as needed

Certified diabetes educators or different diabetes educators:

1. Educate sufferers, families, caregivers, and personnel the way to first-class manipulate diabetes and meet diabetes-associated desires, along with prevention, recognition, and remedy of hypoglycaemia

2. Provide behavioural, academic, psychosocial, and medical assist

3. Recommend assistive gadgets as needed (e.g., use of syringe magnifiers or alternate from use of insulin syringes to insulin pens)

Mental fitness vendors and social employees:

1. Assess sufferers' intellectual fitness reputation and desires

2. Provide emotional and behavioural therapies, as needed

3. Refer as had to make certain sufferers get hold of suitable care and ongoing assist

Neuropsychologists:

1. Determine whether or not sufferers' cognitive impairment is of enough severity to have an effect on diabetes self-control tasks

2. Provide hints for techniques to mitigate the effect of cognitive impairment on diabetes tasks

3. Support and train own circle of relatives individuals on the character of cognitive impairment and the way they could assist the patient

4. Make centered hints for cognitive rehabilitation

5. Consult with different individuals of the clinical group concerning first-class practices given a patient's particular profile of cognitive strengths and weaknesses (e.g., propose a simplified remedy regimen, propose written as opposed to oral communication, or suggest they want for caregiver assist in clinical control)

NON PHARMACOLOGICAL MANAGEMENT

Physical activity

Multi component physical intervention flexibility, strength, balance, endurance, and aerobic training had insufficient data to conclude the effect. There was no study comparing attention control with aerobic training, resistance training, Tai Chi exercises, physical activity, diet and cognitive training. Although, single component physical activity interventions showed unfavourable results, multi domain interventions appeared to promote cognitive function in older persons with normal cognition. Encouraging performing in clinical practice is recommended since the benefits also affect to prevent or manage other chronic illnesses [43].

Cognitive training

There is no clinical trial on the protective effect of cognitive training in adults with normal cognitive function to progress to MCI according to a systemic review. Training with specific domain could improve cognitive function in the trained domains which where reasoning, executive function /attention/processing speed, and memory. Therefore there is insufficient evidence of cognitive training regarding prevention or delay of cognitive decline in adults with normal cognitive function [44].

Food and food habits

This food are used to boost up the brain and memory,

- Fatty fish
- Coffee, Blueberries
- Turmeric, Broccoli
- Pumpkin seeds
- Dark chocolate, Nuts, Oranges
- Eggs, Green tea [45].

Natural ways to improve memory

- Eat less added sugar
- Try fish oil supplement
- Make time for meditation
- Maintain a healthy weight
- Get enough sleep practice mindfulness
- Play brain games
- Exercise more
- Choose anti inflammatory foods [46].

CONCLUSION

Identification of cognitive dysfunction and modification of treatment regimens to accommodate it in older patients is important for successful diabetes management. The principles of managing diabetes in the older population with coexisting cognitive dysfunction are a difficult task.

However, life style modification including regular cognitive and physical activity should be promoted through strong health policies in order to promote successful aging. It is vital to adopt a crew method concerning the patient, family, and caregivers and such as the usage of allied fitness specialists and assistive devices, as well as simplification of medication regimens with a focus on avoiding hypoglycaemia and symptomatic hyperglycaemia, is needed for adults with moderate-to-severe cognitive impairment. More research is required to better understand optimal treatment approaches in cognitive impaired patients.

REFERENCES

1. Medha N, Munshi. Cognitive Dysfunction in Older Adults with Diabetes: What a Clinician Needs to know. Diabetes Care 2017;Apr; 40(4): 461-467. https://doi.org/10.2337/dc161229
2. Brands AM, Biessels GJ, de Haan EH, Kappelle LJ, Kessels RP. The effects of type 1 diabetes on cognitive performance: a meta-analysis. Diabetes Care 2005; 28:726–735; https://doi.org/10.2337/diacare.28.3.726 pmid:15735218
3. Wrighten SA, Piroli GG, Grillo CA, Reagan LP. A look inside the diabetic brain: Contributors to diabetes-induced brain aging. Biochim biopsy's Acta 2009;1792: 444–453. https://doi.org/10.1016/j.bbadis.2008.10.013 pmid:19022375
4. Okereke OI, Kang JH, Cook NR, et al. Type 2 diabetes mellitus and cognitive decline in two large cohorts of community-dwelling older adults. J Am Geriatr Soc 2008; 56:1028–1036 https://doi.org/10.1111/j.1532-5415.2008.01686.x pmid:18384580
5. Brands AM, Biessels GJ, Kappelle LJ, et al.; Utrecht Diabetic Encephalopathy Study Group. Cognitive functioning and brain MRI in patients with type 1 and type 2 diabetes mellitus: a comparative study. Dement Geriatr Cogn Disorder 2007; 23:343–350 pmid:17374953 https://doi.org/10.1159/000100980
6. Manschot SM, Biessels GJ, de Valk H, et al.; Utrecht Diabetic Encephalopathy Study Group. Metabolic and vascular determinants of impaired cognitive performance and abnormalities on brain magnetic resonance imaging in patients with type 2 diabetes. Diabetologia 2007;50:2388–2397 https://doi.org/10.1007/s00125-000792-z pmid:17764005
7. Enzinger C, Fazekas F, Matthews PM, et al. Risk factors for progression of brain atrophy in aging: six-year follow-up of normal subjects. Neurology 2005; 64:1704-1711 https://doi.org/10.1212/01.WNL.0000161871.83614.BB pmid:15911795
8. Fein kohl I, Price JF, Strachan MW, Frier BM. The impact of diabetes on cognitive decline: potential vascular, metabolic, and psychosocial risk factors. Alzheimer's Res Ther 2015;7:46 https://doi.org/10.1186/s13195-015-0130-5 pmid:26060511
9. Brands AM, Kessels RP, Hoogma RP, et al. Cognitive performance, psychological well-being, and brain magnetic resonance imaging in older patients with type diabetes. Diabetes 2006; 55:1800–1806. https://doi.org/10.2337/db05-1226 pmid:16731845
10. Yaffe K, Falvey CM, Hamilton N, et al.; Health ABC Study. Association between hypoglycemia and dementia in a biracial cohort of older adults with diabetes mellitus. JAMA Intern Med 2013; 173:1300–1306. http://10.0.3.233/jamainternmed.2013.6176 pmid:23753199
11. Punthakee Z, Miller ME, Launer LJ, et al.; ACCORD Group of Investigators; ACCORD-MIND Investigators. Poor cognitive function and risk of severe hypoglycemia in type 2 diabetes: post hoc epidemiologic analysis of the ACCORD trial. Diabetes Care 2012;35:787–793 https://doi.org/10.2337/dc11-1855 pmid:22374637
12. Aung PP, Strachan MW, Frier BM, Butcher I, Deary IJ, Price JF; Edinburgh Type 2 Diabetes Study Investigators. Severe hypoglycaemia and late-life cognitive ability in older people with type 2 diabetes: the Edinburgh Type 2 Diabetes Study. Diabet Med 2012;29:328-336. https://doi.org/10.1111/j.1464-5491.2011.03505.x pmid:22023662
13. Whitmer RA, Karter AJ, Yaffe K, Quesenberry CP Jr, Selby JV. Hypoglycemic episodes and risk of dementia in older patients with type 2 diabetes mellitus. JAMA 2009;301:1565–1572 doi:10.1001/jama.2009.460 pmid:19366776
14. Jacobson AM Musen G, Ryan CM, et al.; Diabetes Control and Complications Trial/Epidemiology of Diabetes Interventions and Complications Study Research Group. Long-term effect of diabetes and its treatment on cognitive function. N Engl J Med 2007;356:1842–1852 https://doi.org/10.1056/nejmoa066397 pmid:17476010
15. Munshi M, Grande L, Hayes M, et al. Cognitive dysfunction is associated with poor diabetes control in older adults. Diabetes Care 2006;29:1794–1799. https://doi.org/10.2337/dc06-0506 pmid:16873782
16. Strachan MW. R D Lawrence Lecture 2010. The brain as a target organ in type 2 diabetes: exploring the links with cognitive impairment and dementia. Diabet Med 2011;28:141-47. https://doi.org/10.1111/j.1464-5491.2010.03199.x pmid:21219420
17. Jacobson AM, Ryan CM, Cleary PA, et al.; Diabetes Control and Complications Trial/EDIC Research Group. Biomedical risk factors for decreased cognitive functioning in type 1 diabetes: an 18 year follow-up of the Diabetes Control and Complications Trial (DCCT) cohort. Diabetologia 2011; 54:245–255. https://doi.org/10.1007/s00125 pmid:20803190
18. Cukierman-Yaffe T, Gerstein HC, Williamson JD, et al.; Action to Control Cardiovascular Risk in Diabetes-Memory in Diabetes (ACCORD-MIND) Investigators. Relationship between baseline glycemic control and cognitive function in individuals with type 2 diabetes and other cardiovascular risk factors: the Action to Control Cardiovascular Risk in Diabetes-Memory in Diabetes (ACCORD-MIND) trial. Diabetes Care 2009;32:221–226 https://doi.org/10.2337/dc08-1153 pmid:19171735
19. Launer LJ, Miller ME, Williamson JD, et al.; ACCORD MIND investigators. Effects of intensive glucose lowering on brain structure and function in people with type 2diabetes

(ACCORD MIND): a randomised open-label sub study. Lancet Neurol 2011;10:969–977 https://doi.org/10.1016/S1474-4422(11)70188-0 pmid:21958949

20. Christman AL, Matsushita K, Gottesman RF, et al. Glycated haemoglobin and cognitive decline: the Atherosclerosis Risk in Communities(ARIC)study. Diabetologia 2011;54:1645–1652 https://doi.org/10.1007/s00125-011-2095-7 pmid:21360189

21. Rizzo MR, Marfella R, Barbieri M, et al. Relationships between daily acute glucose fluctuations and cognitive performance among aged type 2 diabetic patients. Diabetes Care 2010; 33:2169–2174. https://doi.org/10.2337/dc10-0389 pmid:20573753

22. Ohara T, Doi Y, Ninomiya T, et al. Glucose tolerance status and risk of dementia in the community: the Hisayama study. Neurology 2011; 77:1126–1134.

DOI: https://doi.org/10.1212/WNL.0b013e31822f0435 pmid: 21931106

23. Novak V, Milberg W, Hao Y, et al. Enhancement of vasoreactivity and cognition by intranasal insulin in type 2 diabetes. Diabetes Care 2014; 37:751–759.

DOI: 10.2337/dc13-1672 pmid:24101698

24. Tomlin A, Sinclair A. The influence of cognition on self-management of type 2 diabetes in older people. Psychol Res Behav Manag 2016; 9:7–20. DOI: 10.2147/PRBM.S36238 pmid:26855601

25. Rosen MI, Beauvais JE, Rigsby MO, Salahi JT, Ryan CE, Crame r JA. Neuropsychological correlates of suboptimal adherence to metformin. J Behav Med 2003;26:349–360 https://doi.org/10.1023/A:1024257027839 pmid:12921008

26. Kazlauskaite R, Soni S, Evans AT, Graham K, Fisher B. Accuracy of self-monitored blood glucose in type 2 diabetes. Diabetes Technol Ther 2009;11:385–392 https://doi.org/10.1089/dia.2008.0111 pmid:19459768

27. Feil DG, Pearman A, Victor T, et al. The role of cognitive impairment and caregiver support in diabetes management of older outpatients. Int J Psychiatry Med 2009;39:199–214. https://doi.org/10.2190%2FPM.39.2.h pmid:19860078

28. Hewitt J, Smeeth L, Chaturvedi N, Bulpitt CJ, Fletcher AE. Self management and patient understanding of diabetes in the older person. Diabet Med 2011;28:117-122 https://doi.org/10.1111/j.1464-5491.2010.03142.x pmid:21166853

29. Sinclair AJ, Girling AJ, Bayer AJ. Cognitive dysfunction in older subjects with diabetes mellitus: impact on diabetes self-management and use of care services. All Wales Research into Elderly (AWARE) Study. Diabetes Res Clin Pract 2000; 50:203–212 https://doi.org/10.1016/S0168-8227(00)00195-9 pmid:11106835

30. Nasreddine ZS, Phillips NA, Bédirian V, et al. The Montreal Cognitive Assessment, MoCA: a brief screening tool for mild cognitive impairment. J Am Geriatr Soc 2005;53:695–699 https://doi.org/10.1111/j.1532-5415.2005.53221.x pmid:15817019

31. Folstein MF, Folstein SE, McHugh PR. “Mini-mental state”: a practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975; 12:189–198 pmid:120220

32. Gadsby R, Hillson R, Forbes A, Bayer AJ. Use of the Mini-Cog as a screening tool for cognitive impairment in diabetes in primary care. Diabetes Res Clin Pract 2013; 100:e23–e25 https://doi.org/10.1016/j.diabres.2013.01.001 pmid:233525794

33. Rachel Hopkins, Kristi shaver et al. Management of adults with diabetes and cognitive problem. Diabetes Spectrum 2016 Nov; 29(4): 224-237. https://doi.org/10.2337/ds16-0035

34. Williamson JD, Launer LJ, Bryan RN, et al; Action to Control Cardiovascular Risk in Diabetes Memory in Diabetes Investigators. Cognitive function and brain structure in persons with type 2 diabetes mellitus after intensive lowering of blood pressure and lipid levels: a randomized clinical trial. JAMA Intern Med 2014; 174:324–333. doi:10.1001/jamainternmed.2013.13656 pmid:24493100

35. Munshi MN, Florez H, Huang ES, et al. Management of diabetes in long-term care and skilled nursing facilities: a position statement of the American Diabetes Association. DiabetesCare 2016;39:308–318. https://doi.org/10.2337/dc15-2512 pmid:26798150

36. Inclair A, Morley JE, Rodriguez-Manas L, et al. Diabetes mellitus in older people: position statement on behalf of the International Association of Gerontology and Geriatrics (IAGG), the European Diabetes Working Party for Older People (EDWPOP), and the International Task Force of Experts in Diabetes. J Am Med Dir Assoc 2012;13:497–502 https://doi.org/10.1016/j.jamda.2012.04.012 pmid:22748719

37. Thorpe CT, Gellad WF, Good CB, et al. Tight glycemic control and use of hypoglycemic medications in older veterans with type 2 diabetes and comorbid dementia. Diabetes Care 2015;38:588–595 https://doi.org/10.2337/dc14-0599 pmid:25592195

38. Sussman JB, Kerr EA, Saini SD, et al. Rates of deintensification of blood pressure and glycemic medication treatment based on levels of control and life expectancy in older patients with diabetes mellitus. JAMA Intern Med 2015;175:1942–1949. doi:10.1001/jamainternmed.2015.5110 pmid:26502220

39. Lipska KJ, Ross JS, Miao Y, Shah ND, Lee SJ, Steinman MA. Po tential overtreatment of diabetes mellitus in older adults with tight glycemic control. JAMA Intern Med 2015;175:356–362 doi:10.1001/jamainternmed.2014.7345 pmid:25581565

40. Munshi M, Slyne C, Segal AR, Saul N, Lyons C, Weinger K. Simplification of insulin regimen in older adults and risk of hypoglycemia. JAMA Intern Med 2016;176:1023–1025

doi:10.1001/jamainternmed.2016.2288

41. Weinstock RS, DuBose SN, Bergenstal RM, et al.; T1D Exchange Sever Hypoglycemia in Older Adults With Type 1 Diabetes Study Group. Risk factors associated with severe hypoglycemia in older adults with type 1 diabetes. Diabetes Care 2016;39:603 610 https://doi.org/10.2337/dc15-1426 pmid:26681721

42. Munshi M, Riddles worth TD, Chaytor NS, et al. Cognitive dysfunction and hypoglycemia in older adult’s with type 1 diabetes: results from the T1D Exchange [Abstract]. Diabetes 2015;64: A385 https://doi.org/10.2337/dc16-1229

43. Kane RL, Butler M, Fink HA, et al. Interventions to Prevent Age-Related Cognitive Decline, Mild Cognitive Impairment, and Clinical Alzheimer's-Type Dementia [Internet]. Agency for Healthcare Research and Quality (US); 2017 Mar.

44. Bruno Bonnechère, Malgorzata Klass, Christelle Langley, and Barbara Jacquelyn Sahakian Brain training using cognitive apps can improve cognitive performance and processing speed in older adults. Scientific Report 2021; 11: 12313. DOI: 10.1038/s41598-021-91867-z; PMID: 34112925

45. Kerri-Ann Jennings, MS, RD — medically reviewed by Kathy W. Warwick, R.D., CDE. 11 Best Foods to Boost Your Brain and Memory – Health line. Nutrition —updated on June 21, 2021. https://www.healthline.com

46. Jillian kabala, MS, RD *14* Natural Ways to Improve Your Memory. March 26, 2018 https://www.medicalnewstoday.com/articles/324044

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