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Original Research Article

Comparison of early and late diagnosis impact of type 2 diabetes on cognitive function: a pilot study

Arbind Kumar Choudhary[1]*, Yogendra Raj Singh[1], Pramod Kumar[2], Altaf Ahmad Mir[3], Ashutosh Kumar Mishra[4]

[1]Department of Physiology, All India Institute of Medical Science, Raebareli, Uttar Pradesh, India
[2]Department of Medicine, All India Institute of Medical Science, Raebareli, Uttar Pradesh, India
[3]Department of Biochemistry, All India Institute of Medical Science, Raebareli, Uttar Pradesh, India
[4]Department of Neurology, All India Institute of Medical Science, Raebareli, Uttar Pradesh, India

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***Correspondence:**
Dr. Arbind Kumar Choudhary,
E-mail: arbindchoudhary111@gmail.com

ABSTRACT

Background: Type 2 diabetes mellitus (T2DM) is known to be associated with cognitive impairment, but the Impact of the timing of diagnosis on cognitive function remains unclear. This pilot project aims to assess the cognitive function of people diagnosed with T2DM at an early vs. late stage. The study will examine several cognitive domains, such as attention, memory, executive function, visuospatial skills, and sensorimotor abilities.
Methods: We recruited 80 adults diagnosed with T2DM, evenly split into 2 groups-one with early diagnosis (≤5 years) (n=40) and other with late diagnosis (≥6 years) (n=40) depending on when their disease was identified. Both groups underwent evaluation for demographic and clinical factors. Cognitive function was assessed using mini-mental state examination (MMSE), Montreal cognitive assessment (MoCA), and Addenbrooke's cognitive examination (ACE-III). Specific domain of cognition wasmeasured as span of attention (Tachitoscope), memory (PGI Battery scale), executive function (Stroop test), visuospatial function (Corsi block test), sensorimotor abilities (auditory /visual reaction time), and intelligence (Koh's Block design test).
Results: Preliminary findings suggest that the early diagnosis group showed significantly average cognitive performance compared to the late diagnosis group. They also showed improved metabolic control and increased levels of physical activity. Individuals in the early diagnosis group had higher educational levels and socioeconomic status, potentially leading to improved disease detection and more effective health management.
Conclusions: These findings indicate that identifying T2DM at an early stage, help in preserving cognitive function as compared to a diagnosis made at a later stage.

Keywords: Cognitive function, Early diagnosis, Late diagnosis, T2DM, Pilot study

INTRODUCTION

Hyperglycaemia and insulin resistance characterize T2DM.[1] It can cause cardiovascular disease, neuropathy, and retinopathy.[2] Recent research links T2DM to cognitive impairment and physical health concerns.[3] T2DM can impair memory, attention, executive function, and processing speed.[4] These obstacles can impact daily life and well-being. Hyperglycaemia-induced neuronal injury, cerebrovascular illness, brain insulin resistance, chronic inflammation, and oxidative stress are crucial to understanding T2DM and cognitive decline. T2DM is linked to cognitive impairment.[5] However, the impact of diagnostic timing on cognitive performance is unknown. T2DM must be diagnosed and treated quickly to reduce problems and improve results. It is unknown if early

T2DM diagnosis improves cognitive function. Exploring cognitive function differences between early and late T2DM diagnosis could affect clinical treatment and public health measures to prevent cognitive deterioration. Diagnose and treat T2DM early to avoid complications and improve results. The effect of diagnosis timing on cognitive function in T2DM patients is unknown. It is unclear if T2DM diagnosis timing affects cognitive performance. Early diagnosis may reduce T2DM's cognitive consequences. This pilot investigation examines how early versus late T2DM diagnosis affects cognitive function to shed light on how diagnostic timing may affect cognitive outcomes. This study's findings may have a profound impact on clinical practice, patient care, and public health policies, potentially revolutionizing the approach to addressing T2DM and cognitive impairment worldwide.

Objectives

This pilot study aims to analyze the effects of early (≤5 years) and late diagnosis (≥6 years or more) of T2DM on cognitive function. The study has the following objectives: To evaluate cognitive function in individuals diagnosed with T2DM at different stages. To examine possible variations in cognitive areas, such as memory, attention, executive function, and processing speed, between the two groups. The purpose of this study is to investigate the relationship between the timing of T2DM diagnosis and cognitive function while considering relevant demographic and clinical factors.

METHODS

Study design

A meticulously designed preliminary study, using a cross-sectional approach, was conducted to evaluate cognitive function in people with T2DM and explore the effects of early and late diagnosis. This research, carried out from July 2022 to March 2024, was a collaborative effort between the department of physiology, all India institute of medical science, Raebareli, and the departments of biochemistry, medicine, and neurology.

Ethical considerations

The study followed the guidelines of the Declaration of Helsinki and received approval from the institutional ethics committee of AIIMS Raebareli [IEC code 2021-3-IMP-1, F.31 BIOETHICS/AIIMS-RBL/APPR/IM/ 2020/11, dated: 12-02-2022]. Before their involvement in the study, all participants provided informed consent. We ensured the confidentiality of the data throughout the study.

Participants

Individuals aged 18-70 were enlisted from outpatient diabetes clinics at AIIMS Raebareli with a confirmed diagnosis of T2DM by a Physician. The criteria for inclusion involved having a confirmed T2DM diagnosis, being able to give informed consent, being fluent in the study language, and being willing to undergo cognitive testing. Exclusion criteria will encompass uncontrolled medical conditions such as active malignancy and severe cardiovascular disease, neurological disorders like dementia and Parkinson's disease, current use of psychoactive medications, and significant psychiatric history.

Sample size

Considering the preliminary nature of the study, we plan to recruit a convenience sample of 40 participants (around 15-20% per group).

Group allocation

Participants were categorized into two groups according to the age at which they were diagnosed with T2DM: Group I (n=40)-early diagnosis (≤5 years) and group II (n=40)-late diagnosis (≥ 6 years or more).

Data collection

Demographic variable: Age, education level, employment status, socioeconomic index, and physical activity (Practicing exercise). Social history (Smoking history and alcohol history).

Medical history: History of diabetes (Years), medicine usage, cardiovascular disorder, any comorbidities, HbA_{1C} level, Blood sugar (fasting/postprandial)**,** frequency of testing: glucose home testing at least once daily/every three months.

Clinical data: Blood pressure, TSH, Free T3, Free T4, insulin, C-peptide, vitamin B12, vitamin D total, blood iron, UIBC, Ferritin, CR protein (Quantitative), lipid profile (Cholesterol, triglyceride, HDL cholesterol, VLDL, and LDL cholesterol), liver function test (Bilirubin total, bilirubin direct, bilirubin indirect).

Assessment of cognitive function

Cognitive function was assessed using a battery of standardized neuropsychological tests, including initial screening of cognition assessment was measured with Addenbrooke cognitive examination (ACE-III), MMSE, and MoCA. Specific domain of cognition wasmeasured as span of attention (Tachitoscope), memory (PGI battery scale), executive function (Stroop test), visuospatial function (Corsi block test), sensorimotor abilities (Auditory/visual reaction time), and intelligence (Koh's block design test).

Screening of cognitive function: ACE-III is a newer version of the established ACE-II and ACE-R and a slightly longer cognitive assessment than the MMSE and

MoCA.[6] The questionnaire covers memory, language, fluency, attention, and visuospatial abilities. A maximum score of 100 can be obtained, with lesser scores indicating better memory and cognitive impairment.

Mini-mental state examination: The MMSE is a cognitive screening tool with ten categories. This brief cognitive screening tool has validated norms for mild, moderate, and severe dementia. The maximum score is 30, and a cut-off score at or below 23 is indicative of cognitive impairment. MoCA-This cognitive screening tool has eight categories that address visuospatial and executive functioning, naming, memory, attention, language, abstraction, delayed recall, and orientation. For each correct answer, one point is given. A maximum of 30 points indicates no cognitive impairment. A score below 26 indicates mild dementia, although a cut-off between mild and moderate dementia has not been established.

Span of attention (Tachitoscope)

The participant's Span of attention, was assessed using the Tachistoscope. This device presented visual stimuli, such as words, for a brief 20 milliseconds. The number of words repeated correctly was divided by the total number of words given and multiplied by 100 to obtain a percentage score. The normal percentage of meaningful words is 75, and meaningless words are 66.

Memory (PGI Battery scale)

The initial subtest assessed remote memory with six questions.[8,9] In the next subtest, five questions assessed recent memory. The final subtest assessed mental balance.

Executive function (Stroop test)

Participants were instructed to read a series of words representing different colors verbally.[10] The number of accurate responses made within 120 seconds was documented. (The distinction between the neutral and conflict conditions was frequently regarded as an interference indicator).

Visuospatial function (Corsi block test)

The examiner taps a certain number of blocks (digits) in a certain order, and the subject must repeat the pattern instantly.[11] The test begins with two units and then adds lengthier ones if the subject does well. The number of objects accurately reproduced determines Corsi's test score.

Sensorimotor abilities (auditory /visual Reaction time)

Auditory and visual reaction times (ART and VRT) were recorded using Medicaid systems RTM-604 (Chandigarh, India).[12] Participants were instructed to press the switch immediately upon seeing the light. The participants were advised to focus on the acoustic signal and press the switch immediately to quantify ART. After three practical trials and the mean of three stimulus readings, reaction time was calculated.

Intelligence (Koh's block design test)

Koh's block design test-We presented a collection of 17 cards featuring an array of vibrant designs, each one more intricate than the last.[13] Scoring was determined by evaluating both the precision of the replication and the efficiency of the participants' movements in completing the design.

Statistical analysis

This was performed using SPSS software version 20.0 (Chicago, US). Mean±SD was calculated for all the parameters. The independent sample 't' test was used to compare the means of different variables in the two groups. $P \leq 0.05$ was considered significant.

RESULTS

Findings regarding demographic characteristics

Socioeconomic and demographic features: The summarized data (Percentage/mean±SD) are described in Table 1. In the late diagnosis group, there was a slightly higher prevalence of males (62.5%) compared to the early diagnosis group (55%). The early diagnosis group had a significantly higher proportion of participants with higher education (literate) at 80.0% compared to 70.0% in the late diagnosis group ($p<0.05$). It appears that the level of education could potentially impact the early detection of T2DM. Employment Status: A much more significant percentage of participants in the late diagnosis group (57.5%) were not working (including retired) compared to the early diagnosis group (35%) ($p<0.05$).

The early-diagnosed group had a significantly higher percentage of individuals with middle income (70%) in comparison to the late-diagnosed group (32.5%) ($p<0.05$). This socioeconomic disparity may be attributed to disparities in healthcare access or education regarding T2DM. Physical Activity: The early diagnosis group had a significantly higher proportion of participants who were active (72.5%) compared to the late diagnosis group (42.5% active) ($p<0.05$). In contrast, the late diagnosis group had a higher proportion of participants who were not active (60%) compared to the early diagnosis group (27.5%). Physical activity can impact both the risk of developing T2DM and the ability to detect it early. There were significant differences in the age and duration of diabetes diagnosed among both groups.

Health practices: Both groups had no history of smoking or alcohol consumption, with all participants being non-smokers and non-alcoholics.

Past medical records: Both groups showed no signs of cardiovascular disorders or other comorbidities, emphasizing comparable health profiles except for diabetes.

Laboratory parameters for diabetes management: However, there was a significant variation in the Frequency of glucose and HbA1c testing at home between the two groups. The early diagnosis group demonstrated a higher rate of regular testing, with 82.5% actively engaging in it, while the late diagnosis group had a lower rate of 70%. The trend observed for more stringent testing criteria showed even more significant discrepancies. The group that received a late diagnosis exhibited poorer glycaemic control, as evidenced by higher average HbA1c levels (10.69% vs. 7.49%), fasting blood sugar (114.65 mg/dl vs. 97.40 mg/dl), and postprandial blood sugar (125.45 mg/dl vs. 115.02 mg/dl). All of these values were above the recommended reference ranges.

The late diagnosis group had a slightly higher body mass index (BMI) of 24.76 kg/m² compared to 23.55 kg/m²; however, no significant difference was observed. The late diagnosis group had a significantly higher average age of 50.42 years, in contrast to the early diagnosis group, with an average age of 39.87 years. This aligns with a longer duration of diabetes in the late diagnosis group, which averaged 8.78 years compared to 2.94 years in the early diagnosis group.

Findings from the clinical data analysis

Understanding the relationship between blood pressure and thyroid function: The summarized data (mean±SD) is in **(**Table 2). Both groups displayed typical ranges for systolic and diastolic blood pressure, with the late diagnosis group demonstrating slightly higher values (systolic 115.05 vs. 114.65 mmHg; diastolic 76.19 vs. 74.24 mmHg). The thyroid function, evaluated through the levels of thyroid stimulating hormone (TSH), free triiodothyronine (T3), and free thyroxine (T4), was found to be within the normal range for both groups, and no notable variations were detected.

Metabolic markers: There were significant variations in the levels of insulin and C-peptide between the late-diagnosis group and the comparison group. Specifically, the late diagnosis group had higher levels of insulin (36.21 µIU/ml vs. 22.60 µIU/ml) and C-peptide (4.13 ng/mL vs. 2.47 ng/ml). There seems to be a higher level of insulin resistance or potential beta-cell dysfunction in the group that was diagnosed later.

Understanding the role of vitamins and iron in metabolism: The vitamin levels (B12 and D) and iron metabolism parameters (Blood iron, UIBC, ferritin) were within normal ranges for both groups, showing no significant differences. This indicates that the micronutrient status is adequate.

Examining the inflammatory and lipid profiles: The levels of C reactive protein (CRP) were low in both groups, suggesting minimal inflammation. The lipid profiles exhibited minor variations but stayed within the expected range for both groups. On the other hand, the group that received a diagnosis later showed slightly elevated triglyceride levels and lower HDL cholesterol levels, indicating a somewhat less favourable lipid profile.

Understanding liver function tests: The liver function, as assessed by the levels of bilirubin (total, direct, and indirect), was found to be within the normal range for both groups. No significant variations were observed, suggesting no indication of liver dysfunction in either group.

Examining the outcomes of cognitive assessment tools

The summarized data (mean±SD) are described in Table 3.

Understanding cognitive function in general: The ACE-III scores revealed that the early diagnosis group had significantly higher scores (90.75±1.74) than the late diagnosis group (85.45±2.70). This indicates that the early diagnosis group exhibited better overall cognitive function. Based on the MMSE scores, the early diagnosis group demonstrated a score of 27.15±1.77, which suggests that their cognition is intact. On the other hand, the late diagnosis group scored significantly lower at 20.35±1.33, indicating mild cognitive impairment. When comparing the MoCA scores, it was observed that the early diagnosis group had higher scores (32.62±1.45) compared to the late diagnosis group (27.98±5.34). The late-diagnosis group exhibited signs of mild cognitive impairment.

Attention and memory attention span (Tachistoscope): The early diagnosis group showed higher scores in meaningful and meaningless word recognition, suggesting improved attention span and information processing. Memory performance showed a notable difference between the early diagnosis group (59.68±1.60) and the late diagnosis group (54.84±4.42). The scores suggest that the late-diagnosis group had an average to moderate level of dementia.

Executive and visuospatial functions: Similar to a physiologist, the group that received an early diagnosis displayed superior performance, making fewer errors and completing the task more quickly. This suggests that their executive functioning is at a higher level. When it comes to visuospatial function, the early-diagnosis group outperformed the late-diagnosis group by a significant margin. The scores of the early diagnosis group (7.34±0.85) were much higher compared to the late diagnosis group (4.02±1.05), suggesting that the latter group may be experiencing cognitive impairment.

Exploring sensorimotor abilities and intelligence: It was observed that individuals in the early diagnosis group exhibited faster visual and auditory reaction times, indicating enhanced sensorimotor integration. Regarding intelligence, there was a notable difference between the early-diagnosis group and the late-diagnosis group. The early diagnosis group scored higher (35.20±3.22), suggesting more vital problem-solving abilities and spatial intelligence. On the other hand, the late diagnosis group had significantly lower scores (25±3.65), indicating a decline in these skills.

Table 1: This table shows a summary of the results for demographic and medical variable in early and late T2DM diagnosis.

Demographic variables	Groups (T2DM)		Reference range
	Early diagnosis, (n=40) (%)	Late diagnosis, (n=40) (%)	
Gender	Male-22 (55)	Male-25 (62.5)	
	Female-18 (45)	Female-15 (37.5)	
Education level	Literate-32 (80)	Literate-28 (70)	
	Illiterate-08 (20)	Illiterate-12 (30)	
Employment status	Working-16 (40)	Working-12 (30)	
	Not working-14 (35)	Not working-23 (57.5)	
	Self-employed-10 (25)	Self-employed-05 (12.5)	
Socioeconomic index (House hold income/year)	Middle-28 (70)	Middle-13 (32.5)	
	Lower-12 (30)	Lower-27 (67.5)	
Practising physical activity	Active-29 (72.5)	Active-17 (42.5)	
	Not-active-11 (27.5)	Not-active-24 (60)	
Social history			
Smoking history	Not smokers-40 (100)	Not smokers-40 (100)	
	Former smokers-00 (00)	Former smokers-00	
Alcoholic history	Not alcoholic-40 (100)	Not alcoholic-40 (100)	
	Former alcoholic-00	Former alcoholic-00	
Medical history			
Cardiovascular disorder	Not found-40	Not found-40	
Comorbidities	Not found-40	Not found-40	
Frequency of testing			
Glucose at home as once daily	Testing-33 (82.5)	Testing-11* (27.5)	
	Not testing-07 (17.5)	Not testing-29* (72.5)	
HbA1c, as once, every 3 months	Testing-28 (70)	Testing-16* (40)	
	Not testing-12 (30)	Not testing-24* (60)	
Laboratory parameters			
Hb A1c level	7.49±0.74	10.69±0.82*	4-6%
Blood sugar-fasting	97.40±4.16	114.65±3.12*	70-110 mg/dl
Blood sugar-PP	115.02±2.80	125.45±2.38*	70-140 mg/dl
BMI (kg/m^2)	23.55±1.23	24.76±0.95	
Age (in years)	39.87±3.19	50.42±3.02*	
Duration of diabetes	2.94±1.16	8.78±1.53*	

*Significant differences observed ($p<0.05$).

Table 2: This table presents the findings of the clinical data analysis in early and late T2DM diagnosis. It showed the variables that exhibited significant differences between groups, as well as those that did not.

Clinical data	Groups (T2DM)		Reference range
	Early diagnosis	Late diagnosis	
Blood pressure			
Systolic	114.65±3.12	115.05±3.3	110-140 mmHg
Diastolic	74.24± 2.25	76.19 ±1.75	70-90 mmHg
Thyroid stimulating hormone (mIU/l)	2.54±0.24	2.67±0.50	0.465-4.68 mIU/l
Free triiodothyronine (T3) (pg/ml)	2.96±0.38	3.17±0.41	2.77-5.27 pg/ml
Free thyroxine (T4) (ng/dl)	1.32±0.21	1.48±0.17	0.78-2.19 ng/dl
Insulin level	22.60±1.29	36.21±1.46*	2.3-26.0 µIU/ml

Continued.

Clinical data	Groups (T2DM)		Reference range	Clinical data
	Early diagnosis	Late diagnosis		
C-peptide	2.47±0.47	4.13±0.77*	0.727-3.68 ng/ml	
Vitamin B12	403.40±72.04	446.62±32.33	239-931 pg/ml	
Vitamin D total	65.87±8.38	70.22±6.11	30-100 ng/ml	
Blood iron	85.25±7.74	91.65±5.75	50-120 microgram/dl	
Unsaturated iron binding capacity (UIBC)	329.55±7.84	283.87±8.72	110-370 microgram/dl	
Ferritin	117.60±9.99	125.02±10.41	20-250 ng/ml	
CRP (Quantitative)	<0.2	<0.2	Upto-0.6 mg/dl	
Lipid profile				
Cholesterol	199.52±5.88	201.20±6.36	180-220 mg/dl	
Triglyceride	110.00±6.28	117.25±4.95	60-165 mg/dl	
HDL cholesterol	65.02±4.79	60.67±5.72	>35 mg/dl	
VLDL	22.72±1.63	23.05±1.66	0-30 mg/dl	
LDL cholesterol	93.63±4.88	94.73±1.40	<128 mg/dl	
Liver function tests				
Bilirubin total	0.46±0.10	0.52±0.08	0.2-1.2 mg/dl	
Bilirubin direct	0.24±.084	0.27±0.050	0.1-0.5 mg/dl	
Bilirubin indirect	0.35±0.12	0.36±0.14	0.2-1.2 mg/dl	

*Significant differences observed (p<0.05).

Table 3: This table presents the findings of cognitive assessments in various domains, as measured by different cognitive assessment tools and specific cognitive tests in early and late T2DM diagnosis.

Cognitive assessment tool	Groups (T2DM)		Reference range
	Early diagnosis	Late diagnosis	
ACE-III	90.75±1.74	85.45±2.70*	88 ≥cognition intact, 83-87-inconclusive or mild cognitive impairment, <83-severe cognitive impairment
MMSE	27.15±1.77	20.35±1.33*	24-30-cognition intact, 18-23-mild cognitive impairment, 0-17-severe cognitive impairment
MoCA	32.62±1.45	27.98±5.34*	30 ≥cognition intact, 26-30-inconclusive or mild cognitive impairment, <26 severe cognitive impairment
Span of attention (tachistoscope) meaningful word	77.38±1.47	72.71±6.10*	Meaningful word-75% ≥cognition intact for, <75% cognitive impairment
Meaningless word	69.24±2.25	62.42±1.64*	Meaningless word-60% ≥cognition intact for, <60% cognitive impairment
Memory (PGI battery scale)	59.68±1.60	54.84±4.42*	57≥cognition intact, 57-63-average/moderate dementia, 49-56-below average, <48 low level dementia
Executive function (Stroop test) Time of completion congruent	43.10±4.78	58.77±10.99*	35-50 sec-cognition intact
Incongruent	80.90±5.19	103.70±7.34*	70-100-cognition intact
No. of errors congruent	0.52±0.29	2.30±0.56	0-1-cognition intact
Incongruent	1.45±0.92	3.68±0.95	0-3-cognition intact
Visuospatial function (Corsi block test)	7.34±0.85	4.02±1.05*	6≥cognition intact, <6-cognitive impairment
Sensorimotor abilities visual reaction time (millisecond	232.52±9.31	286.50±17.89*	200-250 millisecond
Auditory reaction time (millisecond)	281.17±10.62	326.10±13.42*	250-300 millisecond
Intelligence (Koh's block design test)	35.20±3.22	25.00±3.65*	Maximum score-50

*Significant differences observed (p<0.05).

DISCUSSION

This pilot study shows that early T2DM diagnosis can significantly improve cognition. The study demonstrates that T2DM diagnosis timing has a direct impact on health outcomes and management. Our findings provide further support to earlier evidence suggesting that early T2DM detection and treatment may help maintain cognitive function and reduce the risk of diabetes-related cognitive deficits.[3,14] Long-term high blood sugar levels, a typical symptom of uncontrolled diabetes, have been linked to brain and blood vessel damage, which can accelerate cognitive loss.[15-17] Early detection and treatment may significantly reduce the impact of these physiological processes. We found significant changes in insulin and C-peptide levels in the early-diagnosis group, suggesting better metabolic management. Our study further supports earlier findings that the early-diagnosis group has increased physical activity, which may explain their better cognitive outcomes.[18,19] Socioeconomic status and education affect diabetes management and outcomes.[20] Our early diagnosis group may have had better access to healthcare resources and health literacy due to higher literacy rates and socioeconomic position. This helped them manage their disease more effectively, leading to improved cognitive function. Early diagnosis not only enhances socioeconomic status and lifestyle but also improves diabetes management. These patients also experienced a reduction in HbA1c and blood sugar levels, thereby lowering the risk of diabetic complications. However, health management behaviours, particularly blood glucose and HbA1c monitoring, were inconsistent, indicating a potential area for intervention. Access to diabetes education and services could potentially assist later-diagnosed patients with poorer health management, underscoring the practical implications of our research. The study sheds light on physiological and metabolic differences in T2DM patients at different phases. Insulin and C-peptide levels can help explain how a delayed diagnosis may exacerbate insulin resistance and pancreatic beta-cell dysfunction. These factors can significantly affect diabetes treatment and progression. Despite T2DM diagnosis, thyroid function, vitamins, iron metabolism, inflammatory indicators, and liver function remain steady. However, the minor lipid profile deterioration in the late-diagnosis group may indicate a higher risk of cardiovascular disease if untreated. Monitoring lipid profiles and metabolic indicators regularly reduces the risk of problems, especially in later-diagnosed individuals. The "pilot study shows that early T2DM diagnosis preserves cognitive abilities in various areas. Cognitive testing, memory, executive functioning, visuospatial skills, sensorimotor capabilities, and IQ vary. These discrepancies suggest that prolonged high blood sugar exposure in late-diagnosed patients may impair cognition. Improved metabolic regulation, physical exercise, socioeconomic status, and education may also contribute to healthy behaviours and early illness diagnosis. Understanding the importance of early T2DM detection and therapy is vital to minimizing cognitive deterioration. Late diagnosis may cause cognitive problems owing to uncontrolled diabetes. This study adds to the growing body of evidence showing that T2DM diagnosis timing is crucial for controlling the disease's physical symptoms and cognitive performance.

Limitations

Our study's limited sample size and pilot nature make these findings tentative, but they show promise. To understand how early diabetes affects cognitive health over time, large-scale studies are needed.

CONCLUSION

In summary, this pilot investigation on the effects of early and late T2DM diagnosis on cognitive performance found some notable demographic, social, and medical differences between the two groups. Early T2DM. detection improves cognition. Different lifestyle variables and better illness treatment may explain this. These findings emphasize the importance of early screening and diagnosis in preventing diabetes cognitive impairment. Understanding diabetes early detection and control is essential for cognitive function and well-being. However, more extensive research with larger sample sizes is needed to validate these findings and investigate other diabetes-related cognitive issues.

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