Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 5
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Systematic Review of Risk Factors for Cognitive Dysfunction and Nursing Intervention Models in Elderly Patients with Type 2 Diabetes Mellitus

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Abstract: *Background*: Type 2 diabetes mellitus (T2DM) is a common chronic metabolic disorder among the elderly, with a significantly higher incidence of cognitive dysfunction compared to the general population. *Objective*: To systematically evaluate the risk factors for cognitive dysfunction and the efficacy of nursing interventions in elderly T2DM patients, providing a basis for early clinical identification and comprehensive care. *Methods*: Literature was retrieved from databases including China National Knowledge Infrastructure (CNKI), Wanfang Data Knowledge Service Platform, and PubMed, encompassing Chinese and English publications on risk factors and nursing interventions for cognitive dysfunction in elderly T2DM patients from 2024 to 2026. Two researchers independently conducted literature screening and data extraction. *Results*: A total of 17 studies were included. Independent risk factors for cognitive dysfunction in elderly T2DM patients included elevated glycated hemoglobin (HbA1c), prolonged diabetes duration, advanced age, high triglycerides, elevated low-density lipoprotein cholesterol (LDL-C), hypertension, and increased serum inflammatory markers. Regarding nursing intervention models, specialized community-based interventions and hyperbaric oxygen therapy combined with Baduanjin exercise effectively improved cognitive function. *Conclusion*: Clinical practice should emphasize glycemic control in elderly T2DM patients, strengthen early screening for high-risk populations, and adopt diversified nursing intervention approaches to delay cognitive decline.

Keywords: Type 2 diabetes mellitus; Cognitive dysfunction; Risk factors; Nursing intervention; Systematic review

Online publication: May 31, 2026

1. Introduction

Type 2 diabetes mellitus (T2DM) is a common chronic metabolic disorder among the elderly, with a significantly higher incidence of cognitive dysfunction compared to the general population. The primary manifestations include memory impairment, attention deficits, and declined executive function, with severe cases progressing to dementia. Cognitive dysfunction not only compromises patients' ability to self-manage diabetes but also increases the risk of adverse events such as hypoglycemia. Chronic hyperglycemia can

induce microvascular lesions, oxidative stress, and neuroinflammatory responses in the brain, leading to damage in cognition-related brain regions such as the hippocampus and prefrontal cortex. He et al. employed quantitative magnetic resonance imaging (MRI) combined with diffusion tensor imaging (DTI) to demonstrate the presence of iron deposition and white matter microstructural damage in T2DM patients with cognitive dysfunction. Liu Cuicui et al. found that the increased perivascular space distribution in patients with T2DM-associated cerebrovascular disease is closely associated with cognitive dysfunction. In recent years, numerous clinical studies have explored the risk factors and nursing intervention strategies for cognitive dysfunction in elderly T2DM patients from various perspectives; however, systematic synthesis and integration remain lacking. Therefore, this study conducted a systematic literature review to provide insights for early clinical identification and comprehensive nursing care.

2. Materials and methods

2.1. Retrieval strategy

In May 2026, searches were conducted across the China National Knowledge Infrastructure (CNKI), Wanfang Data Knowledge Service Platform, and PubMed databases, covering the period from 2024 to 2026. The Chinese search terms were “elderly type 2 diabetes mellitus” AND “cognitive impairment” AND “risk factors/nursing intervention”, while the English search terms were “elderly type 2 diabetes mellitus” AND “cognitive impairment” AND “risk factors/nursing intervention”.

2.2. Inclusion and exclusion criteria

The inclusion criteria stipulated that study subjects must be T2DM patients aged ≥ 60 years, with research content focusing on the analysis of risk factors for cognitive dysfunction or the evaluation of nursing intervention efficacy. Exclusion criteria included subjects with other confirmed etiologies potentially contributing to cognitive impairment, as well as review articles, conference abstracts, and duplicate publications.

2.3. Literature screening and data extraction

The literature search, screening, and data extraction were independently conducted by two researchers, with discrepancies resolved through discussion. The extracted data included the first author, publication date, study type, sample size, research objectives, and primary outcomes.

2.4. Literature quality evaluation

The Newcastle-Ottawa Scale was employed to evaluate the quality of the included studies, covering three aspects: participant selection, intergroup comparability, and outcome measurement, with a total score of 9 points. Scores ranging from 5 to 6 indicate moderate quality, while scores of 7 or higher indicate high quality.

3. Results

3.1. Literature search results

A total of 20 articles were retrieved, with 2 duplicates excluded. After reviewing the titles and abstracts, 2 irrelevant articles were discarded. Following full-text review, 3 review articles were excluded, resulting in a

final inclusion of 17 articles.

3.2. Basic characteristics of the included literature

Among the 17 included studies, the minimum sample size ranged from 60 cases to a maximum of 399 cases. The research content covered risk factor analysis, predictive value of biomarkers, and evaluation of nursing intervention efficacy. The basic characteristics of the included studies are summarized in **Table 1**.

Table 1. Basic characteristics of included literature

Order number	The first author	Publication date	Research type	Sample size	Purpose of research
1	Li Jinsheng and others [1]	2026	Cross section	100 cases	Metabolomic differences in cognitive impairment among patients with T2DM
2	Liu Cuicui and others [2]	2026	Cross section	116 cases	Correlation between EPVS distribution and MCI
3	Yan Jichun and others [3]	2026	Cross section	60 cases	The predictive value of IL-6 and CRP for cognitive impairment
4	Wang Yan et al. [4]	2026	Cross section	244 cases	Construction of MCI risk factors and predictive models
5	He Pingqing [5]	2025	Cross section	90 cases	QSM combined with DTI for MCI risk assessment
6	Li Dongping et al. [6]	2025	Cross section	180 cases	Factors influencing mild cognitive impairment
7	Water-sensitive, etc. [7]	2025	Cross section	80 cases	The correlation between TIR and cognitive dysfunction
8	Zhang Xiaoyan et al. [8]	2025	Cross section	180 cases	The impact of self-management behaviors on mci
9	Wang Xiaoxiao [9]	2025	Cross section	180 cases	Understanding the influencing factors of cognitive impairment
10	Zhang Fang et al. [10]	2025	Cross section	96 cases	Correlation between urinary albumin/ creatinine ratio and mild cognitive impairment (aMCI)
11	Zhang Wen et al. [11]	2025	Summarize	-	Research Progress on the Relationship Between Sarcopenia and Cognitive Dysfunction
12	Zhu Ruxia et al. [12]	2025	Cross section	120 cases	The predictive value of visceral fat area and LDL-C
13	Cao Mengyuan and others [13]	2025	Cross section	233 cases	The predictive value of urinary AD7c-NTP combined with HbA1c
14	Fan Fangsong et al. [14]	2025	Cross section	118 cases	The predictive value of serum Nesfatin-1 and Klotho
15	Ma Jian et al. [15]	2025	Cross section	186 cases	Correlation analysis between decorin and biglycan
16	Zhang Ling et al. [16]	2024	Cross section	198 cases	Correlation between urinary albumin/ creatinine ratio and mild cognitive impairment (aMCI)
17	Wang Lina et al. [17]	2024	Cross section	160 cases	Correlation between 1,5-dehydroraffinose and MCI

3.3. Risk factors for cognitive dysfunction in elderly patients with T2DM

Through comprehensive analysis of the included literature, the independent risk factors for cognitive

dysfunction in elderly patients with type 2 diabetes mellitus (T2DM) can be summarized as follows.

3.3.1. Factors related to blood glucose control

Elevated HbA1c levels are the most frequently reported independent risk factor, with multiple studies confirming a positive correlation between HbA1c and the risk of cognitive dysfunction through logistic regression analysis (ref. 247910131517). Based on data from 399 patients, Ma Jia et al. found that individuals with HbA1c levels between 7% and 9% had a 2.349-fold higher risk of developing mild cognitive impairment (MCI) compared to those with normal levels; this risk increased to 5.106-fold when HbA1c exceeded 9% [18]. Shui Min et al. demonstrated a positive correlation between TIR levels and MoCA scores, showing that each 1% increase in TIR reduced the risk of cognitive impairment by 2.4% [7]. Wang Lina et al. reported that decreased levels of 1,5-dehydroglucitol serve as a protective factor against MCI [17]. These findings collectively indicate that chronic poor glycemic control is the primary driver of cognitive impairment.

3.3.2. Demographic and disease characteristics

Advanced age and prolonged duration of diabetes are widely recognized risk factors. Wang Yan et al. found that age exceeding 70 years is an independent risk factor for mild cognitive impairment (MCI) [4]. Years of education serve as a protective factor; Ma Jia et al. reported that individuals with over 12 years of education had a 0.243-fold higher risk of developing MCI compared to those without education [18]. Concurrent hypertension significantly increases the risk; Liu Cuicui et al. reported that hypertensive patients had a 5.058-fold higher risk of MCI than non-hypertensive individuals [2]. Zhang Ling et al. demonstrated that both microalbuminuria and macroalbuminuria are associated with an elevated risk of amnestic-type mild cognitive impairment, highlighting the intrinsic link between diabetic kidney disease and cognitive dysfunction [16].

3.3.3. Abnormal lipid metabolism

Multiple studies have confirmed that elevated triglycerides and increased low-density lipoprotein cholesterol (LDL-C) are independent risk factors. Zhu Ruxia et al. found that visceral fat area and LDL-C exhibit high predictive value for cognitive impairment [12]. Wang Xiaoxiao reported that high-density lipoprotein cholesterol serves as a protective factor [9]. Li Dongping et al. also identified elevated homocysteine, increased uric acid levels, and reduced folate levels as associated with cognitive impairment, suggesting the multifactorial contribution of metabolic disturbances [6].

3.3.4. Serum biomarkers

Yan Jichun et al. identified IL-6 and CRP as independent risk factors, with a combined detection area under the curve (AUC) of 0.892 [3]. Fan Fangsong et al. reported that decreased levels of Nesfatin-1 and Klotho were associated with mild cognitive impairment (MCI) [14]. Ma Jian et al. found that reduced decorin levels and elevated biglycan levels were closely linked to cognitive impairment, with a combined predictive AUC of 0.903 [15]. Cao Mengyuan et al. demonstrated that combined detection of urinary AD7c-NTP and HbA1c improved predictive accuracy [13]. Li Jinsheng et al. identified 15 differential metabolites through metabolomics analysis, involving multiple metabolic pathways such as the tricarboxylic acid cycle [4]. See **Figure 1**.

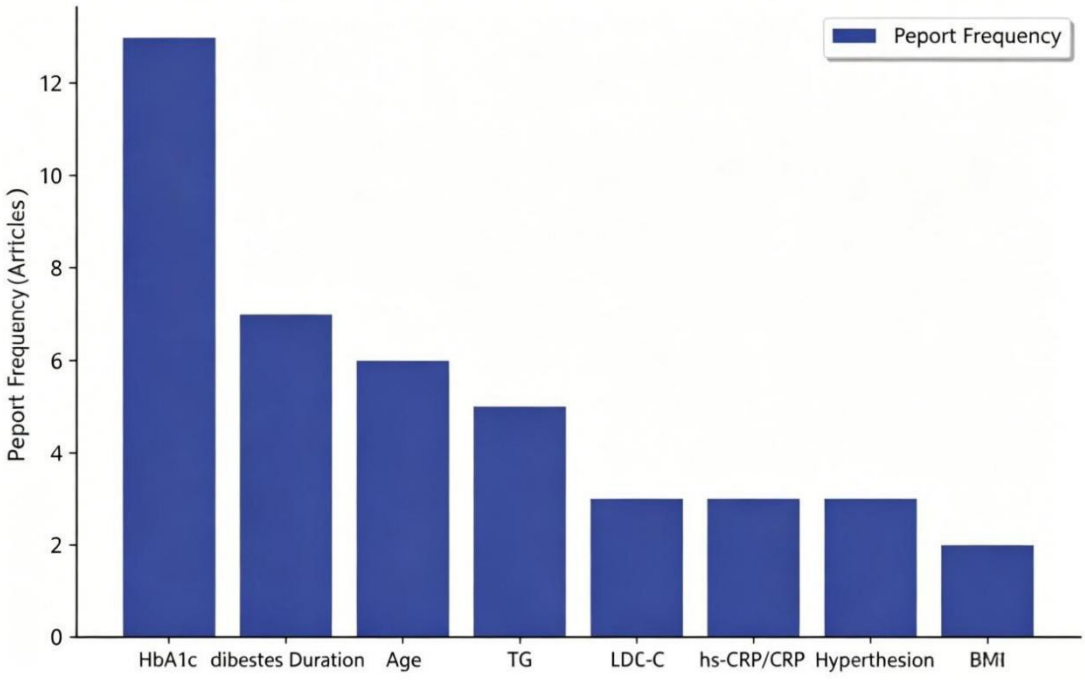

Figure 1. Frequency of reporting cognitive dysfunction risk factors across different studies.

3.4. Nursing intervention model

3.4.1. Targeted community intervention

Ma Jia et al. randomly divided 96 patients into a control group and a study group, with 48 cases in each group. The study group received additional personalized health education, cognitive training, dietary guidance, and exercise prescriptions on top of conventional interventions. Post-intervention, the study group demonstrated higher MoCA scores than the control group, lower fasting blood glucose and HbA1c levels, as well as superior improvements in total cholesterol and triglyceride levels compared to the control group. This study indicates that targeted community interventions can simultaneously improve both cognitive function and metabolic parameters.

3.4.2. Hyperbaric oxygen therapy combined with Baduanjin exercise

Shen Haili et al. divided 60 patients into a control group and an observation group, with 30 cases in each group [19]. The observation group received hyperbaric oxygen therapy three times per week for four consecutive weeks. The observation group showed higher scores in the visuospatial and executive function, delayed memory, attention, and total scores on the MoCA scale compared to the control group. Additionally, levels of glucagon-like peptide-1 (GLP-1) were elevated, while levels of IL-10 and hypersensitive C-reactive protein (CRP) were reduced, confirming that this regimen improves cerebral oxygenation and reduces inflammation, thereby protecting cognitive function.

3.4.3. Self-management behavioral intervention

A study conducted by Zhang Xiaoyan et al involving 180 patients across 8 pairs revealed that the presence of hypertension or hyperlipidemia, a history of hypoglycemia, sleep disorders, and fewer than 3 weekly physical activities were all risk factors for mild cognitive impairment (MCI) [8]. The area under the curve for diabetes

self-management behaviors in predicting MCI was 0.825, with an optimal cutoff value of 17.28 points, indicating that enhancing patients' self-management capabilities have a positive effect on reducing the risk of cognitive impairment. See **Figure 2**.

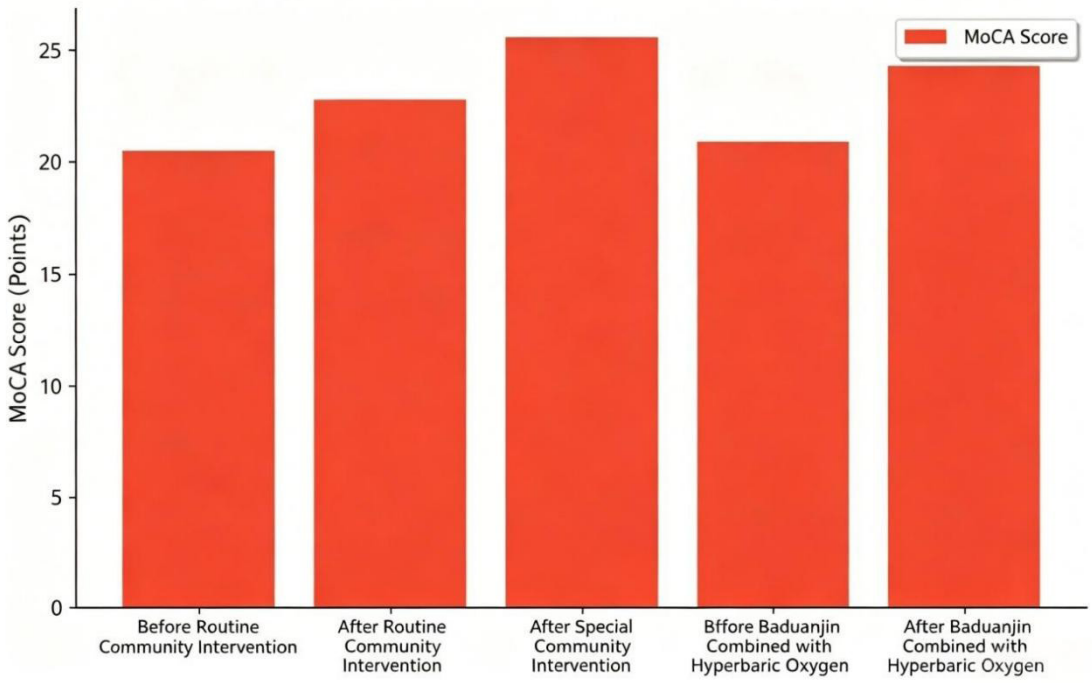

Figure 2. Impact of different nursing intervention models on patients' MoCA scores.

4. Discussion

4.1. Risk factor analysis

The results of this review indicate that elevated HbA1c was confirmed as an independent risk factor in over half of the included studies. Chronic hyperglycemia impairs cognitive function through mechanisms such as promoting the formation of advanced glycation end products, damaging the blood-brain barrier, and exacerbating neuroinflammation. Advanced age, prolonged disease duration, and low educational attainment constitute baseline risks, while concomitant hypertension and dyslipidemia further aggravate cerebrovascular injury. Zhang Wen et al. demonstrated an association between sarcopenia and cognitive dysfunction, suggesting that reduced physical activity and chronic mild inflammation may share a common pathological basis [11]. Zhang Ling et al. and Zhang Fang et al. validated from large-sample perspectives that abnormal urinary albumin-to-creatinine ratios are correlated with cognitive impairment [10,16]. Regarding novel biomarkers, decreased levels of Nesfatin-1 and Klotho indicate weakened neuroprotective mechanisms [14]. Alterations in decorin and biglycan levels are associated with cerebral microvascular lesions; and elevated urinary AD7c-NTP may suggest a tendency toward Alzheimer's disease progression [13,15]. The predictive model developed by Wang Yan et al., based on multiple factors, achieved an area under the curve of 0.853, demonstrating promising clinical application potential [4].

4.2. Analysis of nursing intervention models

The studies included in this review demonstrate the efficacy of diversified intervention strategies. Targeted community interventions integrate health education, cognitive training, and exercise guidance at the community level; research by Ma Jia et al. confirmed their simultaneous improvement of cognitive function and metabolic indicators. Hyperbaric oxygen therapy combined with Baduanjin exercise exerts a synergistic protective effect by enhancing cerebral oxygenation and reducing inflammation [19,20]. Self-management behavioral interventions emphasize patient-centered approaches, while regular exercise plays a critical role in maintaining cognitive function [8]. The three intervention models provide solutions at three levels, namely the community management, integrated traditional Chinese and Western medicine, and behavioral modification; where clinicians may flexibly select or combine them based on individual patient needs.

4.3. Limitations

The literature included in this review is predominantly based on cross-sectional studies, making it difficult to establish clear causal relationships, and there are variations in the assessment tools used across studies. There is limited literature on nursing interventions, all of which are single-center studies with relatively short intervention durations. Future research should conduct more high-quality multicenter randomized controlled trials to verify the independent effects of various factors and the long-term outcomes of interventions.

In conclusion, cognitive dysfunction in elderly patients with type 2 diabetes mellitus (T2DM) results from the combined effects of multiple factors. Elevated HbA1c levels, prolonged disease duration, advanced age, dyslipidemia, and increased serum inflammatory markers are the primary independent risk factors. Clinicians should prioritize glycemic control, enhance early screening, and select appropriate nursing intervention strategies tailored to individual patient conditions.

5. Conclusion

This systematic review identified multiple independent risk factors for cognitive dysfunction in elderly patients with T2DM, with elevated HbA1c being the most consistently reported. Advanced age, prolonged disease duration, dyslipidemia, hypertension, and elevated serum inflammatory markers further contribute to cognitive decline. Among nursing intervention models, targeted community-based programs and hyperbaric oxygen therapy combined with Baduanjin exercise demonstrated meaningful improvements in cognitive function. Given that current evidence is largely derived from cross-sectional, single-center studies with limited sample sizes, future multicenter randomized controlled trials with longer follow-up periods are warranted to establish causal relationships and validate the long-term efficacy of these interventions.

Disclosure statement

The authors declare no conflict of interest.

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