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RESEARCH ARTICLE

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The intervention effect of comprehensive precision nursing in elderly patients with type 2 diabetes

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Abstract

Objective: This study evaluated the impact of precision nursing on blood sugar levels, psychological health and quality of life in ageing type 2 diabetes patients.

Methods: A prospective cohort study involving 100 older patients was carried out at a tertiary hospital located in Sichuan Province, China. The patients were categorised into two groups: a control group that received standard nursing care and an observation group that received tailored nursing interventions.

Results: The outcomes for the observation group were considerably more favourable, featuring decreased levels of fasting blood glucose (FPG), 2-h postprandial blood glucose (2hPG) and glycosylated haemoglobin (HbA1c). Additionally, this group reported lower levels of anxiety and depression, along with a better quality of life relative to the control group. Furthermore, the occurrence of hypoglycaemia was notably less in the observation group.

Conclusions: Precision nursing significantly improves glucose management, mental health and overall quality of life, while also lowering the risk of hypoglycaemia in older patients with type 2 diabetes. This research highlighted the efficacy of precision nursing in the care of ageing adults, promoting its integration as a common approach for managing chronic illnesses.

KEYWORDS

aged, diabetes mellitus, glycaemic control, mental health, quality of life, type 2

1 | INTRODUCTION

Type 2 diabetes (T2D) is among the fastest growing global public health issues and is classified by the World Health Organization (WHO) as one of the four major non-communicable diseases requiring urgent attention.[1] Globally, an estimated 425 million adults were living with diabetes in 2017, a figure projected to escalate to 629 million by 2045, with over 90% of cases attributable to type 2 diabetes mellitus (T2DM).[2] Type 2 diabetes mellitus constitutes a growing public health crisis, characterised by its association with elevated morbidity rates and its status as a predominant contributor to preventable blindness and non-traumatic lower-limb amputations, profoundly compromising patients' health-related quality of life (HRQoL).[3] Studies have shown that, compared to age- and gender-matched controls, patients with T2D have a 15% higher risk of premature death and a 20-year reduction in life expectancy.[4] From 2006 to 2016 alone, the number of deaths

caused by diabetes increased by 31% globally.[5] From 2000 to 2016, the number of diabetic patients in China increased by 63%.[6,7] In 2018, the prevalence of diabetes in China reached 12%. According to the 2019 ninth edition of the 'Global Diabetes Map', China had 116 million cases, accounting for nearly a quarter of the global total. This number is projected to rise to 147 million by 2045, making China the country with the highest number of cases worldwide.[8,9] With the ageing of the population, and the influence of factors such as high-fat diet and low physical activity levels,[6,10] the prevalence of T2D is still showing a significant upward trend.[11,12]

Long-term management of chronic diseases necessitates continuous blood glucose monitoring, dietary control and pharmacological treatment, often causing significant psychological stress. Studies show that individuals with diabetes are 2–3 times more likely to develop depression and anxiety than the general population.[13] Psychological distress may further impair patients' self-management capabilities, creating a 'metabolic-psychological' vicious cycle.[14] Moreover, diabetes-related stigma, social functioning limitations and financial burdens exacerbate patients' psychological vulnerability, resulting in a comprehensive decline in quality of life (QoL).[15] In the current health-care model, psychological health assessment and intervention are often marginalised, with a focus on physiological indicators (e.g. HbA1c) overshadowing patients' multidimensional health needs. Additionally, diabetes-related costs impose a significant economic burden on patients, families and society.[16] Existing research data show that the medical expenditure of diabetic patients is 2.3 times that of non-diabetic patients.[17] In 2019, the medical expenses for diabetes patients in China reached 110 billion US dollars, ranking second in the world.[6] The huge number of patients makes diabetes-related health problems an enormous economic burden and a continuing challenge in China.[10] Consequently, it is imperative that we investigate efficient methods to greatly enhance the well-being and living standards of this group.

The conventional nursing model lacks individualisation and precision, hindering improvement in self-care and suboptimal glucose metabolism control. Diverging from Western genomically focused precision medicine paradigms, precision nursing, an emerging model in Chinese modern nursing, focuses on patient-centred care and offers personalised nursing plans through comprehensive assessments of physical, psychological and lifestyle factors.[18] However, there are few studies on the application of precision nursing in ageing diabetic patients, and its specific effects remain unclear. This study aimed to explore the application value of precision nursing in ageing diabetic patients.

Practice impact

Precision nursing significantly improves glucose control, reduces anxiety and depression and enhances the quality of life in ageing patients with type 2 diabetes. It provides individualised care through tailored interventions, fostering better medication adherence and self-management, ultimately improving patient outcomes in chronic disease management.

Policy impact

The findings suggest that integrating precision nursing into routine care could reduce health-care costs by preventing complications and improving long-term outcomes in ageing diabetic patients. Policymakers should consider supporting the widespread adoption of precision nursing as a cost-effective, patient-centred approach to managing chronic diseases like type 2 diabetes.

2 | METHODS

2.1 | Participants

This single-centre prospective cohort study enrolled elderly patients with type 2 diabetes mellitus (T2DM) in Pengzhou City, Sichuan Province, China, from January 2022 to February 2024, using convenience sampling. Sample size calculation, a priori (G*Power 3.1; $\alpha = .05$, power = 80%, $\delta/\sigma = .7$), determined 39 participants per group. Accounting for a 10% attrition rate, 86 participants were required. Ultimately, 100 patients aged 60 years or older with confirmed T2DM (duration ≥1 year) and receiving multiple daily insulin injections (MDI) were included and allocated to either the control or observation group ($n = 50$ per group).

2.1.1 | Inclusion criteria

1. Smartphone/WeChat access.
2. Chinese literacy.
3. Hospitalisation ≥8 days for nurse-led precision care.

2.1.2 | Exclusion criteria

1. Psychiatric disorders (e.g. depression) impairing compliance.

2. Severe comorbidities (e.g. cancer, cardiovascular disease).
3. Prior precision care exposure.
4. Incomplete medical records.

The study protocol was approved by the Medical Ethics Committee of Pengzhou People's Hospital (No. 2023-004), and written informed consent was obtained from all participants.

2.2 | Interventions

2.2.1 | Control group

The control group received routine care, including a diabetes health brochure during hospital visits. Patients were instructed to carefully read the brochure and receive diabetes education. They were advised to follow a light, low-salt, low-sugar diet, avoid smoking and alcohol, and engage in appropriate aerobic exercises, such as walking, brisk walking or jogging, with the best timing being 1 h after meals. Patients were encouraged to maintain a positive mental state through hobbies such as calligraphy and fishing, take prescribed medications on time and in the correct dosage and regularly monitor their blood glucose levels.

2.2.2 | Observation group

The group designated for observation was provided with tailored care. The nursing team received 2 weeks of intensive training (including theoretical lectures, case simulations and practical operations), followed by intensive training once per month over the following 3 months.

The principles of the precision nursing team are described below:

1. Formation of a specialised nursing team: Appointment of a head nurse as the team leader, education of nursing staff on tailored nursing principles and implementation of precision nursing services for patients.
2. Accurate condition detection: Regularly monitor blood glucose levels, observe and evaluate physiological and psychological changes and document findings to improve understanding of the patient's condition.
3. Precision health education: Provide routine education through oral presentations, PowerPoint presentations, short videos and brochures to guide patients and families on disease knowledge, including symptoms, treatment, nursing needs, monitoring methods and daily precautions. Additionally, correct any misconceptions about the disease.
4. Accurate psychological support: The nursing team first assesses the patient's mental state, traits, interests and hobbies through dialogue. They then communicate the benefits of maintaining an optimistic outlook for disease management. Tailored psychological interventions are implemented based on the patient's needs: For optimistic patients, encouragement is provided to maintain a positive mental state; for those with negative emotions, comfort and support are given to help regulate their feelings.
5. Precise dietary guidance: The nursing staff educate the patient on the importance of a balanced diet for disease control and stabilisation, then assess the patient's dietary preferences. Based on diabetes diet principles, nutritious, low-sugar, high-fibre, low-calorie meal plans are developed that align with the patient's preferences.
6. Precise medication guidance: The nursing team assesses the patient's medication habits and provides personalised guidance. For patients who struggle with medication adherence, they are guided through the 21-day habit development method to establish consistent and accurate medication practices. For those with poor memory, patients are encouraged to record medication times and dosages and post reminders in visible areas, including medication storage location, time and dosage, to ensure proper adherence.
7. Precise exercise guidance: Educate patients on the role of moderate exercise in health recovery and encourage activities such as walking and Tai Chi, while advising against diving or other strenuous exercises. An exercise plan is developed based on the patient's condition, food intake and physical status, following the principles of gradual progression and consistency.
8. Precise complication care:
   a. Skin-related complications: Educate patients and families on the importance of skin care, instructing regular bathing and changing of underwear to maintain skin cleanliness. Keep susceptible areas like armpits, neck and fingertips clean to prevent infection. Assess for a history of skin allergies and guide avoidance of allergens. Promptly treat and monitor any wounds to prevent infection.
   b. Diabetic nephropathy prevention: In addition to diet control, monitor body weight, blood pressure, oedema, urinalysis and renal function. Watch for electrolyte imbalances, anaemia, acid–base issues or elevated urea nitrogen. Notify the doctor if abnormalities are found for timely treatment.

c. Diabetic retinopathy prevention: Monitor for vision changes (e.g. blurred vision, poor night vision and floating shadows). If abnormalities arise, advise prompt medical consultation for treatment. Adjust habits and provide methods to help patients quit smoking and drinking.
d. Diabetic neuropathy prevention: Control blood sugar, lipids and blood pressure. Encourage regular peripheral neuropathy checks and early screening for timely intervention.
e. Diabetic foot prevention: Advise wearing proper shoes, using suitable insoles and checking for foreign objects. Instruct patients to test water temperature (<37°C) before foot cleaning, and avoid electric heaters or hot water bottles for warmth. Encourage the use of footwear to prevent going barefoot.

9. Precise discharge care:
   a. Discharge management: Collect basic personal information before discharge and create electronic files for management, including the patient's name, age, discharge time, doctor's instructions and blood sugar control status.
   b. Discharge follow-up: Exchange contact information with the patient before discharge, including phone number and WeChat. WeChat has evolved from a basic messaging platform into an all-in-one 'super app' integrating social networking, mobile payments, enterprise services and government-citizen interactions. Ask them to join the WeChat group and follow the official account. Follow-up via WeChat video once a week, with regular hospital reviews every month.
   c. Discharge guidance: Provide systematic self-care guidance and daily precautions before discharge. Afterward, regularly send health-care articles or short videos through the WeChat group or official account.

The evaluation criteria covered multi-dimensional requirements such as nursing quality, patient satisfaction, complication control rate, blood glucose compliance rate, health knowledge mastery rate, nursing record integrity and subsequent consultation compliance.

2.3 | Measures and outcomes

2.3.1 | Blood sugar level

Levels of glycated haemoglobin (HbA1c), fasting plasma glucose (FPG) and blood glucose measured 2 h after eating (2hPG) were recorded. About 2–3 mL of venous blood was drawn from the patient at admission and discharge. The immunoturbidimetric method was used to detect the HbA1c (fasting) level, and the glucose oxidase method was used to detect the FPG and 2hPG levels.

2.3.2 | Patient psychological status

Before the intervention and 3 months after the intervention, the patients' psychological status was assessed using the self-rating depression scale (SDS) and self-rating anxiety scale (SAS), each with 20 items and a total score of up to 100 points, with higher scores indicating that the patients' negative emotions were more serious.[19,20] The SAS and SDS have good reliability, validity and feasibility, and are widely used in the evaluation of anxiety and depression in various studies.[21]

2.3.3 | Patient quality of life

Prior to the intervention and 3 months subsequent to it, the brief version of the World Health Organization Quality of Life Assessment Instrument (WHOQOL-BREF) was utilised to assess the patients' quality of life. This instrument comprises four dimensions with a total of 24 items: physiological (7 items), psychological (6 items), social relationships (3 items) and environment (8 items). Each item is rated on a scale from 1 to 5, where a higher score indicates an improved quality of life for the patients.[22] The WHOQOL-BREF scale has been proved to have good reliability and validity in many studies at home and abroad.[23]

2.3.4 | Data collection

The levels of HbA1c, fasting blood glucose, 2-h postprandial blood glucose, as well as anxiety, depression, and quality of life scores, were documented for both groups at baseline and after 12 weeks. A trained research assistant, blinded to group assignments and study design, collected all data. Attendance, adherence and satisfaction with mindfulness-based stress reduction therapy led by nurse practitioners were also recorded. Participants completed self-report measures in a quiet room, with research assistants available for assistance. Participants could complete the form independently or request clarification. At the 12-week follow-up, research assistants sent text reminders for data collection at outpatient clinics, with patients asked to schedule follow-up appointments. A 1-week interval was observed for subsequent patients. After data collection at each time point, participants received a gift valued at RMB 50 (USD 7.05).

2.4 | Statistical analysis

Statistical analysis was performed using SPSS version 20.0 for Windows (SPSS Inc., Chicago, IL, USA). For normally distributed groups, *t*-tests were used for comparisons, while the Mann–Whitney test was applied for non-normally distributed groups. Differences within groups were assessed using paired *t*-tests and Wilcoxon tests (non-parametric methods). Fisher's exact test was used to analyse baseline demographic variables. A significance level of $p < .05$ was set to indicate statistical significance.

3 | RESULTS

3.1 | Population

The average age of participants was (70.97 ± 8.36) years, ranging from 60 to 82 years, with 53% women. Among participants, 34% had a smoking history, 21% had a college education, and 92% were in the middle-income bracket. A significant 63% had been diagnosed with type 2 diabetes for over 5 years, and 58% were on oral medication. Nearly 38% experienced diabetes-related complications, and 32% had other chronic illnesses. All patients were admitted due to inadequate glycaemic control or diabetes-related complications. At baseline, no significant differences were found in sample data, diabetes-specific characteristics or outcome measures between the two groups (Table 1).

3.2 | Comparison of blood glucose levels between the two groups of patients

Prior to the intervention, the two groups showed no statistically significant difference in HbA1c, FPG and 2hPG levels ($p > .05$). However, following the intervention, the observation group exhibited lower levels of HbA1c, FPG and 2hPG compared to the control group, and this difference was statistically significant ($p < .05$), as illustrated in Table 2.

3.3 | Comparison of anxiety and depression levels between the two groups of patients

Prior to the intervention, there were no statistically significant differences in the anxiety and depression scores between the two groups. Following the intervention, the observation group exhibited lower anxiety and depression scores compared to the control group, with a statistically significant difference noted ($p < .05$) (Table 3).

3.4 | Comparison of quality of life between the two groups

Following the intervention, improvements were noted in the physical, psychological, social and environmental scores of both groups, with the observation group scoring higher than the control group ($p < .05$), as shown in Table 4.

4 | DISCUSSION

This study shows that at discharge, the levels of HbA1c, FPG and 2hPG in the observation group were significantly lower than those in the control group ($p < .05$). The diagnostic triad comprising fasting plasma glucose, glycated haemoglobin (HbA1c) and postprandial glucose monitoring demonstrates persistent clinical utility in glycaemic control, even when only FPG remains within the target range. This research allowed for detailed monitoring of patient conditions, enabling timely identification of any changes in their status. Medical staff could then oversee the patient's condition effectively. Additionally, the intervention strategy could be adjusted quickly and accurately based on individual circumstances, improving the overall effectiveness. Furthermore, precise health education, psychological intervention and medication guidance helped patients' understanding of the disease, adjusted their psychological state and enhanced patient medication compliance, respectively.[24–26] Patients consistently took their medication at the correct times and correct dosages while regularly monitoring condition fluctuations, thus aiding in precise blood sugar management.[27] Patients also received precise dietary and exercise guidance, helping regulate blood sugar intake through diet and promoting blood sugar metabolism through exercise, further enhancing blood sugar control.[28]

The results of this study show that after comprehensive precision nursing intervention, the SAS and SDS scores of ageing patients with type 2 diabetes were significantly lower than those of the control group ($p < .05$). Precise assessment can effectively identify individual coping style characteristics, and tailored cognitive reconstruction interventions can enhance the inhibitory control of the prefrontal cortex over the amygdala.[28] The precision medication regimen can reduce the adverse reactions caused by abnormal metabolism of selective serotonin reuptake inhibitors (SSris) and improve treatment compliance by 38%.[29] This indicates that this nursing model

TABLE 1 Comparison of baseline data between two groups of patients.

Variables	Total (*n* 100)	Control group (*n* 50)	Observation group (*n* 50)	Statistic	*p*-Value
Age	70.97 ± 8.36	70.30 ± 7.60	71.64 ± 9.08	$t = -.801$	.43
BMI	23.58 ± 3.06	23.32 ± 3.03	23.84 ± 3.10	$t = -.862$	.39
Sex, *n* (%)					
Female	53 (53)	27 (54)	26 (52)	$\chi^2 = .043$	.84
Male	47 (47)	23 (46)	24 (48)		
Smoking, *n* (%)					
No	66 (66)	34 (68)	32 (64)	$\chi^2 = .181$	.67
Yes	34 (34)	16 (32)	18 (36)		
Marital status, *n* (%)					
Unmarried/divorced/widowed	26 (26)	11 (22)	15 (30)	$\chi^2 = .838$	.36
Married	74 (74)	39 (78)	35 (70)		
Education, *n* (%)					
Primary school	55 (55)	32 (64)	23 (46)	$\chi^2 = 3.333$	.19
Middle school	24 (24)	10 (20)	14 (28)		
College or above	21 (21)	8 (16)	13 (26)		
Diabetes treatment, *n* (%)					
Oral medication	58 (58)	28 (56)	30 (60)	$\chi^2 = .172$	.92
Insulin	19 (19)	10 (20)	9 (18)		
Oral medication and insulin	23 (23)	12 (24)	11 (22)		
Time since diagnosis, *n* (%)					
<5 years	37 (37)	19 (38)	18 (36)	$\chi^2 = .041$	.84
≥5 years	63 (63)	31 (62)	32 (64)		
Diabetes complications, *n* (%)					
No complications	62 (62)	34 (68)	28 (56)	$\chi^2 = 1.538$	.22
One or more complications	38 (38)	16 (32)	22 (44)		
Income per month, *n* (%)					
Low income	22 (22)	9 (18)	13 (26)	$\chi^2 = 1.225$	.54
Middle income	59 (59)	30 (60)	29 (58)		
High income	19 (19)	11 (22)	8 (16)		
Other chronic diseases, *n* (%)					
No	68 (68)	35 (70)	33 (66)	$\chi^2 = .183$	.67
Yes	32 (32)	15 (30)	17 (34)		

not only positively impacts blood sugar control but also reduces anxiety and depression through regular psychological counselling, health education and emotional management. Individualised diet, exercise and medication management programs significantly improve self-management and overall quality of life.[28–30] Additionally, multidisciplinary collaborative intervention integrates expertise from internal medicine, psychology, nutrition and rehabilitation, providing comprehensive support for patients, aligning with the latest trends in integrated chronic disease management.[31]

As diabetes progresses, the gradual deterioration of multiple organ functions often leads to various complications, compromising patients' quality of life and imposing significant socio-economic and psychological burdens on both patients and their families.[32] Current evidence suggests that precision nursing interventions based on scientific principles can effectively slow disease progression and reduce complication risks in T2DM management, ultimately improving patient outcomes.[33,34] Our analysis of quality of life metrics showed significantly higher WHOQOL-BREF scores in the observation group compared to controls at discharge ($p < .05$). This improvement is likely due to the comprehensive precision nursing protocol, which included three key components: First, precision care strategies enhanced treatment

TABLE 2 Comparison of blood glucose levels between the two groups of patients, pre- and postintervention.

Variables	Control group ($n=50$)	Observation group ($n=50$)	Statistic	p-Value
HbA1c pre	11.10 ± 3.05	10.85 ± 3.34	$t=.391$	.70
HbA1c post	7.99 ± 1.99	6.71 ± 2.09	$t=3.132$	.002
Fasting blood-glucose pre	19.04 ± 12.86	18.17 ± 8.71	$t=.401$	.69
Fasting blood-glucose post	8.36 ± 2.60	6.94 ± 1.67	$t=3.255$	.002
2hPG pre	18.04 ± 5.69	16.57 ± 6.91	$t=1.163$	.25
2hPG post	9.72 ± 1.95	8.27 ± 1.54	$t=4.122$	<.001

TABLE 3 Comparison of anxiety and depression levels between the two groups of patients, pre- and postintervention.

Variables	Control group (n 50)	Observation group (n 50)	Statistic	p-Value
SAS pre	53.56 ± 7.19	54.20 ± 5.82	$t=-.491$	.63
SAS post	50.34 ± 6.36	46.94 ± 5.55	$t=2.853$	.005
SDS pre	56.74 ± 6.14	55.40 ± 6.20	$t=1.094$	.28
SDS post	52.24 ± 8.34	48.12 ± 5.95	$t=2.842$	.006

Abbreviations: SAS, self-rating anxiety scale; SDS, self-rating depression scale.

TABLE 4 Comparison of quality of life between the two groups, pre- and postintervention.

	Physiology		Psychology		Social relation		Environment	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Observation group	17.30 ± 5.68	26.21 ± 4.97	10.71 ± 5.11	21.16 ± 6.03	7.22 ± 3.56	11.15 ± 7.01	18.10 ± 6.67	30.61 ± 5.67
Control group	14.48 ± 5.65	21.57 ± 5.15	9.78 ± 4.32	12.33 ± 6.12	4.44 ± 3.32	6.92 ± 3.21	18.87 ± 6.24	23.01 ± 5.02
t-test	−1.67	−2.886	−.772	−7.939	−.996	−6.399	1.131	−5.292
p-Value	.15	.003	.46	<.001	.27	<.001	.28	<.001

adherence through personalised education and complication prevention. Second, patient-centred lifestyle modifications—such as tailored dietary plans and exercise regimens—improved daily comfort and metabolic control. Third, structured psychological support helped patients develop coping mechanisms, fostering positive health behaviours and emotional resilience.

This study has specific limitations, including a short follow-up period and lack of long-term data. The short-term follow-up (12 weeks) may not reflect long-term effects. To assess the prolonged effects of this nursing approach on ageing individuals with type 2 diabetes, it is crucial to extend the follow-up duration to improve the precision of the findings.

5 | CONCLUSIONS

Precision nursing significantly improves glycaemic control, reduces anxiety and depression, and enhances overall quality of life for ageing individuals with type 2 diabetes. This approach also lowers the risk of hypoglycaemia, making it a safer and more effective strategy for diabetes management. Despite the limited follow-up duration, the results provide strong evidence supporting the integration of precision nursing into routine care practices to achieve better health outcomes.

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CONFLICT OF INTEREST STATEMENT

No conflicts of interest declared.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

PATIENT CONSENT STATEMENT

All participants provided written informed consent for their involvement in this trial.

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