Postprint: Effect of Human-Computer Interaction-Based Intelligent Management on Glycemic Control in Patients with Newly Diagnosed Type 2 Diabetes

Authors: Wang Lingxiao, Dong Rongna, Zhou Bing, Guo Lina, Li Jing, Li Jing

Date: 2022-11-16T11:25:10+00:00

Abstract

Background Early intervention in patients with newly diagnosed type 2 diabetes mellitus (T2DM) helps delay diabetes progression. Human-computer interactive intelligent blood glucose monitoring and management, as a novel health intervention management model, its role in disease progression among patients with newly diagnosed T2DM remains unclear. Objective To investigate the effects of human-computer interactive intelligent management on glycemic control and self-care behaviors in patients with newly diagnosed T2DM, and to provide evidence for management strategies for T2DM patients. Methods Using convenience sampling, 200 patients with newly diagnosed T2DM who visited Zhu Xianyi Memorial Hospital of Tianjin Medical University from June to December 2016 were selected. Enrolled subjects were divided into a blood glucose monitoring group and a control group using the random number method. The blood glucose monitoring group received the same intervention as the control group except for the addition of human-computer interactive intelligent blood glucose monitoring. Blood glucose and self-care behavior indicators were recorded at enrollment and after 3 months of follow-up. SPSS software was used to compare inter-group differences with independent samples t-test, and multiple linear regression analysis was performed to analyze factors influencing blood glucose. Results Compared with baseline, both groups showed significantly reduced levels of fasting blood glucose (FBG), 2-hour postprandial blood glucose (2hPG), and glycated hemoglobin (HbA1c) ($P<0.05$), with increased scores on all items of the Diabetes Self-Management Education and Support (DSMES) scale ($P<0.05$). The blood glucose monitoring group exhibited more significant reductions in blood glucose levels ($P<0.05$), and scores on the Summary of Diabetes Self-Care Activities (SDSCA) scale, Type 2 Diabetes Self-Care Scale

(2-DSCS), and all items of the DSMES scale were higher than those of the control group (P<0.05). Blood glucose monitoring behavior improved 2hPG and HbA1c levels in patients with newly diagnosed T2DM, while adherence to medication therapy and diabetic dietary control promoted overall glycemic control (P<0.05). Conclusion Human-computer interactive intelligent blood glucose monitoring and management improves the efficiency of glycemic management by enhancing health behaviors such as blood glucose monitoring, medication therapy, and dietary control, providing an intervention approach for patients with newly diagnosed T2DM.

Full Text

Preamble

Impact of Human-Computer Interaction Intelligent Management on Glycemic Control in Newly Diagnosed Type 2 Diabetes Patients

WANG Lingxiao, DONG Rongna, ZHOU Bing, GUO Lina, LI Jing*

Funding:
- Tianjin Municipal Education Commission Key Project in Philosophy and Social Sciences "Construction of Tianjin Metabolic Chronic Disease Prevention and Control System" (Project No.: 2019JWZD54)
- Tianjin Medical University Chu Hsien-I Memorial Hospital Research Fund "Health Economics Evaluation of the 'Three-in-One Care' Diabetes Diagnosis and Treatment Model" (Project No.: 2019ZXY04)
- Tianjin Medical University Hospital Management Innovation Research Project "Research on Hospital Scientific Research Management Model Based on Pareto Analysis in the Post-Pandemic Era" (Project No.: 2020YG20)

Affiliation:
NHC Key Laboratory of Hormones and Development, Tianjin Key Laboratory of Metabolic Diseases, Chu Hsien-I Memorial Hospital & Tianjin Institute of Endocrinology, Tianjin Medical University, Tianjin 300134, China

Corresponding Author: LI Jing, Deputy Chief Physician; Email: 2003-victor@163.com

---

Abstract

Background: Early intervention in patients with newly diagnosed type 2 diabetes mellitus (T2DM) helps delay disease progression. Human-computer interactive intelligent glucose monitoring management represents a novel health intervention model, though its impact on disease progression in newly diagnosed T2DM patients remains unclear. **Objective:** To investigate the effects of human-computer interactive intelligent management on glycemic control and self-care behaviors in newly diagnosed T2DM patients, providing evidence for management strategies. **Methods:** Using convenience sampling, 200 newly diagnosed T2DM patients admitted to Tianjin Medical University Chu Hsien-I Memorial Hospital between June and December 2016 were recruited and randomly divided into a glucose monitoring group and a control group using a random number method. The glucose monitoring group received human-computer interactive intelligent glucose monitoring in addition to the same interventions as the control group. Glycemic and self-care behavior indicators were recorded at enrollment and after 3 months of follow-up. Independent samples t-tests were applied using SPSS software to compare between-group differences, and multiple linear regression was used to analyze factors influencing blood glucose. **Results:** Compared with baseline, both groups showed significant reductions in fasting blood glucose (FBG), 2-hour postprandial glucose (2hPG), and glycated hemoglobin (HbA1c) levels ($P<0.05$), with increased scores on all dimensions of the Diabetes Management Self-Efficacy Scale (DSMES) ($P<0.05$). The glucose monitoring group exhibited more pronounced reductions in glycemic levels ($P<0.05$), and scored higher on the Summary of Diabetes Self-Care Activities (SDSCA), the 2-DSCS (Diabetes Self-Care Scale), and all DSMES dimensions ($P<0.05$). Improved blood glucose monitoring behavior reduced 2hPG and HbA1c levels in newly diagnosed T2DM patients, while adherence to medication and diabetic diet control promoted overall glycemic control ($P<0.05$). **Conclusion:** Human-computer interactive intelligent glucose monitoring management improves glycemic management efficiency by enhancing health behaviors including glucose monitoring, medication adherence, and dietary control, offering an effective intervention approach for newly diagnosed T2DM patients.

Keywords: Diabetes mellitus, type 2; Human-computer interaction; Blood glucose management; Self-care behavior; Management self-efficacy

Introduction

Diabetes mellitus poses a severe threat to global health, affecting approximately 425 million people in 2017, with China accounting for 114 million cases—the highest and continuously rising number worldwide [1]. The population is predominantly composed of type 2 diabetes mellitus (T2DM) patients, with hyperglycemia as the main pathophysiological manifestation causing systemic vascular and neuropathy. Achieving glycemic control targets represents a crucial reference indicator for improving prognosis in newly diagnosed T2DM patients. Glycemic control relies not only on pharmacological regulation but also requires comprehensive management through diet, exercise, blood glucose monitoring, and other multifaceted approaches. Research indicates that self-management behavior constitutes a key factor in blood glucose management for T2DM patients [2]. The impact of human-computer interactive intelligent management intervention on newly diagnosed T2DM patients remains unclear. This study investigates its role in glycemic control and self-management, aiming to provide reference data for effective health management models for this population.

1.1 Sample Size Calculation

The sample size formula for comparing means between two groups was applied: n1=n2=2[(Zα/2 + Zβ)σ/δ]^2. Setting the test level at α=0.05 and power at 1-β=0.9, with HbA1c as the primary outcome measure, σ represented the estimated population standard deviation of HbA1c, and δ represented the difference in means between the two samples. Based on relevant literature [3], with σ=1.8 and δ=0.9, Z0.05/2=1.96 and Z0.10=1.282 were substituted into the formula, yielding a required sample size of 84.08 per group. A minimum of 85 subjects per group was estimated, and considering a 15% attrition rate and actual data availability, 100 subjects were ultimately included in each group.

1.2 Study Subjects

Inclusion Criteria:
(1) Met the 1999 WHO diagnostic criteria for T2DM; (2) Age $ $18 years; (3) Diagnosed with T2DM within the past month; (4) Capable of using smartphones and glucose monitors.

Exclusion Criteria:
(1) Combined with severe dysfunction of heart, brain, kidney, or other organs; (2) History of mental illness; (3) Pregnant, planning pregnancy, or lactating women; (4) Received medications affecting blood glucose within three months, including steroids, tamoxifen, amiodarone, or methotrexate; (5) Had endocrine disorders such as hyperthyroidism or Cushing's syndrome; (6) Cancer patients undergoing radiotherapy or chemotherapy.

All subjects signed informed consent forms. The experiment was terminated if patients' conditions deteriorated or required treatment plan changes due to complications. This study was approved by the Hospital Ethics Management Committee (Approval No.: DXBYYhMEC2015-21).

1.3 Research Methods

Random grouping was performed using a random number table method, with allocation sequences stored in sequentially numbered sealed opaque envelopes maintained by the study designer. Using convenience sampling, 200 newly diagnosed T2DM patients who visited Tianjin Medical University Chu Hsien-I Memorial Hospital (Tianjin Medical University Metabolic Diseases Hospital) between June and December 2016 and met inclusion criteria were sequentially enrolled and assigned to either the glucose monitoring group or the control group based on the envelope contents. The control group received standardized outpatient diabetes management, while the glucose monitoring group received additional human-computer interactive glucose monitoring intervention. Study indicators were assessed at baseline and after 3 months of intervention.

The control group implemented conventional outpatient management, including distribution of diabetes health education manuals and monthly health education lectures inviting patients, family members, or caregivers, for a total of 3 months. The intervention group received human-computer interactive glucose monitoring management in addition to conventional management, with a management team consisting of attending physicians, responsible nurses, and patients. The human-computer interaction system was supported by the Yino Doctor platform, using Yino glucose meters to measure blood glucose values that were updated in real-time to the mobile software provided to patients, integrated with an online physician workstation management platform. Platform services included patient health accounts, online health consultation and reminder services, and electronic health records. After glucose measurement, data was wirelessly transmitted in real-time to the mobile software for storage and archiving. Patients could query glucose fluctuation graphs, and the software application included an alert system that notified patients to take appropriate action during hyperglycemia or hypoglycemia. Attending physicians could access patients' glucose fluctuations through the system, assisting nurses in developing care plans weekly. Responsible nurses established individual patient profiles, formulated management plans, assisted patients in establishing healthy lifestyles, and implemented nursing operations. They sent weekly health reminder text messages, conducted follow-up calls for patients with glucose fluctuations, reminded them to attend regular outpatient follow-ups, and organized weekly collective education sessions for common issues in the monitoring group, covering diabetes diet, exercise, glucose monitoring, medication, mental health, foot care, and timing of medical visits. They also answered questions about diet management and exercise therapy, enabling patients to learn from and discuss experiences with each other to promote healthy behaviors. During outpatient follow-up visits, physicians analyzed glucose fluctuation graphs, prescribed health plans, answered questions about glucose management, encouraged participation in weekly nurse education sessions to consolidate knowledge, and incorporated patient feedback to continuously improve glucose management behaviors. During follow-up, patients in the glucose monitoring group received complimentary smart glucose meters and 3 months of consumables. Diabetes management self-efficacy was assessed using scales at enrollment, glycemic metabolic indicators were monitored, and patient glucose and self-care behavior indicators were recorded at the end of the intervention.

1.4 Observation Indicators

Basic subject data were collected through questionnaires, patient self-management ability was assessed using relevant scales, and metabolic indicators were monitored. **T2DM glycemic control standards:** Fasting blood glucose (FBG) 4.4–7.0 mmol/L, 2-hour postprandial glucose (2hPG) <10.0 mmol/L, glycated hemoglobin (HbA1c) <7%. Glycemic control rate = (Number of patients achieving glycemic control ÷ Total number of patients) × 100%.

The **Diabetes Management Self-Efficacy Scale (DMSES)** evaluates diabetic patients' beliefs, judgments, or subjective self-perceptions regarding health management. Self-efficacy is the most effective factor for changing health behaviors. Based on the scale developed by McDowell et al. in 2005, the Chinese version of DMSES [4] includes 4 dimensions: healthy diet, healthy behavior, diet and blood glucose, and medication adherence, comprising 20 items. Each item is rated on an 11-point scale from 0–10, with total scores ranging from 0–200; higher scores indicate greater self-efficacy.

The **Summary of Diabetes Self-Care Activities (SDSCA)** assesses diabetic patients' self-management capabilities. The SDSCA scale was revised by Toobert et al. and translated by Wan Qiaoqin et al. [5] in China. Scores represent the number of days in the past week that patients could appropriately manage blood glucose for each behavior. The SDSCA scale has a clear structure with fewer but comprehensive items, where scores are positively proportional to effective behaviors, providing objective and accurate assessment of patient self-management.

The **2-DSCS (Diabetes Self-Care Scale)** was developed by Hurley et al. to evaluate patients' long-term self-management behaviors. Wang Jingxuan et al. [6] adapted and validated the Chinese version in Taiwan in 1998, which includes 6 dimensions: dietary control, regular exercise, medication adherence, blood glucose monitoring, foot care, and prevention and management of hyperglycemia and hypoglycemia.

1.5 Quality Control

Questionnaire distribution and collection were conducted by uniformly trained investigators who explained the purpose and significance of questionnaire completion to patients, obtained informed consent, and promptly checked for missing or incorrect information to assist patients in supplementation and revision. Data were double-checked and entered. Questionnaires with multiple-choice errors, incorrect filling, or missing data exceeding 5% were considered invalid.

A total of 200 questionnaires were distributed, with 192 valid questionnaires recovered, yielding a 96% valid response rate.

1.6 Statistical Methods

SPSS 19.0 software was used for statistical analysis. Count data were described as rates [n (%)], with ^{2} tests for between-group comparisons. Normally distributed continuous data were described as mean ± standard deviation (x ± s), with independent samples t-tests for between-group comparisons. Non-normally distributed data were described as median (interquartile range) [M (P75-P25)], with Mann-Whitney U tests for between-group comparisons. Spearman correlation analysis was used for rank correlation. Multiple linear regression models were applied to analyze factors influencing blood glucose levels. $P<0.05$ indicated statistically significant differences, with a test level of $\alpha=0.05$.

Results

2.1 General Characteristics

After 3 months of follow-up, the glucose monitoring group had 95 remaining patients (1 unable to continue due to condition changes, 1 lost to follow-up, 3 voluntarily withdrew), and the control group had 97 remaining patients (1 withdrew due to surgery, 2 voluntarily withdrew). There were no differences in baseline indicators between the two groups ($P>0.05$), as shown in Table 1 .

2.2 Comparison of Glycemic Levels After Intervention

Both groups showed reduced FBG, 2hPG, and HbA1c levels after intervention ($P<0.05$), with more significant reductions in the glucose monitoring group ($P<0.05$), as shown in Table 2 . After intervention, 67 patients (70.5%) in the glucose monitoring group achieved FBG targets versus 31 (32.0%) in the control group; 49 patients (51.6%) achieved 2hPG targets versus 30 (30.9%); and 67 patients (70.5%) achieved HbA1c targets versus 29 (29.9%). The glucose monitoring group demonstrated higher glycemic control rates ($P<0.05$).

2.3 Comparison of Diabetes Management Self-Efficacy, Self-Management Ability, and Self-Care Behavior

Before intervention, there were no differences in DMSES scores between the two groups ($P>0.05$). After intervention, scores increased significantly ($P<0.05$), with the glucose monitoring group scoring higher than the control group ($P<0.05$), as shown in Table 3 . After intervention, the glucose monitoring group scored higher on all SDSCA self-management behavior items and total score ($P<0.05$), as shown in Table 4 . The glucose monitoring group also scored higher on the 2-DSCS scale and total score ($P<0.05$), as shown in Table 5 . All differences were statistically significant.

Spearman correlation analysis revealed that self-efficacy levels in newly diagnosed T2DM patients were positively correlated with self-care behavior and diabetes self-management behavior, with correlation coefficients of 0.909 and 0.872 respectively ($P<0.01$). Self-care behavior was positively correlated with self-management behavior, with a correlation coefficient of 0.917 ($P<0.01$).

2.4 Multiple Linear Regression Analysis of Factors Influencing Blood Glucose in Newly Diagnosed T2DM Patients

With post-intervention HbA1c level as the dependent variable and scores from each self-care behavior dimension of the 2-DSCS scale as independent variables in multiple linear regression analysis, results showed that dietary control, medication adherence, blood glucose monitoring, regular exercise, and prevention/management of hyperglycemia/hypoglycemia were favorable factors for reducing HbA1c levels ($P<0.05$). With FBG and 2hPG levels as dependent variables and scores from each management behavior dimension of the SDSCA scale as independent variables, general diet, special diet, and medication management behaviors were favorable factors for reducing FBG and 2hPG levels, while blood glucose monitoring behavior promoted reduction in 2hPG level ($P<0.05$). All results are shown in Table 6 .

Discussion

Human-computer interaction (HCI) implements and applies HCI theory through information system modeling, formal description, integrated algorithms, evaluation methods, and software frameworks. With the development of intelligent technology, voice interaction, gesture recognition, image recognition, and brain-computer interfaces have become common HCI forms, greatly promoting artificial intelligence technology development [7]. In healthcare, HCI interface design is more specific and rigorous due to its monitoring and reference functions, requiring more accurate expression and timely, simple operation [8]. HCI technology optimizes medical workflows, provides precision medicine, and effectively supports medical staff in diagnosis, treatment, and evidence-based reasoning by integrating, analyzing data, and retrieving medical information in clinical decision support systems, electronic health records, medical imaging systems, and other computerized collaborative tools [9].

In this study, the blood glucose monitoring system updated interfaces to achieve visualization of electronic health record interfaces, providing clinical decisions based on informatized glucose data. Patients recorded data through glucose monitoring devices, while physicians completed continuous data collection and interpretation remotely, enabling accurate assessment of overall treatment levels. Patients could directly participate in clinical decisions during outpatient visits, allowing the medical team to comprehensively grasp glucose changes. Through remote monitoring, digital consultation, and shared decision-making, patient-centered healthcare was established. Additionally, nurses could review patients' glucose fluctuation trends to understand their conditions and provide more suitable knowledge education methods and content. Compared with traditional glucose testing processes, this system automatically recorded testing times and frequencies without manual documentation, effectively improving patient compliance and sense of achievement in glucose monitoring.

Achieving glycemic control targets can delay the onset and progression of T2DM complications. Current perspectives suggest that blood glucose has a "metabolic memory" effect, where early "glucotoxicity" causes severe tissue and organ damage. Therefore, early intervention to achieve glycemic control has important clinical significance for preventing diabetes complications [10] and constitutes a crucial component of tertiary diabetes prevention. Most newly diagnosed T2DM patients are accidentally diagnosed during physical examinations or treatment for other diseases, or are hospitalized due to clinical complications. When symptomatic patients are diagnosed with diabetes, the disease course is approximately 2–7 years, and most have not received systematic basic diabetes education, thus missing the optimal timing for glycemic intervention [11]. In this study, after follow-up, both groups of newly diagnosed T2DM patients showed reduced FPG, 2hPG, and HbA1c levels. Compared with the control group, the glucose monitoring group demonstrated more significant improvement in glycemic levels, suggesting that human-computer interactive management and glucose monitoring intervention benefit glycemic control in newly diagnosed T2DM patients, provide continuous diagnosis and treatment services, and offer better therapeutic guidance for improving glycemic control [12].

Glycemic control in T2DM patients is closely related to self-management ability. Self-management behavior is a direct influencing factor on glycemic control and a key to preventing acute complications and reducing chronic complication risks [13,14]. In this study, the glucose monitoring group scored higher on all 2-DSCS and SDSCA management behavior items and total scores, suggesting that human-computer interactive intelligent monitoring management-based interventions promote improved short-term and long-term self-management abilities in newly diagnosed T2DM patients. This advantage relates to increased glucose monitoring frequency and timely, targeted treatment plan adjustments, overcoming the limitation of patients being passive information recipients in traditional diabetes treatment models. With the rapid development of "Internet+" technology in recent years, institutions have provided continuous medical services through joint supervision of patients, gradually demonstrating advantages in controlling blood glucose, improving self-management levels, and enhancing quality of life [15].

Self-efficacy refers to an individual's confidence in their ability to perform a specific behavior and achieve expected outcomes, greatly influencing behavior selection and persistence. It is the most effective factor for changing health behaviors and the best predictor of diabetes self-management behavior [16]. In this study, DSMES scale scores in newly diagnosed T2DM patients were positively correlated with self-care behavior and self-management scores. Individual self-efficacy and behaviors interact, influence, and promote each other [17]. DSMES scores increased in both groups after intervention, suggesting that newly diagnosed T2DM patients' understanding of diabetes progressed gradually during treatment, with continuously improving confidence in diabetes management. The glucose monitoring group showed more significant improvement in management self-efficacy, indicating that human-computer interactive monitoring of blood glucose helps improve treatment awareness, enables subjective initiative in making healthy decisions, emphasizes self-management behavior constraints regarding diabetes risks, and improves behavior compliance. This aligns with foreign studies utilizing continuous glucose monitoring systems through pattern management [18].

In this study, compliance with five self-care behaviors—dietary control, regular exercise, medication adherence, blood glucose monitoring, and prevention/management of hyperglycemia/hypoglycemia—were favorable factors for reducing HbA1c levels. FBG and 2hPG levels in newly diagnosed T2DM patients were influenced by general diet, special diet, and medication compliance in management behaviors, while blood glucose monitoring compliance primarily affected 2hPG levels, consistent with research on glycemic control in diabetes patients [19,20]. Blood glucose monitoring helps newly diagnosed T2DM patients promptly modify their behaviors and adjust lifestyles to reduce glucose fluctuations. Medication adherence has the characteristics of accessibility and rapid effect compared with other management behaviors, providing direct successful experiences. The impact of dietary habits on diabetes patients is long-term, and changing patients' dietary habits to improve health status is highly feasible [21]. Human-computer interactive intelligent glucose monitoring management can improve self-care behaviors in newly diagnosed T2DM patients and enhance population glycemic management ability by improving behaviors such as glucose monitoring, medication treatment, and dietary control, offering better advantages for intervention.

Since 2019, the COVID-19 pandemic has severely affected the lives of chronic disease patients, with diabetic patients having higher mortality risk when infected with COVID-19 [22]. Social distancing restrictions have hindered diabetes self-management, including suboptimal glycemic control, increased diabetes-related stress, limited exercise scope, and reduced clinic visits, posing significant risks for glycemic control and reduction of acute and long-term complications. Therefore, future interventions should focus on online chronic disease management, supporting the development and promotion of online consultation to overcome physical distance and conveniently provide personalized services [19]. We advocate constructing network intervention models to strengthen continuous out-of-hospital care for chronic diseases through diversified electronic communication platforms. During the pandemic, the demand for contactless, timely online intervention and mobile interactive management in internet medicine has become more apparent [23].

Active intervention in lifestyle of newly diagnosed diabetes patients can reduce the risk of diabetes complications, lessen social burden, fundamentally reduce diabetes disability rates, and decrease medical costs. This study provides a reference approach. However, limitations exist: sample selection should be expanded to more locations and larger numbers, and changes in time compliance lack continuous records. We recommend multi-center studies with larger samples and long-term, multi-timepoint compliance records to further explore health economics benefits and related data.

This study investigated the impact of human-computer interactive intelligent glucose monitoring management intervention on glycemic control and self-management behaviors in newly diagnosed T2DM patients, providing research data for self-management ability intervention methods and further improving glycemic management efficiency.

Author Contributions: WANG Lingxiao and DONG Rongna contributed to study conception and design, feasibility analysis, literature collection, data organization, and manuscript writing. ZHOU Bing and GUO Lina participated in data collection and organization. WANG Lingxiao and ZHOU Bing contributed to manuscript revision. LI Jing was responsible for quality control and review, supervision, and overall responsibility for the article. All authors approved the final manuscript.

Conflict of Interest: The authors declare no conflicts of interest.

References:

[1] Galicia-Garcia U, Benito-Vicente A, Jebari S, et al. Pathophysiology of Type 2 Diabetes Mellitus[J]. Int J Mol Sci. 2020, 21(17):6275. DOI: 10.3390/ijms21176275.
[2] Jin LL, Ye Q, Ma YY, et al. Effect of trinity involved comprehensive disease management program on self-management ability among community type 2 diabetic mellitus patients: a 2-year intervention study[J]. Chin J Public Health, 2020, 36(5):810-813. DOI:10.11847/zgggws1121368.
[3] Li W, Zhang Y, Ji Y, et al. Health education and management of newly diagnosed diabetic patients[J]. Modern Medicine Journal of China, 2015, 17(6):90-91. DOI: 10.3969/j.issn.1672-9463.2015.06.031.
[4] Chen Q, Wang ZZ, Chen YH, et al. Evaluation of the reliability and validity of the Diabetes Management Self-Efficacy Scale for diabetic outpatients in third level hospitals in Shanghai[J]. Journal of Shanghai Jiaotong University(Medical Science), 2016, 36(5):724-729. DOI: 10.3969/j.issn.1674-8115.2016.05.022.
[5] Wan QQ, Shang SM, Lai XB, et al. Study on the reliability and validity of summary of diabetes self-care activities for type 2 diabetes patients[J]. Chin J Prac Nurs, 2008, 24(7):26-27. DOI: 10.3760/cma.j.issn.1672-7088.2008.07.009.
[6] Wang JS, Wang RH, Lin QJ. Self-care behavior and related factors in outpatients newly diagnosed with non-insulin-dependent diabetes mellitus[J]. Journal of Nursing(China), 1998, 45(2):60-74.
[7] Fan XM, Fan JJ, Tian F, et al. Human-computer interaction and artificial intelligence: from competition to integration[J]. Science in China(Information Sciences), 2019, 49(3):361-368.
[8] Li X, Xu Y. Role of Human-Computer Interaction Healthcare System in the Teaching of Physiology and Medicine[J]. Comput Intell Neurosci, 2022, 2022:5849736. DOI: 10.1155/2022/5849736.
[9] Rundo L, Pirrone R, Vitabile S, et al. Recent advances of HCI in decision-making tasks for optimized clinical workflows and precision medicine[J]. J Biomed Inform, 2020, 108:103479. DOI: 10.1016/j.jbi.2020.103479.
[10] Yao Y, Song Q, Hu C, et al. Endothelial cell metabolic memory causes cardiovascular dysfunction in diabetes[J]. Cardiovasc Res, 2022, 118(1):196-211. DOI: 10.1093/cvr/cvab013.
[11] Laiteerapong N, Ham SA, Gao Y, et al. The Legacy Effect in Type 2 Diabetes: Impact of Early Glycemic Control on Future Complications

(The Diabetes & Aging Study)[J]. Diabetes Care, 2019, 42(3):416-426. DOI: 10.2337/dc17-1144.
[12] Jiang YW, Sun L, Li J, et al. Analysis of the reaching standard and influencing factors of glycated hemoglobin in diabetes patients under comprehensive management[J]. Chin J Prev Contr Chron Dis, 2020, 28(2):121-125. DOI: 10.16386/j.cjpccd.issn.1004-6194.2020.02.009.
[13] El-Radad HM, Sayed Ahmed HA, Eldahshan NA. The relationship between self-care activities, social support, and glycemic control in primary healthcare patients with type 2 diabetes[J]. Diabetol Int, 2022, 30:1-11. DOI: 10.1007/s13340-022-00562-6.
[14] Qi X, Xu J, Chen G, et al. Self-management behavior and fasting plasma glucose control in patients with type 2 diabetes mellitus over 60 years old: multiple effects of social support on quality of life[J]. Health Qual Life Outcomes, 2021, 19(1):254. DOI: 10.1186/s12955-021-01881-y.
[15] Wang Q, Wu H, Wei XJ, et al. Patient self-management of diabetes using the mobile terminal APP: a self-controlled, comparative study in Fangzhuang Community Health Service Center[J]. Chinese General Practice, 2020, 23(7):844-848. DOI: 10.12114/j.issn.1007-9572.2019.00.674.
[16] Mao F, Jiang YY, Xia Z, et al. Analysis of changes in self-efficacy and its influencing factors in type 2 diabetic patients after community-based self-management group intervention[J]. Chin J Prev Med, 2022, 56(7):932-939. DOI: 10.3760/cma.j.cn112150-20220310-00222.
[17] Wang Y, Zeng Z, Ding J, et al. Fear of hypoglycaemia among patients with type 2 diabetes mellitus: a cross-sectional study[J]. Sci Rep, 2021, 11(1):7971. DOI: 10.1038/s41598-021-86954-0.
[18] Lee SK, Shin DH, Kim YH, et al. Effect of Diabetes Education Through Pattern Management on Self-Care and Self-Efficacy in Patients with Type 2 Diabetes[J]. Int J Environ Res Public Health, 2019, 16(18):3323. DOI: 10.3390/ijerph16183323.
[19] Yu X, Chau JPC, Huo L, et al. The effects of a nurse-led integrative medicine-based structured education program on self-management behaviors among individuals with newly diagnosed type 2 diabetes: a randomized controlled trial[J]. BMC Nurs, 2022, 21(1):217. DOI: 10.1186/s12912-022-00970-7.
[20] Yang HX. Correlation between self-management behavior and glycemic control in community patients with type 2 diabetes mellitus[J]. Journal of Contemporary Clinical Medicine, 2020, 33(1):91,88. DOI: 10.3969/j.issn.2095-9559.2020.01.061.
[21] da Rocha RB, Silva CS, Cardoso VS. Self-Care in Adults with Type 2 Diabetes Mellitus: A Systematic Review[J]. Curr Diabetes Rev. 2020, 16(6):598-607. DOI: 10.2174/1573399815666190702161849.
[22] Jacob E, Avery A. Energy-restricted interventions are effective for the remission of newly diagnosed type 2 diabetes: A systematic review of the evidence base[J]. Obes Sci Pract, 2021, 7(5):606-618. DOI: 10.1002/osp4.504.
[23] Aminuddin HB, Jiao N, Jiang Y, et al. Effectiveness of smartphone-based self-management interventions on self-efficacy, self-care activities, health-related quality of life and clinical outcomes in patients with type 2 diabetes:

A systematic review and meta-analysis[J]. Int J Nurs Stud, 2021, 116:103286. DOI: 10.1016/j.ijnurstu.2019.02.003.

Note: Figure translations are in progress. See original paper for figures.