integrity Research Journals

Journal of Practical Medicine and Medical Science
Volume 3(1), pages 15-29, August 2025
Article Number: 43FCB9862
https://doi.org/10.31248/JPMMS2025.022
https://integrityresjournals.org/journal/JPMMS

Review Article

Educational intervention model for individuals with type-2 diabetes mellitus in Ekiti and Kwara State, Nigeria: A Systematic Review

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Received 1st April 2025; Accepted 28th June 2025

ABSTRACT: Type-2 diabetes mellitus poses a significant public health challenge in Nigeria, where limited awareness, poor self-management, and inadequate healthcare resources contribute to disease complications, including the risk of Alzheimer's disease. This paper evaluates educational intervention models designed and implemented to promote and prevent memory impairment among individuals living with T2DM at various levels. The review was conducted using the Centre for Review Dissemination. Online journal databases, including Google Scholar, PubMed, and the Web of Science, were searched extensively for relevant studies published between 2019 and 2023. The selection criteria encompassed qualitative, quantitative, and mixed-method studies that met the inclusion and exclusion guidelines based on the SPIDER framework and provisionally selected 30 studies for the review with detailed of various educational intervention models aimed at improving knowledge, adherence to treatment regimens, and prevention strategies for reducing the risk of Alzheimer's disease among T2DM patients. The review indicated that the majority of T2DM patients lacked awareness of essential educational components, such as disease promotion, prevention, and adherence strategies. Additionally, some healthcare providers were unaware of the significance of educational intervention models in enhancing service utilisation among adults and elderly patients with T2DM. Following further screening, 20 articles met the inclusion criteria and were analysed for information on educational intervention models and the success levels of pre- and post-intervention strategies. The remaining 10 articles explored intervention models focusing on long-term prognostic approaches to T2DM and its progression to Alzheimer's disease. These studies stressed the importance of structured educational programs in mitigating memory impairment risks among T2DM patients. The review highlights the critical need for improved health education strategies to prevent cognitive decline among T2DM patients, such as patient-centered programs that teach individuals how to manage their diabetes through knowledge, skills, and confidence-building. Healthcare providers must enhance their skills and attitudes toward the promotion, prevention, and maintenance of health education initiatives. Addressing the existing gaps through targeted intervention programs that can reduce the risk of Alzheimer's disease among adults and elderly patients in healthcare facilities. Researchers should focus on developing and implementing sustainable educational intervention models tailored to the specific needs of T2DM patients in Nigeria and other similar settings.

Keywords: Educational Intervention Model, Nigeria, self-management, systematic review, type 2 diabetes mellitus.

INTRODUCTION

Educational needs of people living with type 2 Diabetes mellitus are more important than other health issues due to its burden that has been greatly explored in many diverse ways with its link to Alzheimer's disease (Duarte-Díaz *et al*., 2022). Globally, diabetes mellitus is a public health important and a concern to both families, communities, nations, and the international community due to the increase in prevalence and rapid growth of the disease with a higher mortality rate (Vacurova *et al.,* 2022). According to the International Diabetes Federation [IDF], IDF, (2021), several studies have examined the association and progressive link between Diabetes mellitus [DM] and Alzheimer's disease [AD] that increases in the cause and adverse effects, including cognitive impairment leading to Alzheimer's disease known as type 3 DM. Diabetes mellitus is characterised by metabolic disease caused by hyperglycemic resulting from defects of insulin action or insulin resistance due to a lack of production from the islets of the pancreas as a result of a defect in the hormone insulin (Zhou *et al*., 2022; Xiong *et al.,* 2020). In Nigeria, regional variations exist, with Ekiti State recording diabetes prevalence at 10%, while Kwara State reported at 14.2%. (Olamoyegun *et al.,* 2024). Therefore, the link between type 2DM and AD, the disease that distorts memory and other mental functional activities among diabetic patients. DM is a common condition in older people, affecting about 425 million persons older than 65 years, and this has been associated with serious adverse health effects such as cognitive memory impairment leading to Alzheimer disease (Van Nguyen *et al*., 2021; Bică *et al.,* 2020). This progressive disease causes memory loss gradually and later leads to an inability to carry on conversations and other responses to the environment. According to the Centres for Disease Control (2022), Alzheimer disease is a progressive disease beginning with mild memory loss and leading to loss of ability to carry out daily activities, especially in adults aged 65 years old, either of race or ethnicity.

Magliano *et al*. (2021) reported that, as of 2021, China had the highest number of adults aged 20–79 years with diabetes, accounting for approximately 11.3% of the population. Other countries with significant diabetes prevalence include the United States, India, and Pakistan. Likewise, the World Health Organisation (2022) shows that the prevalence of Type 2 diabetes mellitus (DM) has been steadily increasing worldwide over the past few decades, accounting for the majority of all diabetes cases. In Nigeria, the highest pooled prevalence is observed in the southern regions, with a rate of approximately 8.5%, followed by 4.6% in the North-East and 3% in the South-East. In comparison, Europe has a prevalence rate of 8.8% among individuals aged 20–79 years. Khalooei and Benrazavy (2019) identify diabetes as a leading cause of severe health complications and one of the top 10 causes of death globally, with no known cure. Additionally, Ismail *et al*. (2021) highlight that sociodemographic factors, physiological decline, psychological conditions, nutritional deficiencies, and modifiable lifestyle habits are key risk factors for Type 2 DM.

Stapleton *et al*. (2022) highlight that receiving a diabetes diagnosis often causes significant distress for young individuals and their families, leading to prolonged negative health and mental outcomes, particularly among young people. Similarly, Oyedeji *et al*. (2022) emphasise a strong connection between Type 2 diabetes mellitus (T2DM) and common mental disorders, either as comorbid conditions or complications of diabetes. One notable manifestation is cognitive impairment, which has been increasingly recognised as Alzheimer's disease (AD), also referred to as Type 3 diabetes mellitus (T3DM). Michailidis *et al*. (2022) report that Alzheimer's disease (AD) is the fifth leading cause of death among elderly individuals with diabetes mellitus. While there is no known cure for AD, treatment is focused on managing its symptoms. The exact cause of the disease remains unclear; however, both genetic and environmental factors contribute to its development (Lorver, 2020). Pathological hallmarks of AD include extracellular neuritic plaques, intracellular neurofibrillary tangles, and neuronal loss, which are linked to synapse degeneration, oxidative stress, mitochondrial dysfunction, inflammatory responses, and alterations in cholinergic neurotransmission (Wang *et al*., 2021).

The link between Type 2 diabetes mellitus (T2DM) and Alzheimer's disease (AD) is closely associated with insulin resistance and insulin-like growth factor (IGF) signalling. This dysfunction impairs glucose absorption in neurons, leading to reduced energy production and subsequent cognitive impairment (Kirvalidze *et al*., 2022). Building on this connection, Ibitoba (2021) underscores the urgent need for a comprehensive educational model, particularly for individuals affected by kidney disease, T2DM, and hypertension, to mitigate their impact. Ibitoba further emphasises that T2DM is a key predictor of chronic conditions such as kidney disease, hypertension, and stroke. Therefore, medical professionals, especially nurses, should develop educational programs to raise public awareness of associated risk factors. Similarly, Salahshouri *et al*. (2018) highlight the effectiveness of educational interventions targeting psychological factors in improving health outcomes for individuals with T2DM. However, their study identifies a gap in the implementation of educational programs specifically designed to address psychological barriers that hinder self-management. To address this gap, the purpose of this systematic review is to explore the development of an educational intervention model for individuals living with T2DM in Ekiti and Kwara States, Nigeria.

METHODOLOGY

This systematic review spans six years and focuses on

randomised controlled trials (RCTs) and comparative studies to assess the effectiveness of developing an educational intervention model for individuals with Type 2 diabetes mellitus (T2DM). The literature search was conducted using MEDLINE, EMBASE, and PubMed databases, covering studies published between 2019 and 2023. The review process was structured according to a four-step protocol outlined by the Centre for Review Dissemination. Conducted from 2019 to 2023, it adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, with a registered protocol. Screening of studies followed predefined inclusion and exclusion criteria to ensure quality and relevance. The review checklist consists of four key components: (1) an overview of the study background and literature review, (2) research questions and objectives, (3) methodology, assessment criteria, data analysis, and results, and (4) a study flowchart and discussion of findings.

Additionally, data extracted from each study will include the author's name, publication source, year of publication, country of participants or respondents, and demographic details such as age and gender. Other key elements include the study's objectives, methodology, design, setting, sampling techniques, instruments used, outcomes, and key findings. The results were synthesised narratively, reported, and summarised in Table 1. The database search was restricted to studies published in English, ensuring consistency in the review and presentation of findings.

Data Search (search strategy)

Studies were screened based on PRISMA guidelines using specific selection criteria. These included studies published in English, peer-reviewed articles focusing on the development of an educational intervention model for individuals with Type 2 diabetes mellitus (T2DM), and research sourced from MEDLINE and EMBASE databases, specifically in Ekiti and Kwara States, Nigeria. After removing irrelevant and duplicate results, selected abstracts were downloaded and assessed based on predefined inclusion and exclusion criteria. Following an initial screening of abstracts, 30 papers were provisionally selected. Further evaluation reduced the number to 20 articles that met the inclusion criteria and were analysed in alignment with the study's theoretical framework. A comprehensive search of online journals was conducted using Embase, PubMed, MEDLINE, and Google Scholar databases, with additional sources identified through reference scanning of selected studies.

Inclusion and exclusion criteria

The researcher reviewed comparative studies, ensuring broad inclusion criteria to capture all relevant research on the development of an educational intervention model for adults aged 45 and above with Type 2 diabetes mellitus (T2DM) in two different healthcare settings. There were no restrictions on the language of publication; eligible studies published in other languages were translated. The review included studies utilising qualitative, quantitative, and mixed-method approaches. However, certain categories of publications were excluded, including previous literature or narrative reviews, case reports, articles published in languages other than English, and both official and unofficial peer-reviewed reports related to T2DM that lacked evidence of implementation.

Design and registration of the protocol

This is a systematic review (SR) guided by the recommendations of the Joanna Briggs Institute (JBI) (2015) and followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist for scoping reviews (Tricco *et al*., 2018). The protocol was registered under the serial number INPLASY202150091 (Romero-Castillo *et al*., 2018).

Source of data and search strategy

Searches were conducted across multiple databases, including MEDLINE (via PubMed), Excerpta Medica Database (EMBASE), Latin American Caribbean Health Sciences Literature (LILACS via BIREME), and Web of Science. Additionally, gray literature was considered during the selection process. These searches were performed from the inception of each database up until March 2021, as detailed in Supplemental Online 1. The search strategy used for MEDLINE included the following terms: (Type 2 Diabetes) AND (primary healthcare [MeSH Terms]) OR (Care, Primary Health) OR (Healthcare, Primary) AND (Education [MeSH Terms]) OR (Patient education [MeSH Terms]) OR (Education, Patient).

Eligibility criteria of the studies

This systematic review includes randomised controlled trials (RCTs), quasi-experimental studies, and cluster studies published from inception until March 2021. Studies were considered if they were available in Portuguese, English, or Spanish, with both abstract and full text accessible. For study eligibility, the PICO framework (Population, Intervention, Comparator, Outcomes) was applied: **P (Population):** Adults with Type 2 diabetes mellitus (T2DM) receiving primary healthcare. **I (Intervention):** Educational interventions. **C (Comparator):** Standard or routine care. **O (Outcomes):** Improvement in clinical outcomes, including treatment adherence, diabetes management, patient knowledge, and self-care practices.

Data extraction

The extracted data was collected in an Excel spreadsheet, containing the following information: author, year, country, study design, sample size, type of intervention, follow-up, control group, and main findings.

Potential biases and limitations

The study's critical review reveals device methodological limitations and biases that may compromise the reliability and generalizability of the findings. Many of the reviewed studies were hospital-based and urban-centric, often excluding rural and asymptomatic populations, thus introducing selection bias. Small sample sizes and the widespread use of cross-sectional designs limited statistical power and the ability to establish causal relationships. Reliance on self-reported data and non-standardised diagnostic tools contributed to measurement inconsistencies, while the absence of longitudinal data hindered insights into disease progression. Furthermore, the failure to adequately control for confounding factors such as comorbidities and socioeconomic variables weakened the internal validity of the observed associations.

RESULTS

Identification and selection of the studies

In total, 358 studies were identified (Figure 1). Of these, 37 duplicate articles were excluded, with 321 studies being included for reading the title and abstract. Of those 321, 290 studies were excluded because they did not meet the objectives of the type of patient, type of study, educational intervention, location, or results found. Of the 31 remaining studies included for full text reading, 14 articles that did not meet the criteria established in the PICO strategy were excluded. Finally, seventeen studies met the eligibility criteria for inclusion in this scoping review.

Characteristics of studies included

The 17 studies included in the SR were carried out in 11 countries; with these, 65% of the studies were conducted in high-income countries, the rest being from low- and middle-income countries. These studies were published between 2019 and 2023. In relation to the type of study, it was found that 13 of the studies were randomised controlled trials and four cluster-randomised trials. Sample sizes ranged from 76 to 1589, with a mean of 344. The included studies were followed up for different periods, ranging from the first month after the intervention to 24 months. Studies with follow-up at 3, 6, and 12 months predominated.

Although educational interventions showed a wide diversity, common strategies were found, such as education for diabetes control, a diabetes adherence and empowerment program, and activities that included the individual, family, and communities. Education focused on the knowledge of the disease, warning signs, diet, and self-care practices. Regarding the control group, it was evident that all studies included standard care, that is, usual care. Educational interventions for the management of adults with Type 2 DM were identified, which were grouped into four large categories, with the goal of projecting a better understanding of this review and a more delimited guide that serves health professionals in the implementation of interventions that respond to the needs identified in their practical environments.

Therapeutic adherence

Therapeutic adherence has historically represented one of the most important elements in the care of patients with DM2 and, with it, the execution of adequate treatment and control of the disease. Therefore, different countries have focused their educational intervention programs on adequate therapeutic adherence and, with this, seek to contribute to the management Gehlawat ***et al***., 2019) Thus, as a study aimed to provide development of an educational intervention model for people living with Type 2 Diabetes Mellitus in Ekiti and Kwara State, this educational intervention, which was received by the professionals who guided the patients with DM2, allowed a greater adherence to the trseatment, which consequently brought the improvement of the blood glucose levels of the study participants.

In the United States, a study conducted with two groups examined the impact of different educational interventions for individuals with Type 2 diabetes mellitus (T2DM). One group utilised a specialised diabetes education kit designed to enhance diabetes knowledge and communication techniques in healthcare, while the second group received guidance based on the National Health Program, focusing on discussions related to diabetes care. The study found that after the interventions, patients reported significantly higher satisfaction with their treatment (3.93 [95% confidence interval (CI), 2.48-6.21]; $p<0.001$) compared to the second group (3.04 [95% CI, 1.93-4.77]; $p<0.001$), along with improved adherence to treatment (White ***et al***., 2020). Another study implemented an educational intervention using materials developed by an interdisciplinary team based on guidelines from the American Diabetes Association and the American Association of Diabetes Educators. Small-group sessions, lasting 45 minutes each, focused on key self-care practices, including healthy eating, physical activity, regular blood sugar monitoring, timely medication intake, problem-solving, risk reduction, and emotional well-being. As a result, participants demonstrated a 2% improvement in adherence to medication for blood glucose control

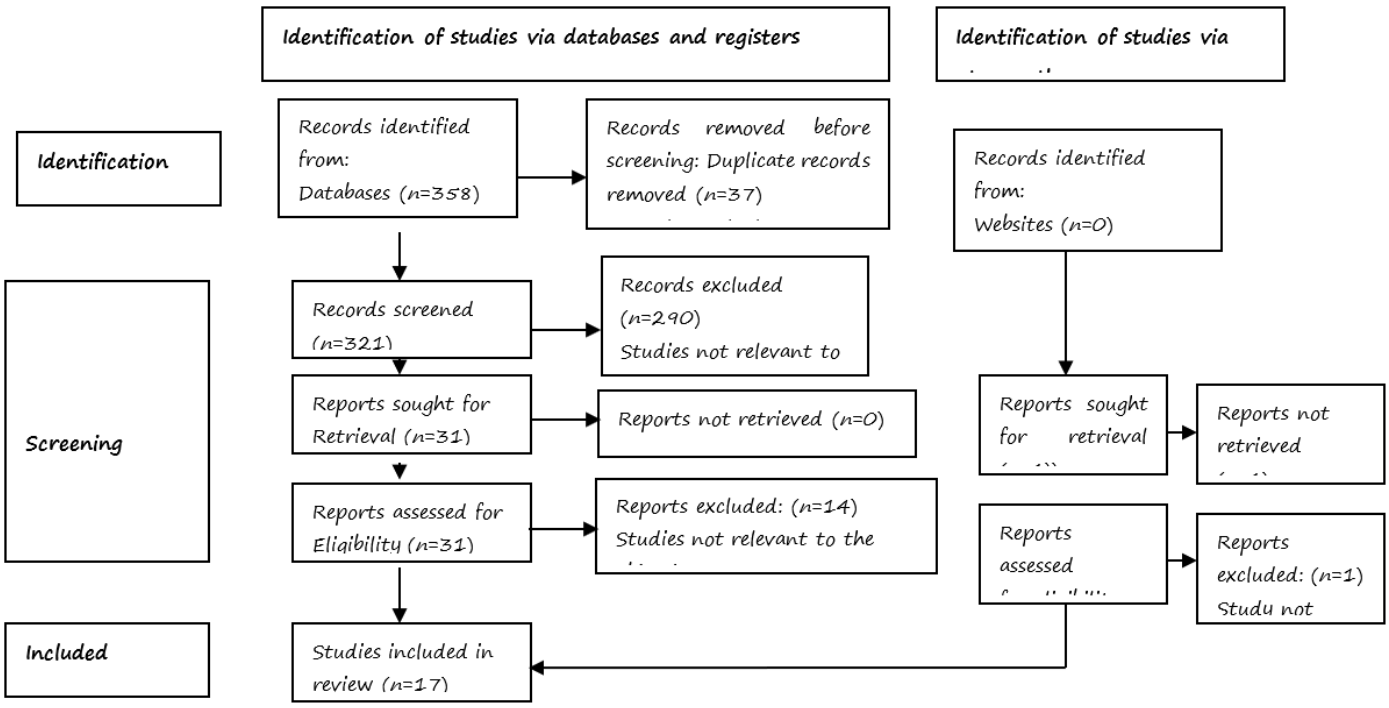

Figure 1. Flow diagram of study selection process.

(Gehlawat *et al*., 2019).

Self-care and self-management in diabetes

Evidence highlights the high morbidity associated with diabetes mellitus, underscoring the need for educational interventions that promote proper disease management and enhance patient self-care. One study applying the theory of self-efficacy to foot self-care behaviour in adults with Type 2 diabetes mellitus (T2DM) demonstrated improvements in performance, emotional and physical well-being, and verbal reinforcement among participants. Comparing the intervention group, where the theory was applied, to the control group receiving standard treatment, results showed significant improvements in self-care and diabetes knowledge ($p<0.01$) (White *et al*., 2020). Structured education programs in primary healthcare settings have also been shown to enhance self-care practices, with a notable improvement of 33.5% [95% CI: 22.9–44.0] (Gehlawat *et al*., 2019). Foot care, in particular, plays a crucial role in promoting self-care and increasing disease knowledge, leading to significant results at both 6 and 12 months post-intervention ($p<0.01$) (Romero Guevara *et al*., 2019). Moreover, adherence and patient empowerment are key indicators that improve through self-care interventions. A study in Brazil implemented group education combined with family visits, demonstrating better outcomes in glycemic control and diabetes self-care (Najafpour *et al*, 2021). Educational interventions have also been shown to significantly increase diabetes-related knowledge in the intervention group, such as diabetes self-management education and support (DSMES) programs, otherwise known as patient-centred programs that teach individuals how to manage their diabetes through knowledge, skills, and confidence-building, encourage medication adherence, enhance problem-solving and decision-making abilities and build self-efficacy and lifestyle modification. whereas knowledge declined in the control group, as reflected in the difference-in-difference (DID) model (DID = 0.91 [95% CI: 0.64–1.18]) (Chen *et al*., 2020). Additionally, community-based, peer-support education programs have proven effective in reducing diabetes-related distress ($p<0.001$) (Presley *et al*., 2020).

Glycemic control of diabetes

The versatility of measures such as web applications for the education of patients with DM2 has allowed a significant reduction in HbA1C ($p = 0.004$) (Presley *et al*., 2020). A study with the intervention of web portals showed a mean decrease in glycated haemoglobin of 1.9% in contrast to standard care, 0.7%, which has a variance of 1.2% ($p = 0.001$) at 12 months. (24) The literature has consisted of demonstrating the positive results of group programs for education in patients with DM2. Two studies showed significant results ($p<0.001$) in the reduction of glycated hemoglobin compared to other interventions,

Table 1. Systematic reviewed of the previous studies.

S/N	Authors	Title	Goals and objectives	Methodology	Sample and sampling technique	Instrument	Results/findings
1	Gehlawat *et al*., 2019 (27) India	Structured Diabetes Education Program for Improving Self-care Behavior in Primary Care Settings of Puducherry: Evidence from a Randomized Controlled Trial	To examine Structured Diabetes Education Program for Improving Self-care Behavior in Primary Care Settings of Puducherry	Randomized controlled trial	314 Intervention: 157 Control: 157	Diabetes Self-Care Activities: •Education sessions of 45minutes •Self-care kits (mirror, an oil bottle, and glucose tablets)	Self-care of the feet: •IG: 3.64 vs. CG: 2.21 •Both groups: 1.95 (1.4-2.4; *p*<0.001) •Inspect the inside of your footwear: • IG: 1.34 vs. CG: 0.04 •Both groups: 0.78 (0.5-1.0; *p*<0.001)
2	Romero Guevara *et al.,* 2019 (28) Colombia	Teaching: Individual" to increase adherence to therapeutic regimen in people with hypertension and type-2 diabetes: Protocol of the controlled clinical trial ENURSIN.	To increase adherence to therapeutic regimen in people with hypertension and type-2 diabetes	Randomized controlled trial	200 Intervention: 98 Control: 102	Teaching: Individual: •Six educational essions of 20 to 40 minutes: Behavior modification; teaching, disease process, prescribed medication, prescribed diet and exercise and coping enhancement • By two nurses	Systolic blood pressure in 24 (mmHg): • IG: 125 (SD 14.6) • CG: 123 (SD 13.9) • HbA1c: • IG: 6.19 (SD 1.71) • CG: 6.15 (SD 1.44) • These results were not significant
3	Jeihoon i *et al*., 2019 Iran	The effect of educational intervention based on BASNEF model on self-medication behavior of type 2 diabetic patients. II	To investigate the effect of educational intervention based on the BASNEF model on self-medication behaviors of type 2 diabetic patients.	The present research is a quasi-experimental and interventional study performed on 200 type 2 diabetic patients under cover of diabetes center of Fasa, Iran.	300 type 2 diabetic patients having health case in the diabetes center of Fasa were invited to participate in this study	iThe tool used for gathering information was a questionnaire designed based on other similar studies	There is significant enhancement in attitude of experimental group 3 months after educational intervention.
4	Bagweneza *et al*., 2019 Rwanda	critical assessment of the nurses' knowledge of essential components of diabetes health education	To examine critical assessment of the nurses' knowledge of essential components of diabetes health education	Randomized controlled trial	314 Intervention: 157 Control: 157	Through a self-appraised questionnaire, the scholars were able to establish the link between the nurses' knowledge and level of health education knowledge on T2DM	, the scholars recommended that there is a need for regular training and retraining of nurses so as to improve their knowledge towards efficient health care for T2DM patients

Table 1. Contd.

S/N	Authors	Title	Goals and objectives	Methodology	Sample and sampling technique	Instrument	Results/findings
5	Sheikhi *et al.,* 2019 Iran	The effect of family centered education on selfcare rate in patients with type 2 diabetes.	To examine effect of family centered education on selfcare rate in patients with type 2 diabetes.	The experimental study sampled	35 patients who were involved in 5 sessions of 60 minutes	relationship between T2DB and memory which is a major thrust	family centered education on selfcare have effect on the rate in patients with type 2 diabetes
6	Sabina, 2019 Kenya	effectiveness of educational intervention on diabetic knowledge & hba1c levels on Kenyan adults with T2DM	To examine effectiveness of educational intervention on diabetic knowledge & hba1c levels on Kenyan adults with T2DM	experimental group was exposed to treatment once in three weeks	143 participants, both male and female, sampled for the study and grouped into experimental and control groups	experimental group was exposed to treatment	Presupposes that a well-structured educational model should be an integral part of Typer II diabetes management in order to improve on patient's self efficacy which is important in lifestyle management. Sabina's study is limited, compare to the current study in the sense that Sabina's study didn't link T2DM with memory capacity
7	Kumar *et al.*, 2019 Pakistan	effectiveness of health education intervention on diabetes mellitus among the teachers working in public sector schools of Pakistan	To examine effectiveness of health education intervention on diabetes mellitus among the teachers working in public sector schools of Pakistan	The quasi-experimental study	139 randomly selected public schools teachers.	intervention is evidence-based regarding it effectiveness in management diabetes among school teachers	close relationship with the current study based on its emphases on the importance of education intervention for the management of DM
8	Chen *et al.* 2020 China	Impact of an educational intervention in primary care on fasting blood glucose levels and diabetes knowledge among patients with type 2 diabetes mellitus in rural China	To examine Impact of an educational intervention in primary care on fasting blood glucose levels and diabetes knowledge among patients with type 2 diabetes mellitus	Randomized clinical trial	1325 Intervention: 665 Control: 660	•Education conferences •Periodic follow-up interviews with physical examination • Specialized medical services	Blood glucose level decreased in the IG compared to the CG: •Difference-in-difference model (DID) = 0.53mmol (95% CI 0.90, to 0.16); *p*=0.005 •Diabetes knowledge score increased significantly in the IG compared to CG: • DID = 0.91 (95 % CI 0.64–1.18)

Table 1. Contd.

S/N	Authors	Title	Goals and objectives	Methodology	Sample and sampling technique	Instrument	Results/findings
9	De la Fuente Coria *et al.,* 2020 (14) Spain	Effectiveness of a primary care nurse delivered educational intervention for patients with type 2 diabetes mellitus in promoting metabolic control and compliance with longterm therapeutic targets: Randomized controlled trial.	To examine Effectiveness of a primary care nurse delivered educational intervention for patients with type 2 diabetes mellitus in promoting metabolic control and compliance with longterm therapeutic targets	Randomized controlled clinical trial	236 Intervention: 97 Control: 139	Structured education provided by a nurse: • Accompaniment to a family member or caregiver • Basic knowledge of diabetes •Use of empowerment model	Glycated hemoglobin (HbA1C) •IG:(−0.55, 95% CI −0.20, −0.90; *p*<0.001) •CG: (0.06, 95% CI −0.14, +0.28, *p*=0.530) •HbA1C <7%: •IG: 35.2% vs. CG: 24.7%
10	Presley *et al.,* 2020 (15) United States	Mobile-Enhanced Peer Support for African Americans with Type 2 Diabetes: a Randomized Controlled Trial	Examine the Mobile-Enhanced Peer Support for African Americans with Type 2 Diabetes	Randomized controlled trial	97 Intervention: 62 Control: 35	Community-based diabetes self-management education and peer support through the mHealth web application: • 12 weekly phone calls • 3 monthly calls	HbA1C reduction after 6 months: •IG: 10.1 (SD 1.7) to 9.6 (SD 1.9) • CG: 9.8 (SD 7) to 9.1 (SD 1.9) • Reduction of diabetes distress in both groups: • *p*<0.001
11	White *et al*., 2020 (16) United States	The Partnership to Improve Diabetes Education Trial: a Cluster Randomized Trial Addressing Health Communication in Diabetes Care.	To examine the Partnership to Improve Diabetes Education	Cluster randomized clinical trial	364 Intervention: 184 Control: 180	Partnership to improve diabetes education: • Literacy-sensitive, provider-centered health communication intervention	Treatment effects on 12 months: Adjusted HbA1C: • IG: (−0.76 [95% CI, −1.08 to -0.44]; *p*<0.001 • CG: (-0.54 [95% CI, - 0.86 to -0.21]; *p*=0.001) • Satisfaction with treatment: • IG: (3.93 [95% CI, 2.48-6.21];*p*<0.001) • CG: (3.04 [95% CI, 1.93-4.77];*p*<0.001) • Self-efficacy: • IG: (2.97 [95% CI, 1.89-4.67]; *p*<0.001) • CG: (1.81 [95% CI, 1.1-2.84];*p*=0.01)
12	Hadziabdic *et al.,* 2020 Sweden	development of a diabetes education model for T2DM migrant patients	beliefs, knowledge, awareness and risk factors of immigrant-patients living in Sweden	identified a gap in previous educational models	immigrant-patients living in Sweden	a theoretical backgrounds about patients' understanding of their health and the corresponding health-related behaviour	They found out that it is crucial for any robust diabetes education model to factor in individual beliefs regarding health and illness and knowledge

Table 1. Contd.

S/N	Authors	Title	Goals and objectives	Methodology	Sample and sampling technique	Instrument	Results/findings
13	Balogh *et al.*, 2020 United Kingdom	key strategies for overcoming psychological insulin resistance in adults with type2 diabetes among the UK subgroup in the emotion study	To examine key strategies for overcoming psychological insulin resistance in adults with type2 diabetes among the UK subgroup in the emotion study	identified lack of understanding and fear of injection as reason for therapy delay in patients	UK subgroup in the emotion	analysed best ways through which T2DM patients	They identified lack of understanding and fear of injection as reason for therapy delay in patients. While emphasizing the importance of insulin in the management of T2DM, they recommended that the procedure should be made easier so as to make patient feel safe and secure for the therapy
14	Association of Diabetes Care and Education Specialists and Kolb, 2021	Effective model of diabetes care and education proposes the ADCES7 Self-Care framework for the behavioural changes expected of a diabetes' patients towards an enhanced self-management	To examine effective model of diabetes care and education proposes the ADCES7 Self-Care framework for the behavioural changes expected of a diabetes' patients towards an enhanced self-management	A pragmatic randomized trial testing nurse-delivered behavioral guidance via phone, with both clinical (e.g. glycemic outcomes) and implementation	proposed a framework capable of ensuring functional education towards self-management of diabetes	To offer a validated, patient-centered behavioral framework (ADCES7) to guide diabetes self-management education and support, driving meaningful behavior change and clinical improvement	Their framework recognizes the important place of a well developed and usage of a Personalized meal plan, gather support, being active, establishing healthy eating patterns, measure portions and monitor intakes
15	Izquierdo, *et al*., 2022 Spain	Educational programs in type 2 diabetes designed for communitydwelling older adults: A systematic review	This systematic review aimed to assess the effectiveness of educational interventions in type 2 diabetes specifically designed for community-dwelling older adults	In accordance with PRISMA guidelines, a systematic search of studies published between 2010 and 2021	In accordance with PRISMA guidelines, a systematic search of studies published between 2010 and 2021	To assess the effectiveness of educational interventions in type 2 diabetes specifically designed for community-dwelling older adults.	Structured DSME programs aimed at older adults have great potential, however there is still room to improve. Applying the principles of a comprehensive gerontological approach and the standards for DSME as continuous monitoring and support could increase their benefits
16	Romero-Castillo *et al.,* 2022 Spain	diabetes management after a therapeutic education program in a qualitative study	To examine diabetes management after a therapeutic education program in a qualitative study	Using an inductive content analysis	The purposive sampling method was used to invite individuals to participate in the study	impact of educational program on the self-management activities of diabetic patients	study revealed that the participants' lifestyles changed significantly after exposure to the intervention programme

Table 1. Contd.

S/N	Authors	Title	Goals and objectives	Methodology	Sample and sampling technique	Instrument	Results/findings
17	Ali *et al.,* 2023 Iran	effect of educational intervention based on PRECEDE model on lifestyle modification, self-management behaviors, and hypertension in diabetic patients	To examine to effect of educational intervention based on PRECEDE model on lifestyle modification, self-management behaviors, and hypertension in diabetic patients	Treatment was exposed within the duration of about 50-55 minutes	300 diabetic patients with hypertension who were split into control and experimental groups in equal halves	This study aims to assess the impact of an educational intervention based on the PRECEDE model on diabetes patients' lifestyle, self-management, and hypertension	Using the t-test, Kolmogorov–Smirnov, and Chi-Square, the results of the analysed data revealed that the PRECEDE model was not only a non-invasive complementary method in the treatment of diabetes
18	Okafor *et al.,* 2023 Nigeria	effect of educational intervention programme on the health-related quality of life (HRQOL) of individuals with type 2 diabetes mellitus in South-East, Nigeria	To examine effect of educational intervention programme on the health-related quality of life (HRQOL) of individuals with type 2 diabetes mellitus in South-East, Nigeria	the quasi-experimental study	the participation of 382 diabetic patients	health-related quality of life (HRQOL) of individuals with type 2 diabetes mellitus	age had a significant implication on the adherence to the self-management guide towards an improved quality of life by the patients, gender has no plac
19	Atolagbe *et al*., 2023 Malaysia	Effectiveness of educational intervention in improving medication adherence among patients with diabetes in Klang Valley, Malaysia	assess the level of medication adherence, medicine and information-seeking behaviour, and the effectiveness of online educational intervention in improving medication adherence and medicine and information-seeking behaviours among patients with diabetes in Klang Valley, Malaysia.	educational intervention, a month of daily general reminders to take their medications and educational materials	Individuals aged 12 years and above with a prior diagnosis of diabetes were identified and randomly divided into (control (n=183), and intervention groups (n = 206).	medication adherence and informationseeking behaviour were obtained	The study concludes that medication adherence and informationseeking behaviours among the study population have been significantly improved after a month of structured intervention. Medication adherence plays a crucial role in risk reduction strategies subsequently it improves the patient's quality of life. Thus, well-planned more robust educational interventions on chronic diseases are warranted to improve the health outcomes of the patients

Table 1. Contd.

S/N	Authors	Title	Goals and objectives	Methodology	Sample and sampling technique	Instrument	Results/findings
20	Okafor *et al.,* 2023 Nigeria	Effect of Educational Intervention Program on Self-Efficacy of Individuals with Type 2 Diabetes Mellitus in South-East, Nigeria	Diabetes Mellitus is a chronic disease, which requires a level of confidence among the sufferers in its management. This study investigated the effect of an educational intervention program on self-efficacy (SE) in diabetic individuals with type 2 diabetes mellitus in South-East, Nigeria	quasi-experimental controlled	The participants were proportionately selected from the 4 tertiary health institutions and assigned to IG and CG using a simple random technique.	Stanford Chronic Disease Self-Efficacy Scale (SCDS). Pretest data were collected,	There was an improvement in most domains of self-efficacy in the intervention group after 6 months of educational intervention.
21	Okafor *et al.,* 2023 Nigeria	Effect of educational intervention programme on the health-related quality of life (HRQOL) of individuals with type 2 diabetes mellitus in South-East, Nigeria	To examine Effect of educational intervention programme on the health-related quality of life (HRQOL) of individuals with type 2 diabetes mellitus in South-East, Nigeria	A quasi-experimental controlled study	three hundred and eighty-two (382) type 2 DM persons recruited from the tertiary health institutions in South East, Nigeria, and randomly assigned to intervention and control groups respectively.	diabetic clinics of the health institutions using the SF – 36 questionnaires	Educational intervention was effective in improving HRQOL in individuals with type 2 DM. Hence, it is recommended for inclusion in all diabetes care plans
22	Mourão *et al*., 2023 Brazil	Effectiveness of a diabetes educational intervention at primary school	to assess the effectiveness of an educational intervention about diabetes for students and school staff	an interventional non-randomized longitudinal study	with the use of theater play and games for students and plus a training for the school staff	interviews were conducted before and after a playful intervention	Actions like these must be encouraged within the school environment, especially in countries with high prevalence of diabetes.

such as home visits or standard care (White *et al*., 2020) Interventions in structured groups have also made it possible to improve the knowledge of patients in relation to DM2, and with this, they have prevented the elevation of HbA1C (Haider *et al*., 2019).

The inclusion of cultural aspects in educational interventions in a Latino population residing in the United States achieved a significant reduction in the HbA1C difference at 3 months (p = 0.043), followed by the reduction difference at 6 months (p = 0.05), and finally at 18 months (p = 0.009) (Pan American Health Organization, 2023). Similarly, a culturally adapted self-care coaching intervention for racial/ethnic minority populations showed significant improvement in blood glucose levels (Chen *et al.,* 2020). Likewise, the individualised educational intervention in a study carried out in

Austria showed significant reductions in weight and cholesterol, but it did not significantly influence metabolic control measured by HbA1C after one year (McGuinness, 2019). With this, physical activity advice as an educational intervention has been effective in promoting a significant reduction in HbA1C 0.5% ($p<0.01$). Additionally, it has left positive results in glycemic control and the health of patients with DM2 (De la Fuente Coria *et al*., 2020). These types of activities that provide accompaniment and support in lifestyle have shown that it is possible to obtain a significant reduction in HbA1C ($p = 0.02$) and in random blood glucose levels ($p = 0.03$) compared to standard care. Thus, approaching the patient as an integral being through empowerment and commitment undoubtedly allows for even more successful interventions for diabetes self-management (Presley *et al*., 2020).

Nursing and its role in educational interventions in patients with DM2

In the development of educational interventions, the multidisciplinary health team plays a fundamental role. However, it is recognised that nursing professionals have a differentiated scope within the team. Patient-centred interventions, which have the execution and accompaniment of the nursing staff, have allowed patients to self-identify their challenges and thus together be able to develop different strategies to overcome them. It has also been shown that the educational strategies that are stimulated by other educational components outside the standard, and that guide the restructuring of behaviors, through education on the disease process, prescribed medication, diet, prescribed exercise, and improvement in coping with the disease by nursing professionals in the care of patients with DM2, it has generated encouraging results (Romero Guevara *et al*., 2019).

A study showed the importance of having professionals who have vast experience in education on DM through various structured and individualised educational interventions. The participants and their caregivers improved autonomy, allowing greater metabolic control and achievement of their long-term therapeutic goals (Romero-Castillo *et al*., 2022). Educational interventions have shown a great role in the care of diseases. The evidence showed that the performance of the nursing professional in the execution of these interventions prevents the increase in HbA1C in patients with diabetes. This is possible through the training of groups with patients with DM2, through familiarisation and training in diabetic education for the identification of risk factors, and the non-compliance with pharmacological treatment when compared to other educating agents (Presley *et al*., 2020).

DISCUSSION

The results of the review made it possible to identify educational interventions in individuals with DM2 in primary health care, which were categorized into four main aspects, representing a challenge for nursing professionals seeking: control of the disease, adherence by the patient to the programs, adherence to the therapeutic regimen, showing to a positive impact on quality of life. Our results were consistent in showing that educational interventions have shown significant impacts on adherence and therapeutic satisfaction. This result agrees with other findings where the patient's adherence to the drug regimen showed a reduction in the severity of complications. It is believed that medication adherence factors in chronic patients can be made up of five major categories, including economic and social factors, the health team, and the patient care system, as well as treatment-related factors. Patient-related factors can be modified through education and increased knowledge (Najafpour and Kalhor, 2021). Likewise, the evidence has shown the positive effects of educational interventions with an emphasis on self-care; these have shown improvements in self-efficacy during the health disease processes faced by the population, highlighting an aspect that becomes relevant and that was evidenced in the results for coping with health conditions, such as empowerment and awareness of the disease. It is also shown that the inclusion approach of the patient and their family environment brings an improvement in knowledge and that it will thus have an influence on the prevention of future complications, such as foot care and other organs that may be affected (Presley *et al*., 2020). Through the application of these educational interventions, different strategies have been implemented, providing educational interventions individually and in groups. However, a meta-analysis supports our findings. It shows significant results to improve knowledge, self-control of the disease based on knowledge about the condition itself, and the treatment and identification of one's abilities.

This consequently brings about the reduction of HbA1C levels in self-care interventions aimed at groups ($p<0.0001$) (De la Fuente Coria *et al*., 2020). Within this review, the relevant role of the use of strategies through technological resources was evidenced, giving an encouraging panorama in the combination of methodologies that seek to adapt to the specific conditions of the population and have shown a favourable impact on the lifestyle of patients presenting a reduction in HbA1C levels up to 0.38%. It also allows secondary results in the improvement of knowledge and other comorbidities, all of which give support for the combination of methodologies that will impact positive results both in the population and in the health system with the use of low-cost strategies (Haider *et al*., 2019). Therefore, showing the very positive results of educational interventions in patients with DM2, the nursing professional plays a very important role in the proper planning and execution of these patient-centered interventions for the self-control of the disease and its role in decision making, demonstrating with this relevant scope in the modification and obtaining of controlled clinical

parameters in patients (Izquierdo *et al*., 2022).

Thus, educational interventions in patients with diabetes mellitus have identified a relevant reference point, when compared to care, not only because it involves compliance with figures between normal values in clinical parameters but also because it allows contributions in the implementation of these programs with different methodologies, multidisciplinary teams, and both individual and group approaches (Presley *et al*., 2020). Although this SR was carried out under PRISMA guidelines, it has some limitations. First, searches were only carried out in MEDLINE, EMBASE, LILACS, Web of Science and gray literature. Second, the analysis of the quality of the included studies showed a lack of information on allocation concealment, blinding of outcomes assessment and blinding of participants and staff in some studies. Lastly, this review did not use the GRADE (Grading of Recommendations, Assessment, Development and Evaluation) methodology to evaluate the degrees of recommendation of the studies selected. Nonetheless, the JBI recommendations were used to assess the level of evidence of the studies.

Conclusion

Critical analysis of the previous scholarly efforts regarding DM generally and T2DM specifically revealed that the place of patients' involvement in the management of DM cannot be overemphasised. The works also showed that patients' involvement should be haphazard, hence the need for an educational intervention program capable of enlightening T2DM patients on their roles and expected activities in the process of self-managing their own health situation. The analysis also indicated that past scholars underscored the importance of careful planning and development, proper implementation, and evaluation of relevant and robust educational interventions for the DM patients in order to properly self-manage their health conditions. And by so doing, there would be less burden. Finally, the empirical studies analysed attested to the importance of such programs, as participants who belonged to the intervention group showed a significant difference in the understanding of their self-management roles compared to their counterparts in the control group. These results were analysed based on their p-value compared against the level of significance of 0.05 alpha level. The findings of this review suggest that educational interventions in patients with DM2 in the primary health care setting can have a positive impact on therapeutic adherence, self-control, and knowledge of the disease. In addition, it was possible to identify the influence of health teams, pointing out the scope of nursing professionals in the construction and implementation of the development of an educational intervention model for people living with Type 2 Diabetes Mellitus in Ekiti and Kwara States for better health outcomes. This way, the value of the performance of the nursing profession in its investigative, academic, practical, and management roles that result in a contribution to the discipline and the community is pointed out.

Recommendations for future research and practice

1. There is a need for a nurse-led educational intervention for people living with Type 2 Diabetes Mellitus that meets up specific culture-sensitive segments in Nigeria, such as the ethnic groupings in Ekiti and Kwara States, because of peculiarities in beliefs about food selection, exercise and other risk factors of T2DM.
2. There is a critical need for empirical evaluation of structured diabetes education programs in Nigeria. Future studies should adapt and test internationally validated models such as DESMOND (Diabetes Education and Self-Management for Ongoing and Newly Diagnosed) and DAFNE (Dose Adjustment for Normal Eating).
3. Finally, to ensure sustainability and relevance, future practice should involve patients and caregivers in the co-development of education content. Healthcare providers, religious leaders, and community stakeholders in program implementation, local and national government, in policy and funding support.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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