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ORIGINAL ARTICLE

Knowledge assessment of self-care activities of diabetes mellitus in a tertiary care hospital

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Abstract

Background Diabetes self-care has been described as an evolutionary, sustainable process of knowledge development in chronic medical conditions. It has been discovered that there is a positive correlation between glycemic control and improvement in quality of life.

Objective This study aims to evaluate the knowledge of self-care activities in type 2 diabetes mellitus(T2DM) and the effect of pharmacist-led intervention in glycemic control using Diabetes Self-Care Management Questionnaire-Revised (DSMQ-R).

Methods The interventional study was conducted among diabetics in a tertiary care hospital for over 6 months. Baseline and follow-up data were analysed using *t*-tests and linear regression to assess changes in knowledge and their relationship with fasting blood sugar (FBS).

Results This study recruited 179 participants, predominantly in the 56–65 age group and mostly male (53%). Importantly 85% with prior T2DM diagnoses, addressing a specific population. The study successfully investigated the link between self-care knowledge and blood sugar control in T2DM patients. While the initial correlation between questionnaire data and fasting blood sugar was moderate ($r = 0.027$, $p = 0.358$), a meaningful 30.46% improvement in participants' knowledge was observed ($p < 0.05$). Notably, half achieved good glycemic control, highlighting the positive impact of education on self-care practices. This confirms the potential of such interventions to empower individuals with T2DM management tools.

Conclusion By demonstrating a significant improvement in knowledge and observing good glycemic control in a substantial portion of participants, the study highlights its potential to empower individuals with T2DM.

Keywords Type 2 diabetes mellitus · Self-care activities · Fasting blood glucose · Diabetes Self-Care Management Questionnaire-Revised (DSMQ-R) · Glycemic control

Introduction

World Health Organization defines diabetes mellitus as a chronic progressive endocrine illness characterized by impaired insulin synthesis or resistance (sensitivity) to insulin or, in a few conditions, both [1]. Diabetes can cause consequential damage to many parts of the body, ultimately leading to multi-organ damage [2]. As a result, the patient must go beyond glycemic management to prevent further microvascular and macrovascular complications through the 7 foundational self-activities of nutritious food, physical activity, medication adherence, coping skills, weight reduction, glucose monitoring and avoidance of social behaviours [3].

In November 2021, International Diabetes Federation estimated around 537 million individuals are living with diabetes mellitus, among which 90 million people

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diagnosed belong to Southeast Asia (20–79 years) with an additional 51 million undiagnosed cases. India is a subcontinent with the highest prevalence of diabetes mellitus, accounting for 87% of the Southeast Asia cases of diabetes mellitus alone. As per International Diabetes Federation (IDF) projection, there will be 152 million individuals with diabetes in the South East Asia area by 2045, up 68% from the current figure, and the prevalence would rise by 30 to 11.3% [4].

Even with so many advancements in clinical and scientific disciplines, diabetes remains one of many difficult chronic diseases to treat for healthcare providers. According to research conducted in Scotland, healthcare professionals have an essential role in patients' comprehension of their glycemic variability when it comes to home care management like medication compliance due to a lack of health-related awareness and negative attitude [3]. The American Diabetic Association has recognized that there was a higher incidence of complications in diabetic patients who had not received any patient counselling regarding self-care behaviour than in patients who have got counselling regarding the same [5]. The goal of diabetic patient treatment is to not only improve glucose control but also to avoid consequences such as impairment and rehabilitation. The American Association of Clinical Endocrinologists also underscores the importance of patients and healthcare providers becoming knowledgeable participants in their diabetes care [3]. It is envisaged that those with the greatest knowledge are likely to have a better comprehension of the condition and a greater effect on its progression and repercussions; therefore, the patients' and their family participation in diabetes self-management education can make a dramatic impact on the development of the disease [6].

Diabetes self-care is the behaviour used by those who have diabetes or are at risk of developing it, to successfully manage it on their own. It necessitates a holistic strategy that requires the patient to adhere to standards such as glucose monitoring, maintaining a healthy weight, a good nutritional diabetic diet, exercising regularly, taking medicines as prescribed, avoiding social habits (smoking, alcohol, etc.) and regular follow-up with their physician [6].

According to a study conducted in Hungary, issues such as price, misconceptions that medications cannot heal diseases, and have influenced diabetes treatment outcomes. There are also other barriers to diagnosing and giving drug therapy such as socio-demographics, hefty drug and equipment costs, patient-provider relationships, limited drug availability and an ignorant attitude, among others. As diabetes cannot be cured, healthcare professionals believe patients' quality of life can be improved through better control of the disease which can be easily accomplished by self-care. Therefore, the responsibility of healthcare providers has been effectively structured.

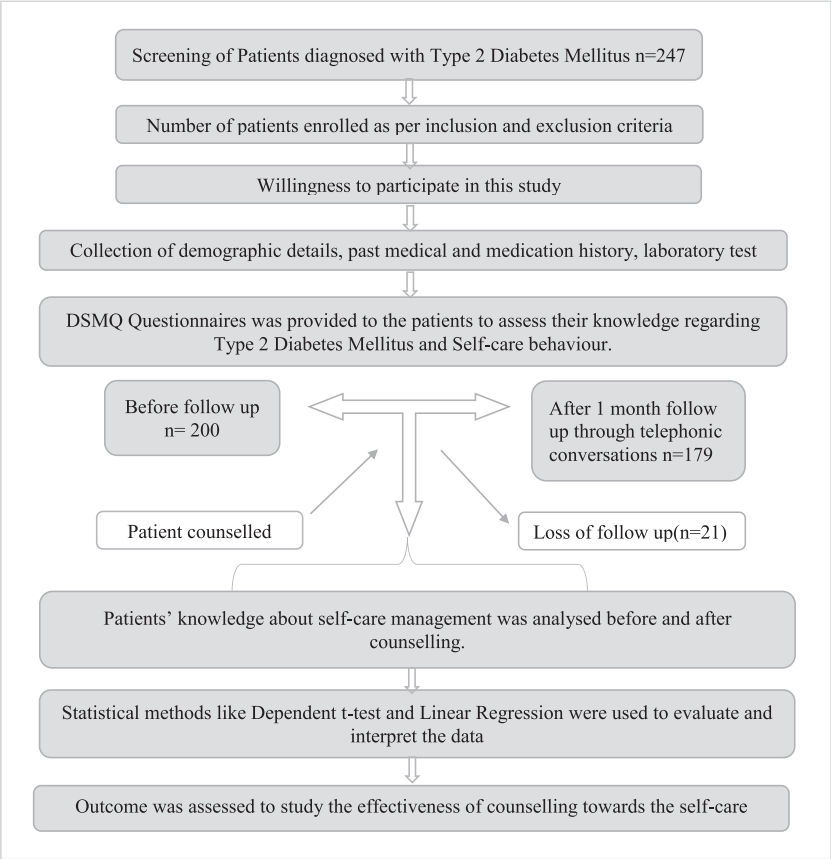

Fig. 1 Study procedure. This figure outlines the steps followed in the study. The process begins with participant recruitment, followed by initial screening and baseline assessment. Participants who meet the study criteria proceed to the intervention phase, which is followed by post-intervention assessments. The final step is data analysis and interpretation

Hence, this study tries to examine how pharmaceutical care can help patients to become more aware of self-care. This current study assesses the knowledge of self-care activities in patients diagnosed with T2DM and uses validated information to educate participants and understand the effect of pharmacist-led education on glycemic control.

Methods and Materials

An interventional study was conducted in a medical research centre from December 2021 to June 2022. Ethical clearance has been acquired from the Institutional Review Board (Ref No; KLE/COP/2021-22/674).

Study design

In-patients and out-patients diagnosed with type 2 diabetes mellitus and aged ≥ 18 years old were selected. Pregnant and breastfeeding women were excluded in addition to patients unable to complete the survey due to psychological/physical disorders or death and candidates who were not able to complete the follow-up. The patient's written consent was procured before the commencement of the study for participation and publication.

Diabetes Self-Care Management Questionnaire-Revised (DSMQ-R)-2021

The DSMQ-R, a diabetic self-care knowledge evaluation tool designed by Dr. Andrew Schmitt, Ph.D., Institute of Diabetes Academy Mergentheim, Germany. The questionnaire has 20+7 items that include glucose control, dietary restriction, physical activity, utilization of healthcare, general perspectives on diabetes treatment and the 7 optional items for patients on intensive-insulin treatment. The patient's responses, which varied from 0 to 3, were used to validate it: 0- "Does not apply to me", 1- "Applies to me to some degree", 2- "Applies to me to a considerable degree" and 3- "Applies to me very much". Scores on the modified scale can range from 0 to 10 such that higher values indicated more successful self-control [7]. Before the final study, the questionnaire was tested for reliability by taking 30 convenient samples. The split-half reliability coefficient was calculated for pre-test scores and it was found to be 0.8913.

Study procedure and intervention

The patients were screened according to the eligibility criteria and enrolled after providing written consent. During baseline evaluation, researchers collected data on participants' sociodemographic, medications, comorbidities, complications and other relevant information alongside self-care measures. To improve diabetes management, participants received a pharmacist-led intervention. This intervention included:

- Face-to-face diabetes education: A peer trained pharmacist delivered personalized 30-min education sessions aligned with American Diabetes Association guidelines [8], covering topics like diet, medication adherence, foot care, blood glucose monitoring, doctor visits and general information about diabetes and its complications.
- Educational materials: Participants received a validated Patient Information Leaflet (PIL) reinforcing the importance of self-care activities like exercise, healthy eating, medication adherence and regular doctor visits.

Table 1 Socio-demographic profile of patients

Demographic profile	No of patients	% of patients
Age groups		
26–35	11	6.15
36–45	18	10.06
46–55	49	27.37
56–65	61	34.08
≥ 66	40	22.35
Sex		
Male	95	53.07
Female	84	46.93
Educational qualifications		
Primary school	89	49.72
Secondary school	49	27.37
Higher secondary school/ diploma	26	14.53
UG/PG	15	8.38
Psychosocial habits		
No habit	122	68.16
Habit	57	31.84
Other parameters	No of patients	% of patients
DM complications		
Retinopathy	14	7.82
Neuropathy	2	1.12
Nephropathy	7	3.91
Diabetic foot	14	7.82
Diabetic ketoacidosis	4	2.23
None	138	77.09
Family history of DM		
Yes	69	38.55
No	110	61.45
Duration of DM		
Newly diagnosed	26	14.53
Previously diagnosed	153	85.47

- Self-monitoring encouragement: Participants were encouraged to keep a record of their blood glucose levels for evaluation.
- Telephone follow-up: After one month, a follow-up call was conducted to assess knowledge gain and adherence to self-care practices. Additionally, participants were reminded to review the PIL for continued guidance on managing their diabetes.

This comprehensive intervention aimed to empower participants with knowledge and tools to actively manage their type 2 diabetes, alongside their routine care provided by doctors and nurses in the Diabetic outpatient department. The complete study procedure is outlined in Fig. 1.

Statistical analysis

Data analysis was performed using SPSS 22.0.0 (IBM SPSS Statistics, New York, USA) using descriptive statistics like frequency and percentage for qualitative characters, and mean, and Standard Deviation for numerical characters. The dependent *t*-test was applied to assess the difference between before and after intervention for numerical characters with normal distribution. Patients with FBS levels < 99 mg/dl were considered to have "good glycemic control", whereas FBS with 100–125 mg/dl were considered prediabetics and > 126 mg/dl as diabetic. The statistical significance was set at a 5% level of significance ($p < 0.05$).

Result

Out of the 200 subjects who were recruited, 21 were excluded because of demise and no follow-up. Therefore, in the final analysis, 179 participants were considered during this pre-post-study. Home visits were not included in the study planning that could have reduced the number of dropouts and missing follow-ups. Most of the sample were male candidates 53% ($n = 96$) diagnosed for more than 5 years (85.47%). The average age of the subjects was 57.6 and those in the age group of 56–65 had the highest prevalence of the disease. The educational qualification of the patients varied from primary schooling (49.72%) to undergraduate/postgraduate, education being the lowest with 8.38%. Under the criteria of habit consumption of alcohol, and tobacco use,122 subjects (68.16%) were on no habits. But on the other hand, 57 (31.84%) had either of the social habits (Table 1). Out of the 179, the number of subjects who faced diabetic complications was only 41 which included 7.82% with retinopathy and diabetic foot, 3.91% with nephropathy, 2.23% with diabetic ketoacidosis and 1.12% with neuropathy.

Fasting blood sugar levels plummeted 52%, with subjects in the target range increasing from 18 to 88 (≥ 126 mg/dl at baseline to ≤ 99 mg/dl on day 30). Linear correlation between the level of self-care and FBS also shows moderate correlation (*r*-0.027) (Table 2). The intervention encouraged positive changes in both attitude and practice, leading to better diabetes management

The dependent *t*-test revealed a mean deviation of 4.64 ± 1.46 DSMQ-R total scores in the pre-analysis and 6.05 ± 1.29 in post-test results, indicating a substantial improvement (30.46%) in the knowledge of the subjects around exhibiting good significance in the study (*p*-value 0.001). People with scores between 6 and 9 made up 53.07% of the cumulative score after the intervention strategy, compared to 16.20% before, which is depicted in Fig. 2.

Table 3 compares the independent variables of the questionnaire at different time points (baseline and follow-up

Table 2 Independent variables of the DSMQ tool

S. No	Variable	Time points	Mean ± SD	% change	*p* value
1.	DSMQ total score	Pre	4.64 ± 1.46	− 30.46	0.0001*
		Post	6.05 ± 1.29		
2.	Dietary control	Pre	4.21 ± 2.23	− 46.37	0.0001*
		Post	6.16 ± 1.59		
3.	Medication adherence	Pre	5.69 ± 2.21	− 29.20	0.0001*
		Post	7.35 ± 1.99		
4.	Glucose monitoring	Pre	3.78 ± 2.36	− 45.20	0.0001*
		Post	5.49 ± 1.85		
5.	Physical activity	Pre	4.49 ± 2.60	− 27.41	0.0001*
		Post	5.72 ± 2.25		
6.	Physician contact	Pre	4.67 ± 1.90	− 21.40	0.0001*
		Post	5.67 ± 2.09		
7.	General view	Pre	5.67 ± 3.08	− 9.56	0.0136*
		Post	6.21 ± 2.64		

*$p < 0.05$

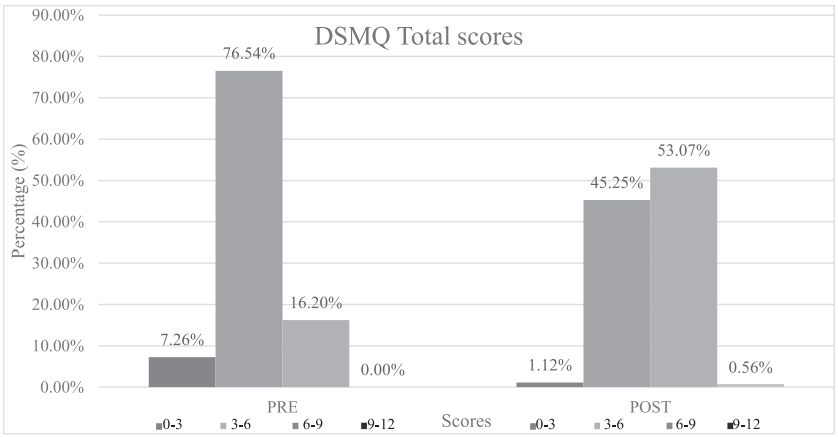

Fig. 2 DSMQ-R scores of pre- and post-analysis. This figure presents a comparison of the Diabetes Self-Management Questionnaire-Revised (DSMQ-R) scores before and after the intervention. The DSMQ score for 6–9 total score range increased significantly from 16% in the pre-analysis phase to 53% in the post-analysis phase

Table 3 Correlation between FBS and DSMQ-R data

Model summary		
r	*r* square	Significance (*p*)
0.027*	0.0001	0.358

$r < 1$(moderately positive correlation)

(day 30)) with a dependent *t*-test. In comparison to other categories like medication adherence (29%), glucose monitoring (45%), physical activity (27%), doctor contact (21%) and general view (9%); there was a substantial change in the percentage for dietary control with 46% from pre to post.

Discussion

The primary objective of this interventional study was to employ the DSMQ-R to examine the association between diabetics' own management of their blood sugar, which revealed inadequate knowledge related to poor diabetic practices. This finding is consistent with the cross-sectional study in Lucknow that found a similar correlation among diabetic patients receiving treatment [9] Additionally, low health literacy might also be a reason [10]. This might be because understanding diabetes helps people develop the problem-solving skills needed to manage it effectively [11].

This study's participant demographics align with existing research showing a higher prevalence of type 2 diabetes among individuals aged 46–65 majority being males [12]. As older adults, they might face challenges in self-care due to coexisting conditions, lifestyle choices, limited health literacy or misconceptions about the disease [12]. As individuals get older, diabetes and poor glucose tolerance become more prevalent [1]. Similar studies in France point to misbeliefs around genetic determinism hindering self-management efforts. But only self-reported activities and outcomes were assessed, which is not completely reliable [13]. Additionally, lack of knowledge about risk factors [14] and the perceived futility of lifestyle changes due to multiple complications [15] can further discourage active engagement in self-care [9]. This resonates with our findings of 22.91% of subjects having diabetic complications, potentially reflecting missed opportunities for prevention through self-care [15]. The average fasting blood sugar during the baseline assessment was > 126 mg/dl which further highlights the potential risk this group faces. This study also discovered that most diabetic patients had uncontrolled diabetes for longer than five years and did not attain the objective targets of FBS (< 99 mg/dl). A longer duration of the condition was positively related to uncontrolled diabetes, according to a study in Jordan [16]. Peer educators delivered 30-min sessions focused on self-care activities, demonstrating the most significant impact on glycemic control and few domains of the DSMQ scale (diet, glucose monitoring, medication adherence) based on our analysis. This, along with educational materials and self-monitoring encouragement, formed our multifaceted intervention.

Effect of self-care on blood glucose levels

The DSMQ-R data and FBS were analysed using linear regression and in addition, there are moderately positive correlation between the level of self-care in type 2 diabetes mellitus patient to FBS ($r = 0.027$, $p = 0.358$). To assess the effect of individual domains with the FBS, descriptive analysis was also done to compare the results. Broadly speaking, there was a significant change in the knowledge aspect of the participants and a positive significance with FBS with the help of pharmacist-led interventions. This remarkable improvement in FBS is significantly greater than reductions observed in a study conducted by Subramanian S.C et al., utilizing similar patient education programs, which typically report reductions in the range of 17% [17].

Table 4 Comparing the FBS levels with categories of final test score in pre- and post-analysis

Categories of total score	≤ 99 mg/dl (target range)		100–125 mg/dl		≥ 126 mg/dl	
	PRE	POST	PRE	POST	PRE	POST
0–3	0	1	1	1	12	0
3–6.	17	32	44	26	76	23
6–9.	1	55	3	13	25	28
9–12.	0	0	0	0	0	1
	18	**88**	**48**	**40**	**113**	**51**

The FBS has shown remarkable improvement in patients with DSMQ scores of 3–6 (32 subjects) and 6–9 (55 subjects) categories compared to the pre-analysis that agrees to the fact that continuous glucose monitoring (CGM) is an essential part of disease prognosis (as shown in Table 4). Further research is warranted to explore the specific mechanisms underlying this exceptional improvement and its long-term sustainability.

While the dependent *t*-test revealed a mean of 4.64 ± 1.46 in the sum score of DSMQ-R during pre-analysis and 6.05 ± 1.29 for post-analysis, indicating a substantial improvement in the knowledge of the subjects around 30.46% with *p* value 0.001 exhibiting good significance, implies that the DSMQ was good psychometrics.

Dietary control

The easier and more effective way to control diabetes would be through lifestyle changes and the participants showed a significant 46% of change indicating their adherence to dietary guidelines, which was possible through the pharmacist-led intervention conducted in this study. Our findings align with a recent meta-analysis of 92 studies from the South Asian region, which reported a significant improvement in dietary scores by an average of 48% following interventions for diabetes management [18]. Around 74% of the population had an improvement in the post scores and further exploration is needed to understand the factors influencing the remaining 26% of participants who did not show significant improvement [19]. Therefore, this study's findings suggest that good dietary behaviour management considerably improves metabolic indicators.

Physical activity

The importance of physical activity and its impact on insulin sensitivity was stressed to the patients that had improved their diabetic knowledge to around 27% compared to the pre-analysis. The results show an improvement in 57.54% of the recruited patients compared to the 19.55% with no change and 22.91% population whose values reduced. This improvement aligns with recommendations suggesting at least 20–30 min of moderate-intensity exercise most days of the week [20, 21]. However, challenges with oedema, pain and foot ulcers were identified as barriers for some participants, suggesting the need for tailored exercise programs that address individual limitations.

Glucose monitoring

Patients were explained to perform random blood sugar tests, A1c tests and fasting blood sugar. They were summarized regarding the use of fingerstick devices, insulin pens and cartridges. Forty-five percent of the change in the current study indicates that the individuals carefully examined their blood sugar levels and only 64.80% of the eligible candidates showed more knowledge than the pre-analysis. Few studies recorded 95% and 49.8% of the people in a study respectively [6, 9], indicating that the intervention was successful in raising metabolic indicators. The total mean score of the fasting blood sugar showed a difference before and after the educational program, especially in newly diagnosed patients (< 5 years of diagnosis).

Medication adherence

In this study, the percentage of change was 29%, showing that many participants took the recommended medication as directed and only 59.78% showed significant improvement in the results after the intervention. In contrast, in the study in Karnataka, just 12.3% of participants "strictly" took the prescription prescribed by the doctor [6]. In Lucknow, the percentage of participants who did so was 95.7% [9]. Participants with habits and those with a family history of diabetes mellitus showed significant improvement ($p < 0.05$) in adherence to medication and care plans. In this study, men seemed to practice better self-care than women. It was in line with a different study that discovered that most women do not obtain treatment for diabetes and give it less priority than males when it comes to treating the condition [22]. But study participants came from a specialized setting and received oral antidiabetics, potentially limiting generalizability

Doctors contact

In contrast to Lucknow, where 100% of subjects kept all their scheduled doctor appointments, the current study's percentage of change showed adherence to regular doctor follow-up at 21% [9]. Only 107 participants showed improvement in the scores about physician follow-up. The pharmacists provided guidelines from the WHO that suggest, seeing a diabetic specialist or physician frequently can help develop a suitable therapy plan, lower the risk of complications and enhance the quality of life among diabetic patients. Targeted interventions for high-risk groups and family involvement may improve diabetic consultations and long-term management [18].

General view

The general aspect of the disease and self-care practice showed less significant change (9%) in this study. This reveals a poor attitude and lack of self-care practice among diabetics. This might be attributed to the short duration of the intervention, the need for more tailored approaches or the influence of unaddressed psychosocial or cultural factors. This contradicts with the Bangalore research suggests family history and social factors also play a crucial role [23]. Future research could explore the specific reasons behind this limited change and investigate the effectiveness of longer-term, personalized interventions, considering the integration of psychosocial support, culturally sensitive approaches and the involvement of family and support systems to further improve patients' attitudes and overall self-care practices.

The current study used a standard questionnaire to assess various areas of diabetes self-care, such as "dietary control," "glucose management," "physical activity," and "healthcare utilization." That revealed that each variable was linked to diabetes self-care knowledge and showed significant change. The current study's findings have offered comprehensive baseline evidence on patients with diabetic self-care practice. This research work also highlights the importance of educational interventions for diabetics' self-management. It can be given in an individual setting, as in this study, or a community situation as well accentuating the relevance of rural diabetes clinics in providing a more practical and cost-effective manner of improving patients' glycemic control and overall condition [6].

Conclusion

To sum up, this study statistically demonstrates the effectiveness of pharmaceutical care in improving both FBS levels and diabetic patients' knowledge and self-care activities, highlighting its valuable contribution to glycemic control. The authors believe that this research would be a powerful catalyst in the better understanding and implementation of self-care practices among type 2 diabetes mellitus patients in India and corroborate the fact that DSMQ-R is a valid and reliable questionnaire that allows for an accurate assessment of self-care behaviour about glycemic management. The importance of sticking to diabetes medication and making lifestyle changes cannot be overstated. These information gaps among diabetics should be addressed by healthcare providers. Regular health education, boosting patient awareness of diabetes and supporting self-care management during treatment will help improve the overall health of diabetic patients also.

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Author contribution DSS: writing—original draft, visualization; AUS: data curation, formal analysis; PAO: methodology, investigation; SS: resources, writing review and editing; AD: conceptualization, supervision.

Data availability The data and materials are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate The research was approved by the institutional ethics committee- Ethics Committee of KLE College of Pharmacy, Belagavi (Ref No; KLE/COP/2021-22/674) and certify that the study was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. Written consent was obtained from the participants.

Consent for publication Written consent of patients was obtained to publish their data.

Competing interest The authors declare no competing interests.

References

1. World Health Organization. Diabetes Available from: https://www.who.int/news-room/fact-sheets/detail/diabetes. Accessed on 07 Mar 2024.
2. DiPiro JT, DiPiro CV, Schwinghammer TL, Wells BG. Pharmacotherapy handbook. McGraw-hill; 2015.
3. Shrivastava SR, Shrivastava PS, Ramasamy J. Role of self-care in management of diabetes mellitus. J Diabet Metabolic Disorders. 2013;12(1):1–5. https://doi.org/10.1186/2251-6581-21-14.

4. Atlas D. International diabetes federation. IDF Diabetes Atlas, 7th edn. Brussels, Belgium: International Diabetes Federation. 2015;33(2). Available from: https://diabetesatlas.org/atlas/tenth-edition/. Accessed on 07 Mar 2024.
5. Funnell MM, Haas LB. National standards for diabetes self-management education programs. Diabetes Care. 1995;18(1):100–16.
6. Shivananda R, Savkar MK, Manchukonda RS, Krishnegowda RS. Self-care practices among type 2 diabetes mellitus patients in rural India. Int J Basic Clin Pharmacol [Internet]. 2020 Oct. 21 [cited 2024 Feb. 18];9(11):1688-94. Available from: https://www.ijbcp.com/index.php/ijbcp/article/view/4387.
7. Schmitt A, Kulzer B, Ehrmann D, Haak T, Hermanns N. A self-report measure of diabetes self-management for type 1 and type 2 diabetes: the diabetes self-management questionnaire-revised (DSMQ-R)–clinimetric evidence from five studies. Front Clin Diabetes Healthcare. 2022;13(2):30.
8. ElSayed NA, Aleppo G, Aroda VR, Bannuru RR, Brown FM, Bruemmer D, Collins BS, Gaglia JL, Hilliard ME, Isaacs D, Johnson EL. 3. Prevention or delay of diabetes and associated comorbidities: standards of care in diabetes—2023. Diabetes Care. 2023 Jan 1;46(Supplement_1): S41-8.
9. Khan MS, Mahmood SE, Ahmad A, Khan AA, Arfin I. Assessment of Self-Care Activities Using Diabetes Self-Management Questionnaire (DSMQ) amongst Diabetes Patients Attending a Rural Health Training Centre in Lucknow. J Evol Med Dental Sci. 2021;10(18):1324–9.
10. Bukhsh A, Nawaz MS, Ahmed HS, Khan TM. A randomized controlled study to evaluate the effect of pharmacist-led educational intervention on glycemic control, self-care activities and disease knowledge among type 2 diabetes patients: A consort compliant study protocol. Medicine. 2018 Mar;97(12).
11. Alruhaim HY, Almigbal TH, Almutairi JS, Mujammami MH, AlMogbel TA, Alrasheed AA, Al Zahrani AM, Batais MA. The association between diabetes numeracy and diabetes self-management among Saudi adults with insulin-treated diabetes. Saudi Med J. 2021;42(5):517.
12. Chentli F, Azzoug S, Mahgoun S. Diabetes mellitus in elderly. Indian J Endocrinol Metabol. 2015;19(6):744.
13. Mosnier-Pudar H, Hochberg G, Eschwege E, Halimi S, Virally ML, Guillausseau PJ, Touboul C, Dejager S. How patients' attitudes and opinions influence self-care behaviours in type 2 diabetes. Insights from the French DIABASIS Survey. Diabetes & metabolism. 2010 Dec 1;36(6):476-83.
14. Mana ST, Mahdi DS, Altemimi MT. The prediction of micro- and macrovascular complications in individuals with T2DM with different risk factors in Iraq. Biomed Pharmacol J. 2022;15(3):1769–82.
15. Shrivastva A, Phadnis S, Rao K, Gore M. A study on knowledge and self-care practices about diabetes mellitus among patients with type 2 diabetes mellitus attending selected tertiary healthcare facilities in coastal Karnataka. Clin Epidemiol Global Health. 2020;8(3):689–92.
16. Bawadi HA, Banks AD, Ammari F, Tayyem RF, Jebreen S. Stage of change of 6 health-related behaviors among patients with type 2 diabetes. Primary care diabetes. 2012;6(4):319–27.
17. Subramanian SC, Porkodi A, Akila P. Effectiveness of nurse-led intervention on self-management, self-efficacy and blood glucose level among patients with type 2 diabetes mellitus. J Complemen Integra Med. 2020;17(3):20190064.
18. Pullyblank K, Scribani M, Wyckoff L, Krupa N, Flynn J, Henderson C, Strogatz D. Evaluating the implementation of the diabetes self-management program in a rural population. Diabetes Spectrum. 2022;35(1):95–101.
19. Diabetes diet: create your healthy-eating plan. Mayo Clinic. 2022. Available from: https://www.mayoclinic.org/diseases-conditions/diabetes/in-depth/diabetes-diet/art-20044295. Accessed on 07 Mar 2024.
20. Pamungkas RA, Chamroonsawasdi K. Self-management based coaching program to improve diabetes mellitus self-management practice and metabolic markers among uncontrolled type 2 diabetes mellitus in Indonesia: a quasi-experimental study. Diabetes Metab Syndrome: Clin Res Rev. 2020;14(1):53–61.
21. Get active | CDC 2022. Available from: https://www.cdc.gov/diabetes/managing/active.html#:~:text=The%20goal%20is%20to%20get,%2C%20shoulders%2C%20and%20arms. Accessed on 07 Mar 2024.
22. Sharma SK, Vishwakarma D, Puri P. Gender disparities in the burden of non-communicable diseases in India: evidence from the cross-sectional study. Clin Epidemiol Global Health. 2020;8(2):544–9.
23. Chinnappan J, Athira KP, Iqbal F, Jasna V, Ashok P, Varghese RS. Assessment of self-care practices among Type 2 diabetic patients in a secondary care teaching hospital. J Drug Deliv Therapeutics. 2020;10(3):119–24.