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"Nurse-Led Diabetic Foot Care Education: Enhancing Foot-Care Knowledge among Adults with Type 2 Diabetes Mellitus

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ABSTRACT: **Background**: Diabetic foot complications are an important cause of morbidity among people with type 2 diabetes mellitus. Adequate knowledge regarding preventive foot care is essential for early recognition of foot problems and prevention of complications. Nurses play an important role in providing structured education and reinforcing appropriate foot-care practices. Aim: To assess the effectiveness of a nurse-led diabetic foot care programme on knowledge regarding diabetic foot care among adults with type 2 diabetes mellitus.

Methods: A quasi-experimental, non-equivalent control group design was adopted. The study was conducted among adults with type 2 diabetes mellitus attending a selected hospital in Lucknow. Participants in the experimental group received a structured nurse-led diabetic foot care programme, while the control group received routine care. Knowledge regarding diabetic foot care was assessed using a structured knowledge questionnaire before and after the intervention.

Results: In the pre-test assessment, 56% of participants had inadequate knowledge, 40% had moderately adequate knowledge and 4% had adequate knowledge. Following the intervention, the proportion of participants with inadequate knowledge decreased to 2%, while the proportion with adequate knowledge increased to 56%. The proportion with moderately adequate knowledge was 42% in the post-test. The overall mean knowledge score increased from 9.91 in the pre-test to 16.20 in the post-test.

Conclusion: The findings demonstrate a substantial improvement in knowledge regarding diabetic foot care following the nurse-led diabetic foot care programme. The findings support the incorporation of structured nurse-led diabetic foot education into routine diabetes care to strengthen preventive foot-care knowledge and self-management.

INTRODUCTION

Diabetes mellitus is a major global public health concern and is associated with considerable morbidity, mortality, disability, and healthcare expenditure. The burden of diabetes has continued to increase worldwide. According to the International Diabetes Federation (IDF) Diabetes Atlas, approximately 589 million adults aged 20–79 years were living with diabetes globally in 2024, and this number is projected to increase substantially in the coming decades [1]. India is among the countries with a substantial burden of diabetes. The ICMR-INDIAB study reported a high prevalence of diabetes and other metabolic non-communicable diseases across different regions of India, emphasizing the need for effective preventive and management strategies [2].

Diabetic foot complications are among the important long-term complications of diabetes mellitus. Diabetes-related foot disease includes conditions such as peripheral neuropathy, peripheral arterial disease, foot deformities, infection, ulceration, and, in severe cases, gangrene and lower-extremity amputation [3]. Diabetic foot ulceration represents a major clinical and

public health problem because it is associated with prolonged treatment, hospitalization, reduced quality of life, disability, and increased healthcare costs [3,4]. A systematic review and meta-analysis reported a global prevalence of diabetic foot ulceration of approximately 6.3% among individuals with diabetes, with a higher prevalence among people with type 2 diabetes [4].

The development of diabetic foot ulceration is multifactorial. Peripheral sensory neuropathy can result in loss of protective sensation, making individuals less likely to recognize trauma or excessive pressure. Peripheral arterial disease, foot deformities, callus formation, previous ulceration, inappropriate footwear, and repetitive mechanical stress can further increase the risk of ulceration [3,5]. A systematic review of diabetic feet at risk of ulceration reported a high prevalence of risk factors among people with diabetes, demonstrating the importance of early risk identification and preventive foot care [5].

Many diabetic foot complications can be prevented or their risk reduced through appropriate preventive measures. Evidence-based recommendations emphasize regular foot assessment, appropriate footwear, foot hygiene, skin and nail care, avoidance of barefoot walking, daily foot inspection, and early reporting of abnormalities to healthcare professionals [6]. The International Working Group on the Diabetic Foot (IWGDF) recommends structured education on foot self-care for people with diabetes, including information regarding foot ulcers and their consequences, protective footwear, regular foot checks, appropriate foot hygiene, and timely professional consultation when foot problems are identified [6].

The American Diabetes Association also recommends comprehensive foot evaluation at least annually to identify risk factors for foot ulcers and amputation. The assessment includes examination of the skin, identification of foot deformities, neurological assessment, and vascular assessment. Individuals with diabetes should also receive education regarding appropriate foot care, including daily foot inspection, skin and nail care, and recognition of abnormalities requiring professional attention [7]. Such recommendations highlight that patient education is an important component of preventive diabetic foot care.

Knowledge regarding diabetic foot care is an important prerequisite for appropriate self-care. Individuals with diabetes need adequate knowledge about the causes and risk factors of diabetic foot complications, daily foot inspection, appropriate hygiene, skin and nail care, footwear selection, prevention of trauma, and early recognition of warning signs. Insufficient knowledge may contribute to inappropriate self-care and delayed recognition of foot problems. A recent systematic review and meta-analysis conducted in India found considerable gaps in diabetic foot-care knowledge, with only a minority of individuals demonstrating good knowledge, highlighting the need for patient-centred and culturally appropriate educational strategies [8].

Nurses have an important role in the prevention and early detection of diabetic foot complications. Through regular patient contact, nurses can assess existing knowledge, identify misconceptions, provide individualized education, demonstrate appropriate foot-care techniques, reinforce preventive behaviours, and encourage timely medical consultation. Nurse-led education can therefore serve as an important component of comprehensive diabetes care.

Evidence from systematic reviews supports the potential value of educational interventions in improving diabetic foot-care knowledge. A systematic review and meta-analysis of diabetic foot-care education found that educational interventions significantly improved knowledge and foot-care behaviour among individuals with diabetes [9]. Similarly, another systematic review examining health education in adults with diabetes reported beneficial effects on podiatric knowledge and self-care outcomes [10]. A broader systematic review and meta-analysis of educational interventions for diabetes-related foot disease found that most included trials demonstrated improvements in diabetic foot knowledge and self-care behaviour, while educational interventions were also associated with reductions in foot-ulcer and amputation outcomes in some analyses [11]. These findings support the importance of structured education as part of preventive diabetic foot care, although variation in intervention content, duration, follow-up, and methodological quality indicates the need for further well-designed studies.

The importance of structured and reinforced education is also emphasized in current international recommendations. The IWGDF recommends that foot-care education should be structured, culturally appropriate, adapted to an individual's risk profile and health literacy, and reinforced periodically [6]. This is particularly relevant in nursing practice because nurses can provide repeated education and reinforcement according to the individual needs of patients.

Need for the Study

Despite the preventable nature of many diabetic foot complications, inadequate knowledge regarding foot care remains a concern. Recent Indian evidence indicates substantial gaps in knowledge, attitudes, and practices related to diabetic foot care among people with diabetes [8]. Patients may be unaware of the importance of daily foot inspection, appropriate footwear,

proper washing and drying of the feet, nail care, avoidance of barefoot walking, prevention of minor trauma, and early reporting of abnormalities. Such knowledge gaps may interfere with the adoption of appropriate preventive behaviours.

Although diabetic foot-care education is recommended by international guidelines, the effectiveness of structured nurse-led educational interventions may vary according to the population, healthcare setting, educational content, duration, and method of delivery [6,9,11]. Therefore, it is important to evaluate structured nursing interventions using measurable outcomes, particularly knowledge regarding diabetic foot care.

A nurse-led diabetic foot-care program can provide systematic education addressing essential aspects of preventive foot care and can allow nurses to identify and address individual knowledge deficits. Evaluation of changes in knowledge following such an intervention can provide evidence regarding the effectiveness of nursing education and may support its integration into routine diabetes care.

Therefore, the present study was undertaken to evaluate the effectiveness of a nurse-led diabetic foot-care program on knowledge regarding diabetic foot care among adults with type 2 diabetes mellitus. The findings may contribute to strengthening preventive nursing interventions and support the incorporation of structured diabetic foot-care education into routine care for individuals with type 2 diabetes mellitus.

AIM

To assess the effectiveness of a nurse-led diabetic foot care programme on knowledge regarding diabetic foot care among adults with type 2 diabetes mellitus

Objectives of the Study

1. To assess the level of knowledge regarding diabetic foot care among adults with type 2 diabetes mellitus before the intervention.

2. To evaluate the effectiveness of a nurse-led diabetic foot-care program on knowledge regarding diabetic foot care among adults with type 2 diabetes mellitus.

Hypotheses

H_0: There will be no significant difference in the pre-test and post-test knowledge scores regarding diabetic foot care among adults with type 2 diabetes mellitus.

H_1: There will be a significant difference in the pre-test and post-test knowledge scores regarding diabetic foot care among adults with type 2 diabetes mellitus.

METHODOLOGY

Research Approach

A quantitative research approach was adopted for the present study.

Research Design

A **Pre-experimental one group pre-test and post-test design** was used to evaluate the effectiveness of a nurse-led diabetic foot-care program on knowledge regarding diabetic foot care among adults with type 2 diabetes mellitus.

The design can be represented as:

Pre-test	Intervention	Post-test
O_1	X	O_2

Where:

- O_1 = Pre-test assessment of knowledge in the experimental group
- O_2 = Post-test assessment of knowledge in the experimental group

- **X** = Nurse-led diabetic foot-care program

Study Setting

The study was conducted in a selected hospital in Lucknow, Uttar Pradesh.

Study Population

The study population comprised **adults with type 2 diabetes mellitus** attending the selected hospitals for treatment and follow-up.

Sample Size

A total of **100 adults with type 2 diabetes mellitus** were included in the study

Sampling Technique

A suitable non-probability purposive sampling technique was used to recruit participants who fulfilled the predetermined eligibility criteria.

Inclusion Criteria

Participants who:

1. Were diagnosed with type 2 diabetes mellitus.
2. Were adults aged 18 years and above.
3. Were available during the period of data collection.
4. Were able to communicate in Hindi or English.

Exclusion Criteria

Participants who:

1. Had a diagnosed severe cognitive or psychiatric condition that interfered with participation.
2. Were critically ill or medically unstable at the time of data collection.
3. Had already participated in a structured diabetic foot-care education program immediately before the study.

Study Variables

Independent variable:
Nurse-led diabetic foot-care program.

Dependent variable:
Knowledge regarding diabetic foot care among adults with type 2 diabetes mellitus.

Tool for Data Collection

Tool 1: Selected demographic variables:
Age, sex, educational status, occupation, place of residence, duration of diabetes, treatment modality, and other relevant variables collected in the study.

Tool 2: Knowledge Questionnaire

A structured knowledge questionnaire consisting of **20 multiple-choice questions** was used to assess knowledge regarding diabetic foot care among adults with type 2 diabetes mellitus. The questionnaire covered diabetic foot complications, risk factors, foot hygiene, daily foot inspection, footwear, nail care, prevention of injuries, and early recognition of foot problems. Each correct response was scored **1** and an incorrect response **0**, with a maximum possible score of **20**. Higher scores indicated better knowledge regarding diabetic foot care.

Description of the Intervention

The nurse-led diabetic foot-care program was developed to provide structured education regarding prevention of diabetic foot complications.

The intervention included information regarding:

- Meaning and importance of diabetic foot care
- Risk factors for diabetic foot complications
- Importance of daily foot inspection
- Foot hygiene and appropriate washing and drying
- Skin care and prevention of dryness and cracks
- Appropriate nail care
- Appropriate footwear
- Avoidance of barefoot walking
- Prevention of foot injuries and burns
- Recognition of early signs of foot problems
- Importance of seeking timely medical care
- General preventive measures for diabetic foot complications

The program was delivered by the researcher using structured teaching methods appropriate for adults with type 2 diabetes mellitus. Educational materials and demonstrations were used as appropriate to reinforce understanding.

Data Collection Procedure

After obtaining permission from the concerned hospital authorities and ethical approval from the appropriate institutional ethics committee, eligible participants were identified according to the inclusion and exclusion criteria. Written informed consent was obtained from each participant before data collection. A pre-test assessment of knowledge regarding diabetic foot care was conducted for the adults with Diabetes using the structured knowledge questionnaire. Following the pre-test assessment, participants received the nurse-led diabetic foot-care program. After completion of the predetermined intervention period, a post-test assessment of knowledge was conducted to participants using the same knowledge assessment tool. Appropriate measures were taken to maintain confidentiality and privacy of participants throughout the study.

Data Analysis

The collected data were coded, tabulated, and analysed using appropriate descriptive and inferential statistical methods.

Descriptive statistics such as frequency, percentage, mean, and standard deviation were used to describe the demographic characteristics and knowledge scores.

Inferential statistics were used to evaluate the effectiveness of the intervention. Appropriate statistical tests, such as the paired *t*-test. The level of statistical significance was set at $\mathbf{p < 0.05}$.

RESULTS

Table 1: Frequency & Percentage of Demographic Variables of Participants (N=100)

S. No.	DEMOGRAPHIC VARIABLES	FREQUENCY	PERCENTAGE
1	Age		

S. No.	DEMOGRAPHIC VARIABLES	FREQUENCY	PERCENTAGE
	a. 30–40 years	24	24%
	b. 41–50 years	32	32%
	c. 51–60 years	28	28%
	d. Above 60 years	16	16%
2	**Gender**		
	a. Male	58	58%
	b. Female	42	42%
3	**Marital status**		
	a. Single	5	5%
	b. Married	82	82%
	c. Divorced/Separated	4	4%
	d. Widowed	9	9%
4	**Religion**		
	a. Hindu	78	78%
	b. Muslim	17	17%
	c. Christian	4	4%
	d. Others	1	1%
5	**Educational status**		
	a. No formal education	18	18%
	b. Primary education	22	22%
	c. Secondary education	27	27%
	d. Higher secondary	18	18%
	e. Graduate and above	15	15%
6	**Occupation**		
	a. Homemaker	24	24%
	b. Self-employed	21	21%
	c. Government employee	12	12%

S. No.	DEMOGRAPHIC VARIABLES	FREQUENCY	PERCENTAGE
	d. Private employee	18	18%
	e. Retired	15	15%
	f. Others	10	10%
7	**Area of residence**		
	a. Rural	57	57%
	b. Urban	43	43%
8	**Duration of Type 2 Diabetes Mellitus**		
	a. Less than 5 years	36	36%
	b. 5–10 years	39	39%
	c. More than 10 years	25	25%
9	**Previous history of diabetic foot ulcer**		
	a. Yes	18	18%
	b. No	82	82%
10	**Previous information regarding diabetic foot-care**		
	a. Yes	38	38%
	b. No	62	62%
11	**If yes, source of previous information**		
	a. Healthcare professional	14	36.8%
	b. Internet/social media	10	26.3%
	c. Television/radio	5	13.2%
	d. Family/friends	4	10.5%
	e. Newspaper/magazines	3	7.9%
	f. Others	2	5.3%
12	**Regular foot-care practice**		
	a. Yes	31	31%
	b. No	69	69%

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Table2: Distribution of Participants According to Level of Knowledge Regarding Nurse-Led Diabetic Foot-Care Intervention for Prevention of Foot Ulcer in Pre-test and Post-test (N=100)

S. No	Level of knowledge	Pre-test			Post-test		
		Frequency	Percentage	Mean	Frequency	Percentage	Mean
1.	Inadequate	56	56 %		2	2 %	
2.	Moderately Adequate	40	40 %	**9.91**	42	42 %	**16.2**
3.	Adequate	04	04 %		56	56 %	

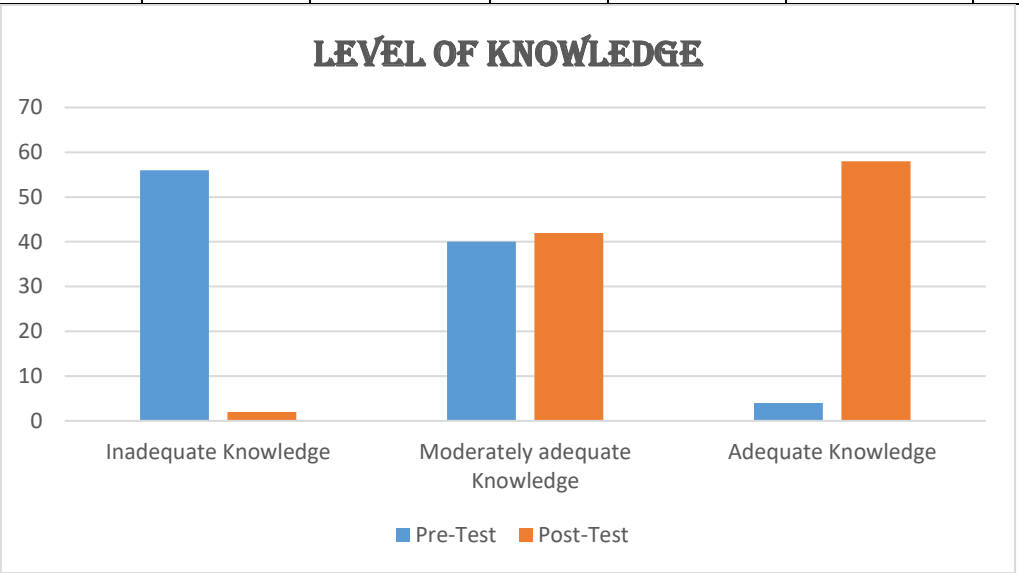


Figure 1: Level of knowledge regarding prevention of foot ulcer before & after Nurse Led Diabetic Foot Care Programme.

Figure 1 showed that in the pre-test assessment, the majority of participants (**56%**) had inadequate knowledge regarding diabetic foot care. Forty percent had moderately adequate knowledge, whereas only 4% demonstrated adequate knowledge. Following the nurse-led diabetic foot care programme, a substantial improvement in knowledge was observed. The proportion of participants with inadequate knowledge decreased from **56% to 2%**. The proportion with adequate knowledge increased from **4% to 56%**, while 42% demonstrated moderately adequate knowledge in the post-test. The overall mean knowledge score increased from **9.91 in the pre-test to 16.20 in the post-test**, representing an absolute increase of **6.29 points**.

Table 3: Comparison of Pre-test and Post-test Knowledge Scores Regarding Diabetic Foot Care

S. No	Assessment	Mean	SD	Mean Difference	Paired *t* value	*p* value
1	Pre-test	9.91	3.275	**6.29**	**1.3188**	**0.010***
2	Post-test	16.20	2.605			

*p < 0.05 = Level of Significance

Table 2 presents the comparison of pre-test and post-test knowledge scores regarding diabetic foot care among adults with type 2 diabetes mellitus who participated in the nurse-led diabetic foot care programme. The mean knowledge score increased from **9.91 ± 3.275** in the pre-test to **16.20 ± 2.605** in the post-test. The mean difference between the pre-test and post-test scores was **6.29**, indicating an improvement in knowledge following the intervention. The paired *t*-test demonstrated a statistically significant difference between the pre-test and post-test knowledge scores (**t = 2.638, df = 99, p = 0.010**, two-tailed). Thus, the findings indicate that the nurse-led diabetic foot care programme was associated with a significant improvement in participants' knowledge regarding diabetic foot care.

DISCUSSION:

The present study demonstrated a substantial improvement in knowledge regarding diabetic foot care following implementation of the nurse-led diabetic foot care programme. In the pre-test, **56% of participants had inadequate knowledge**, 40% had moderately adequate knowledge, and only 4% had adequate knowledge. Following the intervention, the proportion of participants with inadequate knowledge decreased markedly to **2%**, while the proportion with adequate knowledge increased to **56%**. This shift in the distribution of knowledge levels indicates that the educational intervention addressed important gaps in participants' baseline understanding of diabetic foot care.

The finding of inadequate baseline knowledge is consistent with recent evidence from India. Naik et al. conducted a systematic review and meta-analysis involving **20 studies from 13 Indian states and two Union Territories** and reported that only **32% of participants had good knowledge** regarding diabetic foot care, while substantial gaps in preventive foot-care practices were also identified. The authors emphasized the need for culturally appropriate, patient-centred and inter-professional educational strategies to strengthen diabetic foot-care knowledge and practices in India. [8] Thus, the inadequate baseline knowledge observed in the present study is consistent with the broader Indian evidence and highlights the need for structured diabetic foot-care education.

The marked improvement in the present study is supported by Yıldırım Ayaz et al., who conducted a systematic review and meta-analysis of diabetic foot-care education interventions. Twenty-six studies were included in the systematic review, and the meta-analysis demonstrated a significant improvement in knowledge following diabetic foot-care education (**SMD 1.656, 95% CI 1.014–2.299, p < 0.001**). The authors concluded that diabetic foot education improves knowledge and foot-care behaviour among people with diabetes. [13] The substantial shift from inadequate to adequate knowledge observed in the present study is therefore consistent with the evidence supporting structured educational interventions.

The improvement was also reflected in the **mean knowledge score**, which increased from **9.91 ± 3.275 in the pre-test to 16.20 ± 2.605 in the post-test**, giving a mean difference of **6.29 points**. The paired *t*-test demonstrated a statistically significant difference between the pre-test and post-test scores (**t = 2.638, df = 99, p = 0.010; two-tailed**). This finding indicates that participants' knowledge improved significantly following the nurse-led diabetic foot care programme.

The observed improvement in mean knowledge score is supported by Drovandi et al., who synthesized evidence from **29 randomized controlled trials involving 3,891 participants**. Their review found that educational programmes significantly improved diabetes-related foot-disease knowledge in **13 of 16 trials** reporting knowledge outcomes and improved self-care behaviour in **19 of 20 trials**. [11] The consistency between these findings and the present study suggests that structured educational interventions can be effective in improving patients' understanding of diabetic foot prevention and self-care.

The effectiveness of the present intervention may be related to its **nurse-led and structured educational approach**. Nurses have regular opportunities to educate patients, demonstrate preventive practices, clarify misconceptions and reinforce appropriate self-care behaviours. The educational programme in the present study addressed practical aspects of diabetic foot prevention, including daily foot inspection, foot hygiene and appropriate footwear, prevention of injury and recognition of early warning signs. Such focused education may have helped participants translate information into a better understanding of preventive foot care.

Further support for the nurse-led approach comes from the randomized controlled trial conducted by Polat et al. among adults with type 2 diabetes mellitus. Their nurse-led self-efficacy-based hybrid diabetic foot self-management education programme resulted in significant improvements in diabetic foot knowledge, foot-care behaviours and self-efficacy compared with the control condition. [14] These findings support the role of nurses not only as providers of information but also as facilitators of self-management and reinforcement of preventive behaviours.

The content of the present intervention is also consistent with recommendations of the International Working Group on the Diabetic Foot (IWGDF). The IWGDF recommends education and reinforcement of protective foot-care behaviours for people with diabetes who are at risk of foot ulceration. Recommended preventive measures include regular foot examination, appropriate foot hygiene, careful drying of the feet, appropriate nail care, suitable footwear and avoidance of barefoot walking. [15] Therefore, the improvement observed in the present study may be clinically meaningful because the knowledge assessed was directly related to recommended preventive foot-care behaviours.

The reduction in inadequate knowledge from **56% to 2%** and the corresponding increase in adequate knowledge from **4% to 56%** are particularly important from a nursing perspective. These findings suggest that a structured educational programme can address substantial knowledge gaps within a relatively short period. However, knowledge acquisition should be regarded as an important intermediate outcome rather than direct evidence of prevention of diabetic foot ulcers. Knowledge does not necessarily guarantee sustained adherence to recommended behaviours.

This distinction is supported by Drovandi et al., whose meta-analysis found improvements in knowledge and self-care behaviour following educational interventions and also reported a reduction in the risk of amputation; however, the authors noted limitations in the available evidence and recommended larger, higher-quality trials with longer follow-up. [11] Similarly, previous systematic evidence indicates that educational interventions can improve knowledge and self-care behaviour, but evidence regarding longer-term clinical outcomes requires further investigation. [8]

The findings therefore have important implications for nursing practice. Diabetic foot-care education can be incorporated into routine nursing services in outpatient clinics, inpatient diabetes units and follow-up programmes. Education should not be restricted to a single session; periodic reinforcement, demonstration and assessment of patients' understanding may help sustain preventive behaviours. The recent Indian evidence demonstrating persistent gaps in diabetic foot-care knowledge further supports the need for systematic education as part of diabetes management. [13]

Overall, the present study demonstrates that the nurse-led diabetic foot care programme was associated with a **significant improvement in participants' knowledge regarding diabetic foot care**, as demonstrated both by the shift in knowledge categories and by the significant increase in the mean knowledge score. The findings are consistent with systematic reviews and recent randomized evidence supporting structured diabetic foot-care education as an important component of diabetes self-management and diabetic foot-ulcer prevention.

CONCLUSION

The present study demonstrated that the nurse-led diabetic foot care programme was effective in improving knowledge regarding diabetic foot care among adults with type 2 diabetes mellitus. A marked improvement was observed in the level of knowledge and mean knowledge scores following the intervention, with a statistically significant difference between pre-test and post-test scores. The findings highlight the importance of structured nurse-led education in strengthening patients' knowledge and promoting preventive diabetic foot-care practices. Regular diabetic foot-care education may therefore be incorporated into routine nursing care for individuals with type 2 diabetes mellitus to support early recognition and prevention of foot-related complications.

Limitations

1. The study was conducted in selected hospitals in Lucknow; therefore, generalization of the findings to all adults with type 2 diabetes mellitus should be made cautiously.

2. The study used a quasi-experimental design rather than individual randomized allocation.

3. Knowledge was assessed using a questionnaire and therefore depended on participants' responses.

4. The present analysis primarily demonstrates improvement in knowledge; longer-term clinical outcomes such as diabetic foot ulcer development were not assessed in the reported table.

5. Longer follow-up would be useful to determine whether improvement in knowledge is sustained.

Recommendations

1. Structured diabetic foot-care education should be incorporated into routine nursing care for people with diabetes.

2. Periodic reinforcement sessions should be provided to maintain preventive foot-care knowledge.

3. Future studies should evaluate changes in actual foot-care practices in addition to knowledge.

4. Future research should use larger samples and longer follow-up periods.

5. Multicentre randomized controlled studies may provide stronger evidence regarding the effectiveness of nurse-led diabetic foot-care programmes.

6. Future studies should examine clinical outcomes such as foot lesions, diabetic foot ulcers, hospitalization and amputation.

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