Original Research Article

Empowering Staff Nurses: Enhancing Knowledge of Diabetic Ketoacidosis through an Educational Package in a Gurugram Hospital

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Abstract: Diabetic ketoacidosis (DKA) represents a serious acute complication of diabetes mellitus that necessitates immediate identification and intervention. Nurses serve as primary responders in the management of diabetic ketoacidosis (DKA); however, significant knowledge gaps remain, especially in resource-constrained environments. The purpose of this study is to analyze the effect of a structured educational training program on staff nurses' knowledge regarding diabetic ketoacidosis (DKA) at a tertiary hospital located in Gurugram, Haryana. Approach: A pre-experimental one-group pre-test post-test design was implemented involving 60 purposively selected staff nurses at SGT Hospital. A validated structured knowledge questionnaire on diabetic ketoacidosis, comprising 20 multiple-choice questions, was administered prior to and seven days following a 60-minute interactive teaching session. Data were analysed through descriptive statistics and paired t-tests; associations with demographic variables were evaluated using Chi-square tests. Results: In the pre-test, 48.3% of participants exhibited inadequate knowledge, 51.7% demonstrated moderate knowledge, and none achieved adequate knowledge. Post-intervention, no participant exhibited inadequate knowledge; 65.0% demonstrated moderate knowledge, while 35.0% attained adequate knowledge. Mean knowledge scores increased significantly from 10.46 ± 1.55 to 14.73 ± 1.62 (mean difference = 4.27; t = 13.31; p < 0.05). No significant associations were identified between pre-test scores and demographic variables, including dietary pattern (p = 0.193) and source of information (p = 0.522). The structured educational training program markedly improved nurses' understanding of DKA. Integrating regular in-service training and DKA-focused modules into nursing curricula enhances preparedness and patient outcomes.

Keywords: Diabetic Ketoacidosis, Nursing Education, Structured Teaching Programme, Knowledge Assessment, Pre-Experimental Study.

INTRODUCTION

Diabetes mellitus (DM) is a chronic, progressive metabolic disorder characterised by persistent hyperglycaemia due to defects in insulin secretion, insulin action, or both [1]. It has quickly become one of the most urgent and daunting public health challenges facing our world today. The International Diabetes Federation (IDF) estimates that over 463 million adults worldwide have diabetes, and this number is projected to reach 700 million by 2045. if current trends persist [2]. The burden is particularly alarming in low- and middle-income countries, where health systems face resource constraints and limited access to specialist care [3].

India, home to the world's second-largest diabetic population, faces a rapidly escalating epidemic, with approximately 77 million adults living with the condition in 2019 [2]. The Indian Council of Medical Research's national survey has documented a rising prevalence across both urban and rural populations, attributed to sedentary lifestyles, dietary transitions, and increasing obesity rates [4]. This growing disease burden has also been accompanied by a rise in

acute metabolic complications such as diabetic ketoacidosis (DKA), which contribute significantly to morbidity, mortality, and healthcare costs [5].

Diabetic Ketoacidosis: A Serious Acute Complication

DKA is a potentially life-threatening medical emergency that results from absolute or relative insulin deficiency, leading to uncontrolled hyperglycaemia, metabolic acidosis, and ketosis [6]. Most common in type 1 diabetes mellitus (T1DM), but increasingly recognized in type 2 diabetes mellitus (T2DM) under stress (infection, myocardial infarction, or poor treatment adherence) [7, 8].

The pathophysiology of DKA involves a cascade of metabolic derangements. Insulin deficiency and elevated counter-regulatory hormones (glucagon, catecholamines, cortisol, growth hormone) stimulate hepatic gluconeogenesis and lipolysis, This leads to an increase in free fatty acids, which the liver then converts into ketone bodies such as acetoacetate and β-hydroxybutyrate [9]. The accumulation of ketones leads to metabolic acidosis, while osmotic diuresis from hyperglycaemia causes dehydration, electrolyte loss, and, in severe cases, circulatory collapse [6-9].

Clinically, DKA presents with polyuria, polydipsia, nausea, vomiting, abdominal pain, dehydration, tachypnoea with Kussmaul respiration, altered sensorium, and in some cases, coma [10]. Without timely recognition and intervention, DKA can rapidly progress to cerebral oedema, acute kidney injury, arrhythmias, and death [11]. Mortality rates vary globally, from <1% in high-resource settings to >10% in resource-limited regions, often due to delays in diagnosis or inadequate management [12].

Global and National Burden

International data indicate that DKA accounts for 8–29% of hospital admissions for acute diabetes-related complications [13]. In the United States, despite advances in diabetes care, DKA incidence has been rising, particularly among younger adults and those with poor glycaemic control [14]. In India, the exact national prevalence of DKA is underreported, but regional studies suggest it remains a significant cause of emergency admissions among people with diabetes, including those newly diagnosed [15]. Contributing factors in the Indian context include delayed healthcare seeking, poor treatment adherence, inadequate patient education, and insufficient awareness among healthcare providers [16].

Role of Nurses in DKA Management

Nurses occupy a frontline position in the prevention, early recognition, and management of DKA. They are often the first healthcare professionals to encounter patients with symptoms suggestive of acute metabolic decompensation [17]. Their responsibilities include monitoring vital signs and biochemical parameters, initiating prompt insulin and fluid therapy, managing electrolyte imbalances, and educating patients and families about prevention and self-care [18].

However, multiple studies have documented substantial knowledge gaps among nurses regarding the pathophysiology, clinical features, and evidence-based management of DKA [19-21]. These deficits may be due to limited exposure to acute diabetic emergencies, lack of ongoing professional development opportunities, and variability in institutional protocols [22]. Such gaps can lead to delays in diagnosis, inappropriate treatment, and poor patient outcomes [23].

Need for Educational Interventions

Evidence from diverse healthcare settings demonstrates that structured educational programmes can significantly enhance nurses' knowledge and skills in managing DKA [24-26]. Training interventions particularly those combining didactic sessions with case-based discussions and clinical simulations—have been shown to improve diagnostic accuracy, expedite initiation of appropriate therapy, and reduce complications [25, 26]. Furthermore, trained nurses are better positioned to provide patient-centred education, which is essential for preventing recurrent DKA episodes [27].

Given the high prevalence of diabetes in India and the rising incidence of acute complications, there is a critical need to strengthen nurses' competencies in DKA management through targeted educational interventions. This is particularly relevant in tertiary care hospitals, where nurses care for high-acuity patients but may not receive routine, structured updates on evolving clinical guidelines [28].

AIM: The aim of this research is to assess the impact of a structured educational training program on the understanding of staff nurses concerning diabetic ketoacidosis (DKA) at a tertiary hospital situated in Gurugram, Haryana.

OBJECTIVES
1. To assess baseline knowledge of DKA among staff nurses.
2. To assess the impact of an educational training program on the knowledge of nurses.

3. To compare pre- and post-intervention knowledge scores.
4. To identify associations between knowledge scores and selected demographic variables.

By addressing knowledge gaps through structured education, this study aims to contribute to improved clinical preparedness among nurses, ultimately enhancing patient outcomes and reducing the burden of DKA-related complications.

METHODOLOGY

Study Design

A one-group pre-test and post-test was utilised to assess nurses' DKA knowledge after a structured educational training program. This method ensured that only the same participants saw the knowledge change before and after the intervention. Thus, group differences were hidden.

Setting

The study was conducted at Shree Guru Gobind Singh Tricentenary (SGT) Hospital, Gurugram, Haryana, India. The hospital is a tertiary care facility affiliated with SGT University and caters to both rural and urban populations. The setting was selected because of its large nursing workforce and frequent admission of patients with diabetes and its complications, including DKA.

Population

The target population consisted of registered staff nurses employed at SGT Hospital.

Inclusion Criteria
- Registered staff nurses currently working in SGT Hospital.
- Nurses willing to participate and provide informed consent.
- Nurses available during the data collection period.

Exclusion Criteria
- Nurses who had undergone formal training on DKA within the last six months.
- Nurses on extended leave or unavailable during the study period.

Sample and Sampling Technique

A total of 60 staff nurses were selected using non-probability purposive sampling. This approach ensured the inclusion of participants who met the eligibility criteria and were most likely to benefit from the educational intervention.

Study Variables
- **Independent Variable:** Structured educational training programme on DKA.
- **Dependent Variable:** Level of knowledge regarding DKA among staff nurses.
- **Demographic Variables:** Age, gender, educational qualification, dietary pattern, and source of information regarding DKA.

Development of the Tool

A structured knowledge questionnaire was developed based on current clinical guidelines and relevant literature on DKA management [6-18].

Scoring:
- Correct answer = 1 point; Incorrect answer = 0 points.
- Knowledge level classification:
  - **Inadequate**: < 50% (0–10 points).
  - **Moderate**: 51–75% (11–15 points).
  - **Adequate**: > 75% (16–20 points).

Validity and Reliability of the Tool

A panel of eight experts in nursing, endocrinology, and medical education established the questionnaire's content validity. Modifications were made based on their feedback regarding clarity, relevance, and coverage. Reliability was assessed using the split-half method, and the tool demonstrated a reliability coefficient (r) of 0.82, indicating high internal consistency.

Data Collection Procedure
The study was conducted in the following phases:
1. **Pre-test:**
   o The structured knowledge questionnaire was administered to all participants in a demonstration room setting within the hospital premises.
   o The average completion time was 20 minutes.

2. **Intervention:**
   o A structured educational training programme on DKA was delivered on the same day after the pre-test.
   o The session lasted 60 minutes and included PowerPoint presentations, case-based discussions, visual aids (charts, pamphlets), and interactive Q&A session.

3. **Post-test:**
   o Conducted seven days after the intervention using the same questionnaire to assessment of knowledge.

Data Analysis
Descriptive and inferential statistics will be employed. Frequency and percentage will characterize the chosen personal variables, while mean, median, and standard deviation will evaluate the educational training program regarding Diabetic Ketoacidosis and its prevention among staff nurses at SGT Hospital and Research Centre, Gurugram. A paired "t" test will compare pre-test and post-test knowledge scores to evaluate the program, and a chi-square test will analyse the relationship between demographic characteristics and post-test knowledge scores. Statistical significance was defined as p-value < 0.05.

RESULTS
Participant Characteristics
A total of 60 staff nurses participated in the study. Table 1 summarises their demographic characteristics. The majority were female (60%), aged between 26–30 years (50.0%), and held a B.sc Nursing qualification (53.4%).

Table 1: Demographic characteristics of participants (N= 60)

| Variable	Category	Frequency (n)	Percentage (%)
Age (years)	20 - 25years	20	33.3%
	26 - 30 years	30	50.0%
	31 and above	10	16.7%
Gender	Male	24	40%
	Female	36	60%
Educational Qualification	GNM	14	23.3%
	Post Basic B.Sc. Nursing	14	23.3%
	B.Sc. Nursing	32	53.4%
	M.Sc. Nursing	0	0%
Dietary Pattern	Vegetarian	18	30%
	Non-Vegetarian	12	20%
	Eggetarian	30	50%
Source of DKA Information	Curriculum/Teachers	15	25%
	Friends	4	6.7%
	Experience with DKA patients	23	38.3%
	Medical personnel	18	30%

Pre-Test Knowledge Levels
In the pre-test, 48.3% (n = 29) of participants demonstrated inadequate knowledge (<50% score), 51.7% (n = 31) had moderate knowledge (51–75% score), and none achieved adequate knowledge (>75% score). The mean pre-test score was 10.46 ± 1.55, corresponding to 52.3% of the maximum possible score.

Post-Test Knowledge Levels
Following the structured educational programme, none of the participants fell into the inadequate knowledge category. A majority, 65.0% (n = 39), had moderate knowledge, while 35.0% (n = 21) achieved adequate knowledge levels. The mean post-test score increased to 14.73 ± 1.62 (73.65% of the total possible score).

Table 2: Distribution of participants by knowledge level in pre-test and post-test (N = 60)

Knowledge Level	Score Range	Pre-test n (%)	Post-test n (%)
Inadequate	0–10	29 (48.3)	0 (0.0)
Moderate	11–15	31 (51.7)	39 (65.0)
Adequate	16–20	0 (0.0)	21 (35.0)
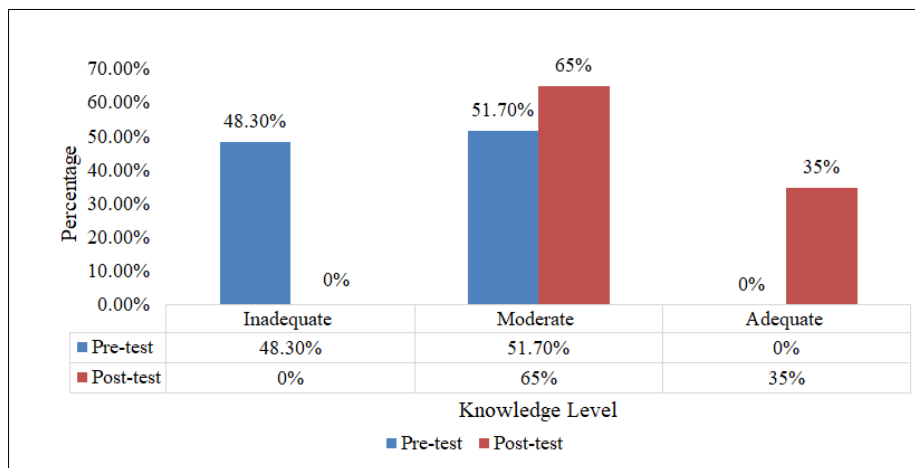
Figure 1

Effectiveness of Educational Training Programme

A paired t-test revealed a statistically significant improvement in mean knowledge scores from pre-test to post-test (mean difference = 4.27, t = 13.31, $p < 0.05$), indicating the programme's effectiveness.

Table 3: Mean scores from before and after the test (n = 60)

Test	Mean ± SD	Mean Difference	t-value	p-value
Pre-test	10.46 ± 1.55	4.27	13.31	<0.05*
Post-test	14.73 ± 1.62			

*Level of Significance at $p < 0.05$.

Association between Pre-test Knowledge and Demographic Variables

No statistically significant association was found between pre-test knowledge scores and demographic variables such as dietary pattern (Chi-square = 1.737, p = 0.193) or source of information (χ^2- value = 0.759, p = 0.522).

Table 4: Analysis of the association between pre-test knowledge scores and demographic variables among nurses

Demographic Variable	N	Mean	SD	χ^2- value	df	P-Value
Age in year						
21-25 years	20	15.100	1.61	1.288	2	0.284
26-30 years	30	14.700	1.55			
31 & above	10	14.100	1.79			
Gender						
Male	24	15.208	1.58	3.568	1	0.064
Female	36	14.416	1.59			
Education						
GNM	14	14.142	1.46	2.506	2	0.091
B.Sc. Nursing	32	15.156	1.43			
Post Basic BSc Nursing	14	14.357	1.98			
Dietary Pattern						
Vegetarian	14	14.484	1.54	1.737	1	0.193
Non-Vegetarian	12	14.037	1.69			
Eggetarian	30	15.400	1.87			
Source of Information						
Curriculum /Teachers	15	14.200	1.39			
Friends	4s	14.555	1.01	0.759	3	0.522
Experience with diabetic ketoacidosis patient prior	23	15.087	1.70			
Medical personnel	18	14.666	1.87			

DISCUSSION

The present study evaluated the effectiveness of a structured educational training programme on staff nurses' knowledge regarding diabetic ketoacidosis (DKA) at a tertiary care hospital in Gurugram, Haryana. The findings revealed a significant improvement in knowledge levels following the intervention, indicating that targeted education can effectively bridge existing knowledge gaps.

Baseline Knowledge and Identified Gaps

At baseline, nearly half of the participants (48.3%) demonstrated inadequate knowledge of DKA, with none achieving an adequate knowledge score. This suggests that despite working in a tertiary hospital, many nurses may not be adequately prepared to manage acute diabetic emergencies. Similar deficits have been reported in other settings. For instance, Barski L *et al*., [7], and Hassen *et al*., [29], found that over half of nurses working in paediatric and critical care units lacked sufficient understanding of DKA management, particularly with respect to fluid therapy and electrolyte balance.

These gaps may stem from several factors: limited exposure to DKA cases in certain clinical units, insufficient in-service training, and variability in institutional protocols. In India, where formal continuing nursing education is not uniformly mandated, the risk of outdated or incomplete clinical knowledge is heightened [16].

Impact of the Educational Programme

Following the intervention, the proportion of participants achieving adequate knowledge increased from 0% to 35%, while no one was left in the inadequate category. The average knowledge score went up from 10.46 ± 1.55 to 14.73 ± 1.62, and this increase was meaningful ($p < 0.05$). This aligns with studies by Mekky *et al*., [30], and Shaker *et al*., [31], both of which reported substantial post-training gains in nurses' knowledge and practice related to DKA.

The structured approach of this programme integrating theoretical content with interactive discussions and visual aids likely contributed to improved retention, as supported by educational theory and previous empirical findings [25]. Furthermore, the seven-day gap between intervention and post-test suggests that the improvement was not merely due to immediate recall, but reflected short-term retention of knowledge.

Comparison with Other Studies

The results are consistent with findings from Allotey *et al*., [32], who documented significant knowledge gains among nurses in Ghana following a similar educational intervention on DKA management. In their study, nurses with prior exposure to DKA cases or previous training performed better post-intervention a pattern also observed in the current research, although the association between prior exposure and baseline scores was not statistically significant here.

Internationally, structured educational programmes have shown similar benefits. Esmail SEM *et al*., [33], on diabetes education for nursing students found improvements in knowledge in over 60% of reviewed interventions, especially when using interactive or technology-enhanced methods. While our study used traditional classroom-based teaching, the effectiveness suggests that even low-cost, resource-appropriate methods can yield substantial improvements in LMIC contexts.

Association with Demographic Variables

In the present study, no significant association was found between pre-test knowledge and demographic factors such as dietary pattern or source of information. This contrasts with Hassan A *et al*., [34], who found that age and educational exposure significantly influenced DKA awareness among patients. This finding is supported by Prajapati *et al*., (2021), who also found no significant link between nurses' knowledge of diabetic complications and their demographic characteristics. Similarly, Shrestha *et al*., (2020) reported that factors like age and education level did not significantly influence pre-test knowledge scores regarding DKA. The difference may be due to the relatively homogeneous professional background of our participants all being registered nurses with similar clinical roles which could minimise demographic variability in knowledge.

Implications for Practice

Given the critical role nurses play in early detection and management of DKA, regular in-service education should be institutionalised in hospital settings. Incorporating DKA management into mandatory clinical competency updates could help maintain high preparedness levels. Additionally, simulation-based training could further strengthen clinical decision-making skills and readiness for emergencies [25].

Limitations

The study's pre-experimental design, while practical, lacks a control group, which limits the ability to attribute all observed changes solely to the intervention. The sample was drawn from a single tertiary hospital, which may limit

generalisability. Additionally, the follow-up period was short; longer-term studies are needed to assess sustained knowledge retention and translation into clinical practice.

CONCLUSION

The findings of this study confirm that a structured educational training programme is effective in improving staff nurses' knowledge regarding diabetic ketoacidosis. A significant increase in post-test scores demonstrates that targeted, interactive teaching can bridge knowledge gaps and enhance nurses' preparedness for managing acute diabetic emergencies. Regular refresher programmes and integration of DKA-focused content into nursing practice are recommended to maintain competency and support better patient outcomes.

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