

The Effectiveness of an Educational Intervention on Knowledge Regarding Hyperbaric Oxygen Therapy (HBOT) for Diabetic Foot Recovery Among Fourth-Semester Nursing Students

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Abstract—Background:Diabetic foot ulcers (DFUs) are a common and serious complication of diabetes mellitus, often leading to infection, hospitalization, and even amputation. Hyperbaric Oxygen Therapy (HBOT) is an emerging adjunctive treatment that promotes wound healing by enhancing tissue oxygenation. However, knowledge about HBOT remains limited among nursing students.

Aim:

To assess the effectiveness of a structured educational intervention in improving the knowledge of fourth-semester nursing students regarding Hyperbaric Oxygen Therapy (HBOT) for diabetic foot recovery.

Methods:

A pre-experimental, one-group pre-test post-test design was used. Sixty fourth-semester B.Sc. Nursing students were selected through purposive sampling. A validated structured questionnaire was administered before and after an educational intervention on HBOT. Data were analyzed using descriptive statistics, paired t-test, and chi-square test. A p-value of <0.05 was considered statistically significant.

Results:

The findings revealed that the mean pre-test knowledge score was 7.8 ± 1.8 , which significantly improved to 12.4 ± 1.5 post-intervention. The paired t-test showed a significant improvement ($t = 18.4, p < 0.001$). Most students shifted from moderate to adequate knowledge levels after the intervention. Chi-square analysis showed a slight association between prior knowledge and pre-test scores ($p=0.064$).

Conclusion:

The study concludes that structured educational interventions are highly effective in enhancing nursing students' knowledge regarding HBOT. Integrating such innovative topics into nursing education can better prepare future nurses for advanced clinical practice in managing diabetic foot complications.

Index Terms—Hyperbaric Oxygen Therapy, Diabetic Foot Ulcers, Nursing Students, Educational Intervention, Knowledge Enhancement, Pre-test Post-test Design

I. INTRODUCTION

Health is a multifaceted construct encompassing physical, mental, and emotional well-being. Whereas many acute ailments resolve without significant long-term impact, chronic conditions like diabetes mellitus (DM) precipitate a host of complications—including diabetic foot ulcers (DFUs)—that can radically diminish quality of life and increase morbidity.

Diabetes mellitus, defined by impaired insulin production or utilization, predisposes patients to vascular, neuropathic, and immunologic deficits that culminate in DFUs. Such ulcers are challenging to manage and can lead to infection, prolonged hospitalization, and even major or minor amputations. With the global incidence of diabetes rising, healthcare systems face increasing pressure to devise effective treatment strategies for its complications. Hyperbaric Oxygen Therapy (HBOT) plays a significant role in wound healing, particularly for chronic and complex wounds like diabetic foot ulcers, radiation injuries, and non-healing surgical wounds. Similarly, Kranke et al. (2004) in a Cochrane review concluded that HBOT significantly enhances healing rates in chronic diabetic wounds compared to conventional therapy.

Hyperbaric Oxygen Therapy (HBOT) offers significant clinical benefits by enhancing oxygen delivery to tissues, promoting faster wound healing, reducing inflammation, and improving infection control. By providing 100% oxygen under high pressure, HBOT stimulates angiogenesis, accelerates collagen production, and enhances the immune

response, making it particularly effective for chronic wounds, radiation injuries, diabetic foot ulcers, and non-healing surgical wounds. Additionally, HBOT has shown efficacy in reducing amputation rates in diabetic patients, mitigating the effects of carbon monoxide poisoning, and improving recovery in post-surgical or trauma cases. Wang et al. (2003) reported that hyperbaric oxygen therapy substantially improves wound healing time and reduces amputation rates in diabetic patients.

One promising innovation is Hyperbaric Oxygen Therapy (HBOT). By delivering 100% oxygen under pressure, HBOT enhances the oxygen gradient within tissues, thereby stimulating angiogenesis, suppressing inflammation, and accelerating wound repair. A systematic review and meta-analysis by Sharma et al. (2021) revealed that HBOT significantly improves complete healing rates in diabetic foot ulcers and reduces major amputation risks, positioning it as a valuable adjunct in diabetic foot management. Furthermore, emerging research (e.g., Harrison et al., 2018) indicates that HBOT may also mitigate other diabetes-related complications.

Despite the growing evidence for HBOT, its integration into routine clinical practice remains limited—partly due to insufficient awareness among healthcare providers. Nurse educators play a pivotal role in bridging this knowledge gap. By equipping nursing students with comprehensive knowledge about HBOT, not only do we prepare them for clinical challenges, but we also enhance the overall standard of diabetic foot care.

II. STUDY OBJECTIVES

Primary Objective

To evaluate the effectiveness of a structured educational intervention in increasing the knowledge of fourth-semester nursing students about Hyperbaric Oxygen Therapy (HBOT) for diabetic foot recovery.

Research Objectives

1. To determine the pre-intervention knowledge level of fourth-semester nursing students regarding HBOT in diabetic foot recovery.
2. To determine the post-intervention knowledge level of fourth-semester nursing students regarding HBOT in diabetic foot recovery.
3. To assess the effectiveness of Educational Intervention

4. To explore any associations between students' demographic characteristics and their post-intervention knowledge levels.

HYPOTHESES

- Null Hypothesis (H_0): There will be no significant difference in the knowledge level regarding HBOT for diabetic foot recovery among fourth-semester nursing students when comparing pre-intervention and post-intervention scores.
- Alternative Hypothesis (H_1): There will be a significant improvement in the knowledge level regarding HBOT for diabetic foot recovery among fourth-semester nursing students after the educational intervention.

III. METHODOLOGY

Research Design

A pre-experimental, one-group pre-test post-test design was selected to quantitatively assess the impact of the educational intervention on the target population's HBOT-related knowledge.

Research Approach

A purely quantitative approach was utilized to gather numerical data that could be statistically analyzed to reveal significant differences between pre-intervention and post-intervention knowledge scores.

Study Setting

The study was conducted at a nursing college where fourth-semester B.Sc. Nursing students were enrolled. This setting was chosen because it represents a critical stage in the students' clinical training, where knowledge about emerging therapies can strongly influence future practice.

POPULATION AND SAMPLE

- Target Population: All fourth-semester B.Sc. Nursing students in the selected institution.
- Sample Size: Sixty nursing students.
- Sampling Technique: Purposive sampling was used to select students who met the inclusion criteria (e.g., currently in the fourth semester, willing to participate, and present during the intervention).

INCLUSION AND EXCLUSION CRITERIA

- Inclusion Criteria:
 - Students must be in the fourth semester.
 - Students must provide informed consent.

- Students must be present on the day of the educational intervention.
- Exclusion Criteria:
- Students are already exposed to advanced training on HBOT.
- Students absent during the educational session.

DATA COLLECTION

Instrumentation

A structured questionnaire was developed and validated by nursing educators and subject matter experts to ensure content validity. The questions were designed to assess knowledge on:

- The pathophysiology of diabetic foot ulcers.
- Mechanisms of HBOT.
- Clinical applications and effectiveness of HBOT.
- Current evidence supporting HBOT use in diabetic foot recovery.

Procedure

1. Informed Consent: All participants were provided with comprehensive information regarding the study and consent was obtained.
2. Pre-test: Participants completed a baseline knowledge assessment via Google Forms prior to receiving any intervention.
3. Educational Intervention: A standardized educational session focusing on HBOT—covering topics such as its principles, mechanisms, clinical evidence, and implications for diabetic foot care—was delivered.
4. Post-test: Immediately following the intervention, the same questionnaire was administered to assess changes in knowledge.

DATA ANALYSIS PLAN

- Descriptive Statistics: Frequency distributions, percentages, mean scores, and standard deviations were calculated to summarize the demographic data and knowledge scores.

- Inferential Statistics: A paired t-test was employed to compare pre-test and post-test scores. The significance level was set at $p < 0.05$.

ETHICAL CONSIDERATIONS

- Approval for the study was obtained from the Institutional Ethics Committee.
- Participants were thoroughly informed about the study, ensuring voluntary participation.
- Data were anonymized to protect the identities of the participants.
- Students were informed of their right to withdraw from the study at any stage without any academic penalty.

IV. RESULT

Objective 1:

To assess the pre- and post-intervention knowledge level of fourth-semester nursing students regarding HBOT for diabetic foot recovery.

1.1 Distribution of Students According to Demographic Variables

Table 1 shows the distribution of students according to their demographic characteristics. The majority of students (50%) were in the age group of 20–21 years. Most of them were females (75%) and belonged to urban areas (63.3%). A significant proportion (80%) had no prior knowledge about HBOT, and 41.7% had clinical exposure to diabetic foot cases. However, none of the students had observed HBOT therapy in the clinical setting.

Table 1 shows the demographic characteristics of students. Majority were aged 20–21 years (50%), female (75%), and from urban areas (63.3%). Most (80%) had no previous knowledge regarding HBOT.

Table1: Frequency and Percentage Distribution of Demographic Variables of Students (n=60)

Variable	Category	Frequency (f)	Percentage (%)
Age (years)	18–19	20	33.30%
	20–21	30	50%
	22–23	10	16.70%
Gender	Male	15	25%
	Female	45	75%
Area of Residence	Urban	38	63.30%
	Rural	22	36.70%
	Yes	12	20%

Previous Knowledge on HBOT	No	48	80%
Clinical Exposure to Diabetic Foot Cases	Yes	25	41.70%
	No	35	58.30%
Observed HBOT in Clinical Setting	No	60	100%
Family History of Diabetic Foot/Diabetes	Yes	18	30%
	No	42	70%

1.2 Pre-test and Post-test Knowledge Levels

The pre-test findings revealed that 75% of students had moderate knowledge, 13.3% had inadequate knowledge, and only 11.7% had adequate knowledge regarding HBOT.

Following the educational intervention, post-test results showed that 83.3% of students achieved an adequate level of knowledge.

Table 2: Knowledge Level of Students Before and After Intervention (n=60)

Knowledge Level	Pre-Test (f/%)	Post-Test (f/%)
Inadequate (0–5)	8 (13.3%)	0 (0%)

Moderate (6–10)	45 (75%)	10 (16.7%)
Adequate (11–15)	7 (11.7%)	50 (83.3%)

Objective 2:

To determine the effectiveness of the educational intervention in improving knowledge about HBOT for diabetic foot recovery among fourth-semester nursing students.

The effectiveness of the educational intervention was assessed by comparing the pre-test and post-test mean knowledge scores.

The mean pre-test score was 7.8 ± 1.8 , while the mean post-test score increased significantly to 12.4 ± 1.5 .

Table 3: Mean and Standard Deviation of Pre-test and Post-test Knowledge Scores (n=60)

Test	Mean (M)	Standard Deviation (SD)
Pre-Test	7.8	1.8
Post-Test	12.4	1.5

Table 3 shows that mean knowledge score increased from 7.8 (SD=1.8) in pre-test to 12.4 (SD=1.5) in post-test after intervention.

Table 4: Paired t-test Value for Effectiveness of Educational Intervention (n=60)

Comparison	Mean Difference	Standard Error	t-value	p-value	Inference
Pre-test vs Post-test	4.6	0.25	18.4	0.001 (p<0.05)	Significant

Table 4 shows that the educational intervention was statistically significant in improving knowledge ($t=18.4, p<0.001$). Using a paired t-test, the calculated t-value was 18.4 with a p-value of 0.001, indicating a statistically significant improvement in knowledge after the intervention.

Objective 3:

To find out the association of knowledge scores with selected demographic variables.

The association between pre-test knowledge levels and demographic variables such as age, gender, area of residence, previous knowledge, and family history of diabetes was assessed using the Chi-square test.

The findings showed that:

- Age, gender, area of residence, and family history had no significant association with pre-test knowledge scores.
- Previous knowledge about HBOT showed a slightly significant association ($p=0.064$) with the knowledge level.

Table 5: Chi-Square Values Showing Association Between Pre-test Knowledge and Demographic Variables (n=60)

Demographic Variable	χ^2 Value	df	p-value	Inference
Age	4.15	4	0.385	Not Significant
Gender	0.917	2	0.632	Not Significant
Area of Residence	2.8	2	0.247	Not Significant
Previous Knowledge	5.5	2	0.064	Slightly Significant
Family History of Diabetes	2.1	2	0.35	Not Significant

Table 5 shows no significant association between pre-test knowledge scores and demographic variables like age, gender, or area. However, previous knowledge showed a slightly significant association.

Summary of Findings

- Majority of students initially had moderate knowledge about HBOT.
- Post educational intervention, a significant improvement in knowledge level was observed.
- Educational intervention was statistically effective.
- Previous exposure to HBOT information had some influence on pre-test knowledge, but other demographic factors did not.

V. DISCUSSION

The findings of the present study indicate that a structured educational intervention significantly enhanced the knowledge of fourth-semester nursing students regarding Hyperbaric Oxygen Therapy (HBOT) for diabetic foot recovery. Improved understanding of HBOT is critical given its increasing role as an adjunctive therapy in managing diabetic foot ulcers—a complication that poses substantial global healthcare challenges. A similar improvement in knowledge levels following educational interventions was observed by Ali, Jadoon, and Khan (2020) among nursing students on diabetic foot care practices.

In the pre-test, the majority of students demonstrated moderate knowledge. Following the intervention, the post-test showed a statistically significant improvement, with most students achieving an

adequate level of knowledge. The mean pre-test score was 7.8 ± 1.8 , which increased to 12.4 ± 1.5 post-intervention. The paired t-test analysis revealed a t-value of 18.4 ($p<0.001$), indicating that the educational intervention was highly effective.

Well-informed nurses play a crucial role in patient education, ensuring individuals receive accurate, comprehensive, and practical health information. By staying updated on medical advancements, treatment protocols, and emerging therapies, nurses can guide patients in understanding their conditions, making informed decisions, and adhering to prescribed treatments. Their ability to communicate complex medical concepts in an accessible manner helps improve patient compliance, fosters trust, and enhances overall healthcare outcomes. Whether explaining medication regimens, preventive care measures, or innovative treatments like Hyperbaric Oxygen Therapy (HBOT), knowledgeable nurses empower patients with the education needed to manage their health effectively, reducing complications and promoting wellness. Abbas and Archibald (2007) emphasized that patient education significantly reduces the incidence of diabetic foot complications, highlighting the nurse’s pivotal role.

These findings are consistent with those of Sharma et al. (2021), who reported improved clinical outcomes when healthcare professionals were educated about HBOT protocols. Similarly, Harrison et al. (2018) emphasized that increasing awareness of HBOT’s mechanisms among medical professionals leads to better patient advocacy and clinical decisions.

Furthermore, the study aligns with research conducted by Ahmed et al. (2020), which showed that nursing

students' knowledge and clinical confidence significantly improved following structured educational interventions on advanced therapies.

The chi-square analysis revealed that there was no significant association between knowledge scores and most demographic variables like age, gender, and area of residence. However, prior exposure to HBOT information demonstrated a slightly significant association, suggesting that even minimal prior knowledge can enhance learning outcomes. Similar recommendations were made by Thom et al. (2015), advocating for the integration of HBOT knowledge into nursing and allied health education to improve patient outcomes.

IMPLICATIONS FOR NURSING PRACTICE:

- **Enhanced Clinical Decision-Making:** With increased knowledge, future nurses are better equipped to recognize the potential benefits of HBOT and may become advocates for incorporating such advanced therapies into patient care protocols.
- **Patient Education:** Well-informed nurses can effectively educate patients and caregivers about innovative treatment alternatives, potentially reducing the incidence of severe complications.

Comparison with Previous Studies:

Our results are consistent with previous research (Sharma et al., 2021; Harrison et al., 2018), which emphasizes the positive outcomes associated with HBOT in diabetic foot management. This study extends the literature by demonstrating that educational interventions can bridge the knowledge gap even before nurses enter the clinical arena.

VI. CONCLUSION

The findings of the present study conclude that a structured educational intervention significantly improves the knowledge of fourth-semester nursing students regarding Hyperbaric Oxygen Therapy (HBOT) for diabetic foot recovery. Given the increasing burden of diabetes-related complications, educating future nurses about innovative treatments like HBOT is imperative.

The study recommends integrating HBOT education into the nursing curriculum to enhance clinical competency and encourage the adoption of evidence-based practices. Strengthening the knowledge base of nurses at the student level can positively impact patient

care outcomes, especially in managing chronic diabetic wounds.

RECOMMENDATIONS FOR FUTURE RESEARCH

- Conduct longitudinal studies to assess long-term retention and clinical application of HBOT knowledge.
- Replicate the study across multiple institutions with larger sample sizes for better generalizability.
- Incorporate varied teaching methods like simulations, role plays, or case studies to enhance engagement and learning outcomes.

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