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Original article

Effectiveness of the Educational Program on Nurses' Knowledge concerning Hyperosmolar Hyperglycemic State

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ABSTRACT

Hyperosmolar Hyperglycemic State (HHS) is one of the acute diabetic complications that commonly seen with type 2 diabetes mellitus (T2DM). This represents a critical case necessitating prompt and efficient intervention to prevent potential severe complications. Nursing plays a crucial role in the care of these patients at the critical care settings. Specifically, the project aims to investigate whether nurses' HHS knowledge can be enhanced by educational programs. Quasi-experimental design was used to investigate the effect of the educational program on nurses' knowledge about HHS at Al-Diwaniyah Teaching Hospital in three unites: Cardiac Care Unites (CCU), respiratory care unit (RCU) and emergency room (ER). A non-probability (purposive) sample was chosen from nurses who works in these three unites, the study group consisted of 35 nurses, while the control group comprised 41 nurses. A statistical package for social science (SPSS) program, version 26 was used for descriptive and inferential statistics. By comparing the nurses' knowledge about HHS between the test before (6.4286± 1.35659) and after the program (8.2000± 1.10613), there is a significant difference in nurses' knowledge after the program in the study group, but as for the control group, there is no difference. By comparing the nurses' knowledge regarding nursing care of HHS between the test before (14.0286± 2.05062) and after the program (16.6286± 1.41600), there is a significant increase in nurses' knowledge about nursing care of HHS after the program in the study group. The finding of study show that the educational program was effective to enhance nurses' knowledge about HHS.

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INTRODUCTION

Diabetes mellitus (DM) is a worldwide public health concern [1]. Diabetes affects numerous nations in the twenty-first century, with around 246 million individuals globally [2]. (DM) is characterized by elevated blood sugar levels due to abnormal insulin action or secretion [3]. This disorder is one of the most significant health problems due to the high morbidity rate, disability, and death, as well as the public cost associated with its treatment and associated comorbidities [4]. Hyperosmolar Hyperglycemic State (HHS) is a significant problem of diabetes characterized by extreme hyperglycemia, hyperosmolality, and dehydration without ketoacidosis [5, 6], it is usually prominent in the elderly with uncontrolled type 2 diabetes, although it can also be found in adolescents and teenagers [7], and it is related with a precipitating event [8]. The most prevalent triggering factor is infection [9], the most prevalent of them are urinary tract infections and pneumonia [10]. HHS is more commonly seen in type 2 diabetes (T2D) [6].

Despite the fact that HHS has a lower hospitalization rate than DKA and accounts for less than 1% of all diabetic-related registrations, its fatality rate is higher than DKA and may exceed 40%, whereas DKA fatality is less than 5% [5,11].

Cerebral edema is major dangerous implications on hyperglycemic crisis care; however, it is uncommon [12]. In response to the need for better assistance for diabetic individuals, various changes have been made to diabetic patients' treatment and care, as well as the role of nurses, these adjustments are intended to address the increased incidence of diabetes-related morbidity [13]. Research shows that nurses have a significant impact on patient self-management of their diseases, especially when associated with proactively caring for them [14]. As the number of diabetics on hospital wards increases, it is reasonable to expect that the majority of nurses will be adequately experienced and knowledgeable about diabetes inpatient care, and that they will provide satisfactory and effective care to patients with diabetes [13]. Studies from previous decades show that patients consistently report unsatisfactory experiences with inpatient care, especially as a result of staff, especially nurses, lacking diabetes knowledge [15, 16].

Increasing diabetes prevalence and complications necessitate training nurse specialists in this field with the necessary skills and knowledge [2]. There's need for effective training programs to enhance nurses' knowledge in managing diabetic emergencies. Many studies have indicated that the educational program is useful in improving nurses' knowledge in different fields [17-20]. The present study was aimed to examine the effectiveness of the educational program on nurses' knowledge regarding HHs. Specifically, the study aims to determine whether nurses' knowledge of hyperosmolar hyperglycemia has been improved by the educational program.

METHODS

Study design

The quasi-experimental design carried out on critical care nurses to assess the effectiveness of educational program on nursing knowledge about HHS.

Study setting

The search was carried out in Iraq at the Al-Diwaniyah Teaching Hospital, in the units prepared to receive critical cases, including cases of HHS. These units are; emergency room, respiratory care unite, and cardiac care unite. This hospital was selected because it contains critical care units that receive patients from various regions within the province, including those with diabetes.

Study sample

A non-probability (purposive) sample was selected from nurses who works in these three unites respiratory care unite, cardiac care unite and emergency unite. As a result, a net total of 88 nurses was divided into study and control groups based on odd and even sequences, resulting in 44 nurses in each group. 9 nurses from the study group did not complete the program and were consequently excluded, leaving 35 participants. In the control group, 3 nurses did not complete the follow-up test, yielding a total of 41 participants.

Study instrument

The questionnaire was developed to examine nurses' knowledge of HHS following the educational program. It consists of two parts; part I: Demographic Data: Age, gender, marital status, educational level, field of work, and years of experience are the six demographic characteristics included in this part. Part II: Nurses knowledge HHS.

The questionnaire was developed by reviewing relevant literature on hyperosmolar hyperglycemic state, and it was adjusted based on expert opinions. This part aim to assess nurse's knowledge about HHS, which contains 15 items divided into 2 domains.

A: Assess nurse's knowledge toward HHS, consist of 5 items.

B: Assess nurse's knowledge toward nursing care of HHS, consist of 10 items.

All the items of nurses' knowledge were multiple-choice questions of four choices for each. These rated as (1) for correct choice and (0) for the wrong choice. The time of questionnaire answer list, for each nurse took about 10_15 minutes. Scores of responses are categorized according to the following: poor nurses' knowledge (1-1.33), moderate nurses' knowledge (1.34-1.67), good nurses' knowledge (1.68-2).

Validity of instrument and educational program

The educational program and questionnaire were validated by committee comprising 12 accomplished professionals, each boasting a minimum of five years of experience within their respective domains. This panel was convened to meticulously examine the content of both the program and questionnaire, focusing on their alignment with the requisite knowledge pertaining to (HHS). The experts were given a copy of the program as well as the questionnaire to examine

and evaluate the program's tools and content. Changes and revisions were made in response to the insightful comments and recommendations of the experts. This required the removal of certain elements and the insertion of other ones.

Reliability of instrument

Test-retest reliability method was used to measure reliability of the questionnaire. The reliability of the questionnaire was evaluated using this approach. This was achieved by giving the questionnaire to a sample of ten nurses, testing again after a period of fifteen days, and figuring out the correlation between the results of the first and second tests by using Pearson correlation coefficient. The results showed that there is good stability in the questionnaire (r=0.761).

Session of the programs

First lecture: Definitions, Characteristics and precipitating factors of HHS. Second lecture: Clinical presentation and Pathophysiology of HHS. Third lecture: diagnostic criteria and medical management of HHS. Fourth lecture: Nursing care of HHS. Tools used in the lecture

RESULTS

As in table 1, the study provides a comprehensive overview of Nurses' characteristics in the context of the study and control group. In the study group, participants' ages ranged from 20 to 30 years recording the highest (94.2%) percentage, with an average age of 24.82±3.47 years. Conversely, the control group recorded (95.1%) of the age group of 20 to 30 years, with an average age of 24.65±3.306 years.

The study and control groups both showed a predominant male presence, with 54.3% and 48.8%, respectively. Educational levels reveal that the highest percentage of both groups (study and control) were Diplomas with 54.3% of Nurses in the study group and 58.5% in the control group. Most nurses work in CCU, the study group demonstrated (51.4%) while the control group recorded (43.9%). Regarding marital status, the majority of nurses in both the study group (57.1%) and the control group (61%) were single.

Table 1. Distribution of Study Sample by their Socio-Demographic Variables.

Variables	Classification	Study Group		Control Group	
		N	%	N	%
Age/ years	20 to less than 30	33	94.2	39	95.1
	30 to less than 40	2	5.8	2	4.9
	Total	35	100	41	100
	Mean± SD	24.82 ± 3.47		24.65 ± 3.306	
Sex	Male	19	54.3	20	48.8
	Female	16	45.7	21	51.2
Years of experience	1-Less than 5 years	27	77.1	28	68.3
	5-less than 10 years	7	20	11	26.8
	Above 10 years	1	2.9	2	4.9
Educational level	Diploma	19	54.3	24	58.5
	Bachelor's	12	34.3	13	31.7
	Higher education	4	11.4	4	9.8
Area of work	RCU	10	28.6	10	24.4
	CCU	18	51.4	18	43.9
	Emergency	7	20	13	31.7
Marital status	Single	20	57.1	25	61
	Married	15	42.9	16	39

No.= Number; %= Percentage

Table (2a) + (2b) reveals that the subject responses in the study group recorded (7 items) while the control group recorded only one item in the control group as a good level. Other items were divided into moderate (7 items) and poor (one item) in the study group, while the control group recorded (6 items) moderate and (8 items) poor level of knowledge.

Table (2a). Nurses' Knowledge in General HHS Domain in the study and control group (First domain).

General Hyperosmolar Knowledge	Study Group					Control Group			
	Class	n	%	M.s	Ass	n	%	M.s	Ass
Which of the following manifestations is less likely to be present in HHS compared to diabetic ketoacidosis (DKA)?	Incorrect	17	48.6	1.51	M	30	73.2	1.26	P
	Correct	18	51.4			11	26.8		
one of the following complications is more commonly with HHS compared to DKA?	Incorrect	12	34.3	1.65	M	30	73.2	1.26	P
	Correct	23	65.7			11	26.8		
HHS can be a life-threatening condition primarily due to which of the following complications?	Incorrect	14	40	1.60	M	28	68.3	1.31	P
	Correct	21	60			13	31.7		
what is the usual blood glucose level seen in HHS before starting treatment?	Incorrect	7	20	1.80	G	23	56.1	1.43	M
	Correct	28	80			18	43.9		
one of the following statements is false regarding the HHS?	Incorrect	13	37.1	1.62	M	31	75.6	1.24	P
	Correct	22	62.9			10	24.4		

Table 2b. Nurses' Knowledge in nursing care HHS Domain in the study and control group (Second domain).

Hyperosmolar Nsg. Care Knowledge	Study Group					Control Group			
	Class	n	%	M.s	Ass	n	%	M.s	Ass
When administering intravenous potassium to a patient with severe hypokalemia, what is the most appropriate nursing action?	Incorrect	4	11.4	1.88	G	1	2.4	1.97	G
	Correct	31	88.6			40	97.6		
While assessing the patient with suspected HHS, what finding should the nurse prioritize?	Incorrect	29	82.9	1.17	P	40	97.6	1.02	P
	Correct	6	17.1			1	2.4		
What is the target range for blood glucose levels during the HHS management?	Incorrect	13	37.1	1.62	M	32	78	1.21	P
	Correct	22	62.9			9	22		
What is the essential goal of initial fluid replacement therapy in HHS management?	Incorrect	10	28.6	1.71	G	33	80.5	1.19	P
	Correct	25	71.4			8	19.5		
In a patient with HHS, what nursing intervention is essential to avoid complications related to rapid fluid administration?	Incorrect	19	54.3	1.45	M	36	87.8	1.12	P
	Correct	16	45.7			5	12.2		
In HHS, what should the nurse closely monitor when managing electrolyte disturbances?	Incorrect	0	0	2	G	18	43.9	1.56	M
	Correct	35	100			23	56.1		
What is the primary goal of nursing process during rehydration for a patient with HHS?	Incorrect	10	28.6	1.71	G	20	48.8	1.51	M
	Correct	25	71.4			21	51.2		
A patient with HHS. What nursing action is essential to monitor for potential neurological complications?	Incorrect	13	37.1	1.62	M	26	63.4	1.36	M
	Correct	22	62.9			15	36.6		
When educating a patient with HHS on self-care, what should the nurse emphasize related to insulin therapy?	Incorrect	10	28.6	1.71	G	20	48.8	1.51	M
	Correct	25	71.4			21	51.2		
A patient with HHS, what is the nurse's priority when transition from IV insulin to subcutaneous insulin therapy?	Incorrect	10	28.6	1.71	G	20	48.8	1.51	M
	Correct	25	71.4			21	51.2		

Each item evaluated as Poor [P]=1-1.33, Moderate [M]=1.34-1.67, Good [G]=1.68-2

Table 3 shows high statistical differences of nurses' knowledge were recorded between the pretest and posttest of the study group.

Table 3. Comparison HHS knowledge between Pretest-Posttest Study-control Groups

Groups	Periods	M	SD	Paired t- test	d.f	P value	Sig.
Study	Pre-test	6.4286	1.35659	-8.012	34	.000	HS
	Post-test	8.2000	1.10613				
Control	Pre-test	6.4878	1.00304	-.628	40	.534	Ns
	Post-test	6.5366	1.05113				

M: Mean, SD: Standard deviation, t: t-test, d.f: Degree of freedom, Sig:Significance level at 0.05.

Table 4 recorded high differences between the pretest and posttest of the study group with no differences in the control group.

Table 4. Comparison HHS nursing care between Pretest-Posttest Study-control Groups

Groups	Periods	M	SD	Paired t- test	d.f	P value	Sig.
Study	Pre-test	14.0286	2.05062	-7.680	34	.000	HS
	Post-test	16.6286	1.41600				
Control	Pre-test	13.6341	1.56135	-2.727	40	.009	Hs
	Post-test	14.0000	1.37840				

M: Mean, SD: Standard deviation, t: t-test, d.f: Degree of freedom, Sig: Significance level at 0.05.

Table 5 showed the mean differences of the nurses' knowledge between the study and control groups show a notable difference in the all domains related to HHS.

Table 5. Comparison of Study and control Groups concerning nurses' knowledge domains.

Domains	Groups	M	SD	t-value	d.f	P value	Sig
General Hyperosmolar Knowledge	Study	8.200	1.106	6.171	68	.000	Hs
	Control	6.600	1.062				
Hyperosmolar Nsg. Care Knowledge	Study	16.62	1.416	8.07	68	.000	Hs
	Control	14.00	1.306				

M: Mean, SD: Standard deviation, t: t-test, d.f: Degree of freedom, Sig: Significance level at 0.05

Table 6 showed no significant associations were revealed between the sex and nurses' knowledge about HHS.

Table 6. Sex differences of Study Group concerning nurses' knowledge domains.

Domains	Groups	M	SD	t-value	d.f	P value	Sig
General Hyperosmolar Knowledge	Male	8.263	.991	.363	33	.719	Ns
	Female	8.12	1.258				
Hyperosmolar Nsg. Care Knowledge	Male	16.78	1.357	.727	33	.472	Ns
	Female	16.43	1.504				

M: Mean, SD: Standard deviation, t: t-test, d.f: Degree of freedom, Sig: Significance level at 0.05

No significance correlation was recorded in table 7 between nurses knowledge and marital status.

Table 7. Marital status differences of Study Group concerning nurses' knowledge domains

Domains	Groups	M	SD	t-value	d.f	P value	Sig
General Hyperosmolar Knowledge	Single	8.2000	1.10501	.722	33	.477	Ns
	Married	8.2000	1.14642				
Hyperosmolar Nsg. Care Knowledge	Single	16.8000	1.10501	.823	33	.416	Ns
	Married	16.4000	1.76473				

M: Mean, SD: Standard deviation, t: t-test, d.f: Degree of freedom, Sig: Significance level at 0.05.

Table 8 demonstrated that years of experience showed significant correlation only with General Hyperosmolar Knowledge ($p < 0.05$). The other domain revealed no correlation.

Table 8. Differences of age and years of experience of Study Group concerning nurses' knowledge domains

Variables		General DKA Knowledge	DKA Nsg. Care Knowledge	General Hyperosmolar Knowledge	Hyperosmolar Nsg. Care Knowledge	Overall Knowledge
Age	Pearson Correlation	.050	.263	.277	.130	.253
	Sig. (2-tailed)	.775	.127	.107	.456	.142
	N	35	35	35	35	35
Years of experience	Pearson Correlation	.019	.236	.364*	.093	.246
	Sig. (2-tailed)	.913	.171	.032	.597	.155
	N	35	35	35	35	35

M: Mean, SD: Standard deviation, d.f: Degree of freedom, Sig: Significance level at 0.05.

Table (9) revealed no significant differences were recorded with domains of nurses' knowledge about HHS.

Table 9. Area of working Differences of Study Group concerning nurses' knowledge domains

Area of working		df	Mean Square	F	Sig.
General Hyperosmolar Knowledge	Between Groups	2	2.349	2.037	.147
	Within Groups	32	1.153		
	Total	34			
Hyperosmolar Nsg. Care Knowledge	Between Groups	2	1.849	.918	.410
	Within Groups	32	2.015		
	Total	34			

M: Mean, SD: Standard deviation, F: ANOVA test, d.f: Degree of freedom, Sig: Significance level at 0.05.

Table (10) the level of education demonstrates high statistical significant differences with General Hyperosmolar Knowledge domain and overall knowledge.

Table 10. Differences of educational level of Study Group concerning nurses' knowledge domains

Variable \ Level of education		df	Mean Square	F	Sig.
General Hyperosmolar Knowledge	Between Groups	2	5.697	6.035	.006
	Within Groups	32	.944		
	Total	34			
Hyperosmolar Nsg. Care Knowledge	Between Groups	2	4.417	2.382	.109
	Within Groups	32	1.854		
	Total	34			

M: Mean, SD: Standard deviation, F: ANOVA test, d.f: Degree of freedom, Sig: Significance level at 0.05.

DISCUSSION

The finding revealed that most participants (94.2%) within the ages of 20 and 30, in the average age of 24.82±3.47 years, In the control group 95.1% of participants within age 20 to 30 years, with an average age of 24.65±3.306 years (see table 1). These results are comparable with the study conducted by Baiez and Mohammod, who discovered that the majority of the samples' ages were (20-30) years, accounting for (61.4%) [21]. This suggests Most nurses working in critical care units are between the ages of 20-30, there is other study conducted in Iraq in Baghdad hospitals showed the demographic distribution of age that the majority of nurses are within age 21-30 [22].

The study group found that the male population was more represented than the female population, with roughly 54.3% of all participants, over the halfway point. Women made up approximately 45.7% of the study group, indicating a slight minority presence. This data implies that men predominate women in the study group. Conversely, within the control group the proportion of female participants amounted to approximately 51.2% of the total, nearly matching that of male participants. In spite of this almost equal distribution, there was still a noticeable male preponderance in the study sample. These results are consistent with a similar pattern seen in an Iraqi study, which showed that the majority of nurses were

men, accounting for 81.4% of nurses [23], and there is a study that reached the opposite result (60%) of the study subject were females [24].
About 77.1% of the study group and 68.3% of the control group had one to five years' experience, it is consistent with a study in Egypt that assessed the impact of a training program on nurse performance and health outcomes for diabetic ketoacidosis patients. The study found that 97.5% of nurses had less than 5 years of experience [25], the outcome is consistent with a study that found that almost all of nurses have 1- 5 years of experience [26], result is due to a significant number of newly graduated nursing staff who are just employed and the transfer of existing nursing personnel [27]. The majority of the participants held a diploma, with 54.3% of nurses in the study group and 58.5% in the control group. Those results are consistent with the study's finding that the majority of the participants had a diploma degree [28]. The majority of participating nurses' work in CCU, the study group demonstrated (51.4%) while the control group recorded (43.9%). This not in the same line Mousa et al, who found the majority of nurses from intensive care unit in Baghdad teaching hospital [29].

A comparison of the study group's knowledge of HHS before (6.4286± 1.35659) and after (8.2000± 1.10613) program implementation by nurses demonstrates noticeable improvements. On the other hand, there was no variation that could be seen in the control group (Table 6). These results are consistent with those of Pontejos [30], whose study of "diabetes education for nursing staff in primary health care" also showed an important increase in knowledge acquisition overall. The findings of the research align with Huley's, [31] observations, which show that total corrected answer scores increased after program participation. Additionally, the study revealed a significant improvement in nurses' total knowledge scores after the program was implemented as opposed to before. Significant statistical differences were noted between the pre- and post-program knowledge of the hyperosmolar hyperglycemic state (HHS) for all of the items. The research by Alishaq, [32] carried out in Abu Dhabi and Dubai hospitals to improve nurses' knowledge of inpatient diabetes management through diabetes educational interventions is in line with this study, according to Alishaq's findings, nurses' general knowledge and information levels were significantly higher after training sessions than they were before.
By comparing the nurses' knowledge regarding nursing care of HHS between the test before (14.0286± 2.05062) and after the program (16.6286± 1.41600), there is an improvement in the nurses' knowledge after the educational program in the study group table (7). This finding is agree with study showing that the positive effects of diabetes education programs on enhancing nurses' knowledge, It can have implications for the development of diabetes education materials in nursing curriculums and the development of continuing education programs designed for practicing nurses [33] .But as for the control group, there is no difference table 7.
Correlation only with General Hyperosmolar Knowledge domain and years of experience ($p < 0.05$) This result was agree with the study carried by Saad Shaker et al. [34] which entitled" Effect of Training Program on Nurses' Performance and Health Outcomes for Patients with Diabetic Ketoacidosis" who revealed that the better mean knowledge scores among younger nurses those who have the least experience. The other domain revealed no correlation, this result concerts with study conducted by Abees and Mohammed [35]. And there is a correlation between nurses' knowledge and educational level in relation to general hyperosmolar knowledge domain.

CONCLUSION

A study shows that nurses' comprehension of HHS is improved by implementing an education program.

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Conflicts of Interest

There are no conflicts of interest.

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فاعلية البرنامج التعليمي على معارف الممرضين بشأن حالة فرط الاسمولية السكري

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المستخلص

تعد حالة فرط الأسمولية السكرية واحدة من المضاعفات السكرية الحادة الشائعة التي تُرى مع مرض السكري من النوع الثاني. تمثل هذه الحالة حالة حرجة تتطلب تداخلاً سريعًا وفعالًا لمنع المضاعفات الشديدة المحتملة. يلعب التمريض دورًا حاسمًا في رعاية هؤلاء المرضى في أماكن الرعاية الحرجة. على وجه التحديد، يهدف المشروع البحثي إلى التحقيق فيما إذا كان من الممكن تعزيز معارف الممرضين حول حالة فرط الأسمولية السكرية من خلال البرنامج التعليمي. تم استخدام التصميم شبه التجريبي للتحقيق في تأثير البرنامج التعليمي على معارفة الممرضين بحالة فرط الأسمولية السكري في مستشفى الديوانية التعليمي في ثلاث وحدات: وحدات العناية القلبية و وحدة العناية التنفسية وغرفة الطوارئ. تم اختيار عينة غير عشوائية (غرضية) من الممرضين الذين يعملون في هذه الوحدات الثلاث، وتألفت مجموعة الدراسة من 35 ممرض، بينما ضمت المجموعة الضابطة 41 ممرض. تم استخدام برنامج الحزمة الإحصائية للعلوم الاجتماعية (SPSS)، الإصدار 26 للإحصاء الوصفي والاستدلالي. من خلال مقارنة معارف الممرضين حول فرط الأسمولية السكرية بين الاختبار قبل البرنامج (6.4286 ± 1.35659) وبعد البرنامج (8.2000 ± 1.10613)، حيث يوجد فرق كبير في معارف الممرضين بعد البرنامج في مجموعة الدراسة، أما بالنسبة للمجموعة الضابطة، فلا يوجد فرق. من خلال مقارنة معارف الممرضين فيما يتعلق بالرعاية التمريضية لفرط الأسمولية السكرية بين الاختبار قبل البرنامج (14.0286 ± 2.05062) وبعد البرنامج (16.6286 ± 1.41600)، وجدت زيادة كبيرة في معارف الممرضين حول الرعاية التمريضية لفرط الأسمولية السكرية بعد البرنامج في مجموعة الدراسة. تظهر نتائج الدراسة أن البرنامج التعليمي كان فعالاً في تعزيز معارف الممرضين حول فرط الأسمولية السكرية.

الكلمات المفتاحية: الفاعلية، البرنامج التعليمي، معارف الممرضين، حالة فرط الأسمولية السكرية.