Effectiveness of an Educational Program for Nursing Intervention on nurses' knowledge about Chemotherapy Administration for Patients With Cancer

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Abstract

Objective: To determine the effectiveness of education program on nursing staff knowledge toward nursing intervention on chemotherapy administration.

Study Design: A quasi-experimental design (study group and control group)

Place and Duration of Study: This study was conducted at Al-Diwaniya teaching hospital/ Oncology unit from 30^{the} June 2024 to 20th January 2025

Methods: A non- probability (purposive) sample was selected to obtain representative and accurate data. From (60) nurses working at Oncology Unit. The study participants were divided into two groups: (30) nurses were assigned to the study group who were exposed to the educational program, and (30) nurses who were assigned to the control group were not exposed to the educational program. Date was collected through the use of constructed program and instruments used in the research (Knowledge of safe handling, administration, and waste management of chemotherapeutic drugs among oncology nurses working at Khartoum Oncology Hospital, Sudan) was used after obtaining the researchers' approval, the study instrument included two sections: Demographic Data, and knowledge about nursing intervention on chemotherapy administration.

Results: The study results show that the effectiveness of the educational program was clearly observed on study group during a positive effect on overall Nurses' Knowledge, while no effect on the

overall knowledge of nurses in the control group was clearly observed.

Conclusion: The researcher concluded that the educational program was effective in the enhancement of nursing staff knowledge toward nursing intervention on chemotherapy administration, and there were statistical significant differences between the study and control group at post-test measurements regarding patients' knowledge at P. value <0.05.

Recommendations: The study recommended the necessity of implementing the developed program, in addition to intensify the work of the continuing nursing education unit to provide educational courses focusing on nursing intervention about chemotherapy administration (preservice and inservice) at Oncology Unit.

Keywords: Educational program, nursing intervention, and chemotherapy administration.

الخلاصة

الهدف: تحديد فعالية البرنامج التعليمي على معارف الملاكات التمريضية تجاه التدخلات التمريضية في إعطاء العلاج الكيميائي.

تصميم الدراسة: تصميم شبه تجريبي (مجموعة الدراسة ومجموعة الظابطة)

مكان ومدة الدراسة: أجريت هذه الدراسة في مستشفى الديوانية التعليمي / وحدة الأورام من ٣٠ يونيو ٢٠٢٤ إلى ٢٠ يناير ٢٠٢٥

المنهجية: تم اختيار عينة غير احتمالية (غرضية) للحصول على بيانات تمثيلية ودقيقة. من (٦٠) ممرض يعمل في وحدة الأورام. تم تقسيم المشاركين في الدراسة إلى مجموعتين: تم تعيين (٣٠) ممرض في مجموعة الدراسة الذين تعرضوا للبرنامج التعليمي، و (٣٠) ممرض تم تعيينهم في المجموعة الظابطة لم يتعرضو للبرنامج التعليمي. تم جمع البيانات من خلال استخدام برنامج وأدوات تم تصميمها في البحث (معرفة التعامل الآمن والإدارة وإدارة النفايات للأدوية الكيميائية بين ممرضين الأورام العاملين في مستشفى الأورام بالخرطوم، السودان) بعد الحصول على موافقة الباحثين،

وتضمنت أداة الدراسة قسمين: البيانات الديموغرافية، والمعرفة حول التدخلات التمريضية في إعطاء العلاج الكيميائي.

النتائج: أظهرت نتائج الدراسة أن فعالية البرنامج التعليمي لوحظت بوضوح على مجموعة الدراسة من خلال التأثير الإيجابي على المعارف الكلية للممرضين، في حين لم يلاحظ أي تأثير واضح على المعارف الكلية للممرضين في المجموعة الظابطة.

الاستنتاج: خلص الباحث إلى أن البرنامج التعليمي كان فعالاً في تعزيز معارف الملاكات التمريضية تجاه التدخلات التمريضية في إعطاء العلاج الكيميائي، وكانت هناك فروق ذات دلالة إحصائية بين مجموعة الدراسة والمجموعة الظابطة في قياسات ما بعد الاختبار فيما يتعلق بمعرفة الممرضين عند قيمة $P < 0.05$.

التوصيات: أوصت الدراسة بضرورة تنفيذ البرنامج المتطور، بالإضافة إلى تكثيف عمل وحدة التعليم التمريضي المستدام لإعطاء دورات تعليمية تركز على التدخلات التمريضية حول إعطاء العلاج الكيميائي (قبل الخدمة وأثناء الخدمة) في وحدة الأورام.

الكلمات المفتاحية: البرنامج التعليمي، التدخلات التمريضية، وإعطاء العلاج الكيميائي.

Introduction:

Cancer occurs as a result of many changes in the genes that control the way our cells work. Cancer is described as a proliferative, invasive and metastatic disease. Cancer is a disease caused by uncontrolled and uncontrolled growth of a cell or type of cell that produces aggressive malignant tumors. In the late 1920s, cancer was one of the three main causes. Today, tumors remain among the leading causes of death worldwide [1,2,3].

Cancer is a complex disease and many factors including genetic and environmental factors can promote its occurrence. It is considered one of the major health problems in the world and is also considered the second cause of death in the United States, according to World Health Organization estimates. Globally, it is estimated that by 2030, while the prevalence of cancer is increasing, will increase the number of cancer cases from 14.1 to 21.6 million. In Iraq, according to the Iraq Cancer Council (ICB) 2022, the number

of new cancer cases is 39,068 and the number of deaths due to cancer is 11,421 (Iraq Cancer Council (ICB) 2022) [1,4,5].

Patients with cancer now have several alternatives for therapy because to advancements in oncology. The potential to enhance patient outcomes is offered by these innovative combinations, targeted and immunotherapies, and new hormonal and chemotherapeutic drugs. The primary and most widely used kind of treatment is chemotherapy. Worldwide, more than a million chemotherapy injections are given every day. In addition to its potent effects on chemotherapy, it can have a number of adverse consequences that might impact the course of treatment, the prognosis, and the patient's reaction to it, such chemotherapy-related leaks [6,7].

Cytotoxic drugs (CDs) are a broad class of chemical substances and are sometimes referred to as antineoplastic, anticancer, or cancer chemotherapeutic medications. Because they can kill cancer cells by preventing cell proliferation, they are frequently used to treat cancer. Depending on their chemical structure and drug pharmacodynamics, cytotoxic medications can be divided into a number of classes, including mitotic inhibitors, alkylating agents, antimetabolites, antineoplastic antibiotics, topoisomerase inhibitors, and miscellaneous [8].

Chemotherapy aims to eradicate cancer cells. The way that traditional chemotherapy treatments function is by destroying cells that divide quickly. Although it destroys rapidly proliferating cancer cells, it can also damage rapidly proliferating healthy cells, damaging the cells lining mucous membranes throughout the body, including as the stomach, throat, and mouth, as well as the cells that create blood. The reproductive system, hair follicles, and bone marrow [1].

Chemotherapy drugs must be administered precisely in order to treat cancer patients, since improper administration might endanger patient safety and produce less than ideal results. Unfortunately, the complexity of administering chemotherapeutic

medicines is rapidly increasing, making correct administration a difficult problem. Many academics have suggested that standardized standards for the administration of chemotherapy medicines be adopted and that these recommendations be followed in order to reduce chemotherapy mistakes [9].

Errors in the administration of chemotherapy are acknowledged globally. It is unknown how many chemotherapy administration mistakes occur locally. Among the leading causes of death in the US, medical mistakes are in third. Among adult cancer patients receiving prescription orders in an outpatient environment, Walsh et al. found an mistake rate of 8.2 per 1000, of which 5/1000 had the potential to cause damage and 1/1000 led to patient injury [6].

When developing the guidelines, a number of factors were taken into account in order to minimize mistakes and any possible harm to patients undergoing chemotherapy. These include suggestions for proper training and competence assessments of all medical personnel who administer chemotherapy, sufficient staffing, and a well-defined chemotherapy administration procedure that adheres to the standard chemotherapy patient route, along with useful checklists for use at key stages of the pathway. Additionally, SOPs (standard operating procedures) were created for every process [10].

Nurses are the cornerstone of cancer patient care and have played an active role throughout history. Assessing the patient, treating the disease's symptoms, offering supportive care, and teaching him about the illness are their primary responsibilities. In oncology units, the nurse is in charge of giving the patient chemotherapy, handling it safely, calculating dosages depending on the patient's body surface area, inserting a venous cannula, and administering intravenous chemotherapy. The nurse also has to continuously check the patient's status and do follow-up laboratory testing. Additionally, it involved treating side effects, teaching patients and their families about the negative consequences of

chemotherapy, safely delivering the medication, and offering them emotional support throughout the procedure [1,4].

METHODS

Study design

A quasi-experimental design (study group and control group) was used to achieve the goals of the study.

Setting and period

The study was conducted at Al-Diwaniyah Teaching Hospital, Oncology Unit. The researcher had chosen this hospital because this hospital is the only teaching hospital that contains Oncology Unit in Al-Diwaniya city. The period of this study started from 30^{the} June 2024 to 20th January 2025

Sampling and sample size

A non- probability (purposive) sample was selected to obtain representative and accurate data. From (67) nurses working at Oncology Unit in Al-Diwaniya Teaching Hospital, (7) nurses were excluded from the educational program (pilot study). The study participants were divided into two groups: (30) nurses were assigned to the study group who were exposed to the educational program, and (30) nurses who were assigned to the control group were not exposed to the educational program and shared the same demographic characteristics.

Inclusion and exclusion criteria:

All nursing' staff that is works in the oncology unit and who have agreed to participate in the study and the pilot study sample was excluded.

Study instruments and data collection

Study instruments through a review of pertinent literature and consultation with a panel of experts, the researcher created a questionnaire to evaluate the effectiveness of nursing intervention

on chemotherapy administration. The instrument consists of two part: Part one: Socio-Demographic Characteristics are concerned with collecting demographic data from the nursing staff and consists of (six) items built by the researcher, including age, gender, educational level, years of experience and years of experience in Oncology Unit, and training courses related nursing intervention on chemotherapy administration. Part two Knowledge about nursing intervention on chemotherapy administration; The tool used in the research (Knowledge of safe handling, administration, and waste management of chemotherapeutic drugs among oncology nurses working at Khartoum Oncology Hospital, Sudan) was used after obtaining the researchers' approval: In this part, the knowledge of the nursing staff regarding nursing intervention on chemotherapy administration in the Oncology unit was evaluated. The questionnaire consists of 26 questions divided into three paragraphs. The first paragraph consists of eight multiple-choice questions related to the uses of chemotherapy, its types, precautions and safe handling. The second paragraph consists of ten questions related to giving chemotherapy and identifying exposure risks, and the answer to it is true or false. As for the third and final paragraph, it consists of eight multiple-choice questions related to the disposal of chemotherapy waste and the management of side effects.

Ethical considerations

Following the Nursing College Council's approval, the researcher conform an explanation of the study, including its goals and project, to the Central Statistics Organization of the Iraqi Ministry of Planning, the Technical Section of the Al-Diwaniyah Health Directorate, the Ministry of Health's planning department, and other official bodies to get agreement to acts the research and collect data. Each nurse then provided written informed consent to the researcher. In accordance with the subject's consent sheet, the researcher informed the participants that their involvement in the study is entirely voluntary and gave them his word that the data would be kept private and secure both during and after the study.

Statistical analysis

Descriptive and inferential statistical procedures were conducted. The descriptive analysis was presented with frequency, percentage, and mean and standard deviation. Paired-Samples t-test, "compares the means of two variables" for a single group, ANOVA it was used to determine the association between sociodemographic characteristics and the patient's knowledge statistically significant when the p-value is < 0.05. All the data were analyzed with SPSS Statistics (version 26).

Results:

Table 1: Demographic data of the Study Sample (N= 40 Nurses).

Demographic Data	Rating and Intervals	Groups			
		Study		Control	
		Freq.	%	Freq.	%
Age / years	24	13	43.3	10	33.3
	25-29	9	30.0	7	23.3
	30-34	4	13.3	5	16.7
	35-39	3	10.0	5	16.7
	40	1	3.3	3	10.0
	Total	30	100.0	30	100.0
Gender	Male	12	40.0	10	33.3
	Female	18	60.0	20	66.7
	Total	30	100.0	30	100.0
Educational Level	primary school	10	33.3	5	16.7
	Diploma	14	46.7	14	46.7
	Bachelors	6	20.0	9	30.0
	0thers	0	0	2	6.7
	Total	30	100.0	30	100.0
Years of Experience/Hospital	1-5	17	56.7	12	40.0
	6-10	5	16.7	7	23.3
	11-15	7	23.3	6	20.0
	16+	1	3.3	5	16.7
	Total	30	100.0	30	100.0
Years of Experience/Oncology	1-5	17	56.7	17	56.7
	6-10	9	30.0	9	30.0
	11+	4	13.3	4	13.3
	Total	30	100.0	30	100.0
Training Courses	Yes	7	23.3	8	26.7

	No	**23**	**76.7**	**22**	**73.3**
	Total	**30**	**100.0**	**30**	**100.0**

Table (1): Revealed that the majority of sample were at same age group (less than 24) years old (43.3%) in study group and (33.3%) in control group. Regarding sex, (73.3%) in study sample were male in both groups. Regarding the educational level, the majority of the sample for both groups are diploma holders (46.7%). In addition, (40%) of participants had 1-5 years concerning years of experience in the hospital in control sample and more than half of participants (56.7%) in study group, as well as the same percentage also applies to the both groups of years of experience in oncology unit. The majority (76.7%) of nurses in study group and (73.3%) in control sample have not participated in training sessions regarding nursing intervention on chemotherapy administration.

Table 2: Overall Assessment of the Study Sample Responses at the Pre- Post Test for Study Group.

Main studied domains	Levels	Pre-test				Post-test			
		Freq.	%	Mean	Assessment	Freq.	%	Mean	Assessment
Knowledge regarding chemotherapy uses and types, precautions and safe handling used during preparation:	Low	15	50.0	1.27	Low	0	0	1.69	Good
	Fair	15	50.0			11	36.7		
	Good	0	0			19	63.3		
	Total	30	100.0			30	100.0		
Knowledge regarding administering chemotherapy, identifying exposure risks:	Low	5	16.7	1.52	Fair	0	0	1.82	Good
	Fair	18	60.0			3	10.0		
	Good	7	23.3			27	90.0		
	Total	30	100.0			30	100.0		
Knowledge regarding disposal of chemotherapeutic waste and managing side effects:	Low	6	20.0	1.41	Low	0	0	1.72	Good
	Fair	23	76.7			9	30.0		
	Good	1	3.3			21	70.0		
	Total	30	100.0			30	100.0		
Overall Nurses' Knowledge	Low	6	20.0	1.40	Fair	0	0	1.75	Good
	Fair	24	80.0			4	13.3		
	Good	0	0			26	86.7		
	Total	30	100.0			30	100.		

							0		

f: Frequency, %: Percentage, M: Mean of total score, (low= 1-1.33, Fair= 1.34-1.67, Good= 1.68-2

Table (2): Overall, the table indicates a positive trend in the nurses' knowledge regarding chemotherapy administration, precautions, and safe handling. At the pre-test, 80% of nurses had fair overall knowledge, while 20% had low knowledge, and 0% had good knowledge. While at the post-test, a substantial improvement is seen, with 86.7% of nurses having good knowledge and only 13.3% having fair knowledge.

Table 3: Mean Difference (Wilcoxon Signed Rank) between The Knowledge of the Study Group Responses at Two Levels of Measurement (Pre-Test and Post-Test)

Main studied domains	Periods of Measurements	Mean	N	Std. Deviation	Wilcoxon Signed Rank	d.f.	p-value
Knowledge regarding chemotherapy uses and types, precautions and safe handling used during preparation:	**Pre-test**	**1.27**	**30**	**.187**	**4.83**	**29**	**0.001 HS**
	Post-test	**1.69**	**30**	**.121**			
Knowledge regarding administering chemotherapy, identifying exposure risks:	**Pre-test**	**1.52**	**30**	**.192**	**4.75**	**29**	**0.001 HS**
	Post-test	**1.82**	**30**	**.133**			
Knowledge regarding disposal of chemotherapeutic waste and managing side effects:	**Pre-test**	**1.41**	**30**	**.119**	**4.85**	**29**	**0.001 HS**
	Post-test	**1.72**	**30**	**.093**			
Overall, Nurses' Knowledge	**Pre-test**	**1.40**	**30**	**.104**	**4.78**	**29**	**0.001 HS**
	Post-test	**1.75**	**30**	**.073**			

std = standard deviation; D.F = degree of freedom; NS = non- significant; HS= High significant.

Table (3): Overall Nurses' Knowledge: The overall mean knowledge score showed a statistically significant increase (p-value = 0.001) from pre-test to post-

test. This indicates that the educational program had a positive and significant impact on nurses' overall knowledge regarding chemotherapy administration.

Table 4: Overall Assessment of the Study Sample Responses at the Pre-Post Test for Control Group

Main studied domains	Levels	Pre-test				Post-test			
		Freq.	%	Mean	Assessment	Freq.	%	Mean	Assessment
Knowledge regarding chemotherapy uses and types, precautions and safe handling used during preparation:	Low	6	20.0	1.400	Fair	3	10.0	1.475	Fair
	Fair	22	73.3			24	80.0		
	Good	2	6.7			3	10.0		
	Total	30	100.0			30	100.		
Knowledge regarding administering chemotherapy, identifying exposure risks:	Low	10	33.3	1.423	Fair	11	36.7	1.450	Fair
	Fair	17	56.7			14	46.7		
	Good	3	10.0			5	16.7		
	Total	30	100.0			30	100.0		
Knowledge regarding disposal of chemotherapeutic waste and managing side effects:	Low	4	13.3	1.429	Fair	6	20.0	1.462	Fair
	Fair	24	80.0			21	70.0		
	Good	2	6.7			3	10.0		
	Total	30	100.0			30	100.0		
Overall, Nurses' Knowledge	Low	6	20.0	1.41	Fair	1	3.3	1.46	Fair
	Fair	22	73.3			27	90.0		
	Good	2	6.7			2	6.7		
	Total	6	20.0			30	100.0		

f: Frequency, %: Percentage, M: Mean of total score, (low= 1-1.33, Fair= 1.34-1.67, Good= 1.68-2)

Table (4): shows overall, Nurses' Knowledge at the pre-test, 73.3% of nurses had fair overall knowledge, while 20% had low knowledge, and 6.7% had good knowledge, while at the post-test, a substantial improvement is seen, with 90% of nurses having fair knowledge and only 3.3% having low knowledge.

Table 5: Mean Difference (Wilcoxon Signed Rank) between The Knowledge of the Control Group Responses at Two Levels of Measurement (Pre-Test and Post-Test)

Main studied domains	Periods of Measurements	Mean	N	Std. Deviation	Wilcoxon Signed Rank	d.f.	p-value
Knowledge regarding	Pre-test	1.47	30	.148	1.062	29	.288 NS

chemotherapy uses and types, precautions and safe handling used during preparation:	**Post-test**	**1.45**	**30**	**. 185**			
Knowledge regarding administering chemotherapy, identifying exposure risks:	**Pre-test**	**1.42**	**30**	**.140**	**0.86**	**29**	**0.388 NS**
	Post-test	**1.45**	**30**	**.185**			
Knowledge regarding disposal of chemotherapeutic waste and managing side effects:	**Pre-test**	**1.42**	**30**	**.138**	**1.18**	**29**	**0.238 NS**
	Post-test	**1.46**	**30**	**.164**			
Overall, Nurses' Knowledge	**Pre-test**	**1.374**	**30**	**.096**	**1.436**	**29**	**.151 NS**
	Post-test	**1.407**	**30**	**.104**			

std = standard deviation; D.F = degree of freedom; NS = non- significant; HS= High significant.

Table (5): Overall Nurses' Knowledge: No statistically significant differences were found between the pre-test and post-test scores in any of the knowledge domains or in the overall nurses' knowledge regarding chemotherapy administration. This indicates that the control group's knowledge remained relatively stable over the study period.

Table 6: Mean Difference (Mann-whitney test) between The Knowledge of the Study and Control Group Responses at Pre-Test and Post-Test

Main studied domains	Periods of Measurements	Groups	N	Mean Rank	Sum of Ranks	Mann - whitney U	p-value
Knowledge regarding chemotherapy uses and types, precautions and safe handling used during preparation:	**Pre-test**	**Study**	**30**	**30.62**	**918.50**	**.550**	**.582**
		Control	**30**	**28.30**	**792.50**		
	Post-test	**Study**	**30**	**41.42**	**1242.50**	**4.981**	**0.000 HS**
		Control	**30**	**19.58**	**587.50**		
Knowledge regarding administering chemotherapy, identifying exposure risks:	**Pre-test**	**Study**	**30**	**35.63**	**1069.00**	**2.342**	**0.119 HS**
		Control	**30**	**25.37**	**761.00**		
	Post-test	**Study**	**30**	**43.22**	**1296.50**	**5.710**	**0.000 HS**
		Control	**30**	**17.78**	**533.50**		
Knowledge regarding	**Pre-test**	**Study**	**30**	**29.97**	**899.00**	**0.250**	**0.802 NS**
		Control	**30**	**31.03**	**931.00**		

disposal of chemotherapeutic waste and managing side effects:	**Post-test**	**Study**	**30**	**42.63**	**1279.00**	**5.503**	**0.000 HS**
		Control	**30**	**18.37**	**551.00**		
Overall, Nurses' Knowledge	**Pre-test**	**Study**	**30**	**30.53**	**916.00**	**0.015**	**0.988 NS**
		Control	**30**	**30.47**	**914.00**		
	Post-test	**Study**	**30**	**43.82**	**1314.50**	**5.916**	**0.000 HS**
		Control	**30**	**17.18**	**515.50**		

HS = High significant; NS = non- significant

Table (6): Overall nurses' knowledge showed no statistically significant difference was found between the study and control groups at the pre-test. This suggests that both groups had comparable baseline knowledge overall. While a statistically significant difference was found between the study and control groups at the post-test. The study group demonstrated significantly higher knowledge scores compared to the control group overall. This suggests that the educational intervention had a positive impact on the nurses' overall knowledge.

Discussion:

This table presents the demographic characteristics of the study participants, divided into two groups: Study (n=30) and Control (n=30). Concerning nursing staffs' age, the result of the study uncovers that the majority of participants in both groups were aged 24 years or less (43.3% in the study, 33.3% in the control). This indicates that the sample is predominantly made up of younger nurses. The researcher explains that a large number of newly recruited nurses have chosen to work in the oncology unit because of the desire and enthusiasm to care for patients with cancer. This result is confirmed by a study conducted by Saker et al. (2022), where it was found that most of the participants (40%) were under 24 years of age [11].

The percentage of females in the study group was higher (60%) compared to the control group (66.7%). The increase in females is attributed to the higher percentage of females being accepted to study nursing than males. The study result is consistent

with the study of Fadhil and Hassan (2018), which found that (74%) of the participating nurses were female in the oncology unit [4].

Regarding the educational level, the study showed that more than a third of the participants in both groups (46.7%) graduated from nursing institutes and obtained a diploma. This was confirmed by Muhammad and Aburaghif (2018), who found that (40%) of the participants graduated from nursing institutes [12]. The results were consistent with Mansour, (2019), who found a that more than a half of the participants (52.5%) graduated from nursing institutes and obtained a diploma [13].

Regarding years of experience in the hospital, most nurses in both groups had experience ranging from 1 to 5 years (56.7% in the study, and 40% in the control group). Similar to hospital experience, most nurses had 1-5 years of experience in oncology units (56.7% in Study, 56.7% in Control), and the study result is consistent with the study of Abdullah and Rasheed (2018) which found that more than half of the sample (65%) of nurses had less than 5 years of experience [14].

Regarding training courses on administering chemotherapy, the study results indicated that the majority of participants (76.6 % in the study and 73.3 % in the control group) did not have training courses in this field. The results differ from a study conducted by Mamdouh et al. (2022) in Egypt to assess the knowledge and practices of oncology nurses regarding the safe administration of intravenous chemotherapy, which showed that the majority of nurses had training courses on chemotherapy [1].

The researcher explains the results of his research that the nursing staff is not involved in training courses related to administering chemotherapy in cancer units, whether inside or outside Iraq.

Table (3.2 & 3.4) overall assessment of the study sample responses at the pre-post test for study group and control group shows a significant Improvement in Knowledge in study group: Overall, the results demonstrate a significant improvement in the participants' knowledge after the educational intervention. This is

evident in the shift from lower levels (Low and Fair) to the Good level in all three domains.

The study findings manifested that the knowledge of the participants for Study Group regarding Nursing Intervention on Chemotherapy Administration in the pre-test was low knowledge as shown in table (3.2) this means that nurses have had inadequate knowledge in concerning to Nursing Intervention on Chemotherapy Administration in oncology units. In previous studies conducted by Habib et al. [15], According to Abdullah and Rasheed [16], the nursing staff involved in administering chemotherapy medications lacks enough information about these medications. The findings are similarly consistent with those of a research by Chaudhary and Karn [17], which found that participants had inadequate knowledge about the use of personal protective equipment when administering chemotherapy drugs. As the result makes clear, the majority of the nursing staff lacked oncology training and knew very little about the use of chemotherapy, the significance of cytotoxic medications, and how to handle the psychological and physical side effects that cancer patients endure. If oncology nurses lacked advanced knowledge, this discovery would have a significant impact on nursing care for cancer patients and chances for medication administration errors can be high. According to the researcher's findings, the majority of the nursing staff had not participated in any training sessions pertaining to nursing interventions in the administration of chemotherapy. As indicated in tables (3.2), the post-test results demonstrated that nursing staff members' knowledge had improved following the implementation of the educational program.

These findings agree with a study conducted by Jabbar and Mohammed (2012) Illustrated that the education program was effective in improving the knowledge of the participating nurses [18]. Moreover, a study by Chaudhary and Karn concluded that the effectiveness of educational program regarding nurses' Knowledge concerning chemotherapy precautions had a positive effect on the study group [17].

The study also reveals that, at a p-value of 0.0001, there was a highly statistically significant difference between the study group's overall responses in the pre-test and post-test measurement periods.

The knowledge of overall nurse's knowledge showed the biggest improvement, going from a pre-test mean score of 1.40 to a post-test mean score of 1.75 right after; this difference was statistically significant (p-value 0.0001).

These results are in line with a study by G. Abd-Elrazik (2018), which shows that the mean nurse's knowledge scores (Mean ± SD) about chemotherapy, safe handling of chemotherapy, and overall knowledge improved significantly before and after the implementation of a chemotherapy program [19].

As indicated in table (3.3), these results demonstrate that the study group's nursing staff members' knowledge has improved from the pre-test to the post-test.

While the overall knowledge level of the nurses showed a minimal improvement in control group, with a slight shift from 73.3% in the Fair category to 90% in the Fair category. The findings of this study suggest that the control group, which did not receive the educational intervention, showed limited improvement in their knowledge of chemotherapy administration as shown in table (3.4).

Table (3.5) Overall Nurses' Knowledge: No statistically significant differences were found between the pre-test and post-test scores in any of the knowledge domains or in the overall nurses' knowledge regarding chemotherapy administration. This indicates that the control group's knowledge remained relatively stable over the study period. The results of the Wilcoxon Signed Rank test suggest that the control group's knowledge regarding chemotherapy administration, precautions, and safe handling did not change significantly over the course of the study. The researcher explains this result as expected to happen in the control group because this group did not receive any educational intervention.

Table (3.6) Overall Nurses' Knowledge: No statistically significant difference was found between the study and control groups at the pre-test. This suggests that both groups had comparable baseline knowledge overall. While a statistically

significant difference was found between the study and control groups at the post-test. The study group demonstrated significantly higher knowledge scores compared to the control group overall. The researcher interprets this result as indicating that the educational intervention had a positive impact on the nurses' overall knowledge as the study group demonstrated significantly higher knowledge scores than the control group in all knowledge domains at the post-test.

Conclusion:

The effectiveness of the educational program was clearly observed on the study group through the positive effects on all questionnaire items including knowledge related to the uses and types of chemotherapy, precautions and safe handling of chemotherapy administration, identifying exposure risks, in addition to disposing of chemotherapy waste and managing side effects at pre- and post-test measurements. The knowledge of the nursing staff in the control group did not have any effect or change at pre- and post-test measurements. There were no statistically significant differences between the study group and the control group at pre-test measurements regarding total knowledge, while there were statistically significant differences between the study group and the control group at post-test measurements.

Recommendation:

The study recommended the necessity of implementing the advanced program and repeating it once or twice a year, as well as updating the knowledge of nursing staff by encouraging and motivating them to participate in special training programs and conferences on nursing interventions in chemotherapy administration. Similar research should be conducted in other Iraqi cities with a larger sample size.

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