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Effect of an Educational Training Program on Nurses' Competency in Caring For Older Adults At-Risk For Diabetic Foot Ulcer in Alexandria, Egypt

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Abstract: Prevention of diabetic foot ulcer is highly recommended for diabetic patients especially in older adult population. Nurses must be competent in the early recognition and management of this problem to reduce its burden. This study was carried out to evaluate the effect of an educational training program on nurses' competency in caring for older adults at-risk for diabetic foot ulcer. A quasi experimental research design (One group pretest and posttest) was implemented in this study, in the training unit of the Ministry of Health and Population, Smouha / Alexandria. Thirty nurses were selected randomly from 10 out of total 16 governmental general hospitals affiliated to the Ministry of Health and Population in Alexandria Governorate. Tools of data collection were I-Nurses' Profile Questionnaire, II-Nurses' Diabetic foot Knowledge Questionnaire, III- Elderly Patient with Diabetic Foot Ulcer Case Study. Results showed a statistically significant difference between nurses' total level of knowledge and their practice in case study application before and after the application of the program f: 3.151 p: 0.025 & f: 19.599 P: 0.000 respectively. It could be concluded that the educational training program had a positive effect on nurses' competency which includes their knowledge and practice to care for older adults at-risk for diabetic foot ulcer. Recommendations; The gerontological nurses should apply the Inlow's 60- Seconds Diabetic Foot Screen as a part of their routine nursing care for diabetic elderly patients. Raise the nurses' awareness through continuing education on diabetic foot and its care.

Key words: Educational Program · Nurses' Competency · Older Adult At-Risk · Diabetic Foot Ulcer

INTRODUCTION

Diabetic foot ulcer (DFU) is a major overwhelming and destructing complication of diabetes mellitus (DM), with high morbidity, disability and resources utilization. Incidence every year is estimated to be around 2% and experience of DFU life time incidence lies between 15 and 25 % [1, 2]. Diabetic peripheral neuropathy is one of the most common risk factors leading to DFU and is the vast majority of hospital admissions for those with DM [3]. Treatment of DFU is challenging because of their multifactorial etiology. It places an affliction on patients, their families, health care system and society [1]. DFU accounts for a leg lost every 30 seconds worldwide [3]. Amputation needs rehabilitation and adaptation to the prosthesis. It causes pain, suffering, loss of mobility and live long dependence to the patient.

Older age with DM bring the most noteworthy rates of major lower extremities amputation [4]. The lower limbs amputation prevalence in diabetic patients in the United States is approximately 2 times higher for persons aged 65 years and older compared to those less than 65years, with higher rates all over the developing countries [5-7]. A study was done in Alexandria, Egypt 2015, showed that the prevalence of DFU was 8.7% (10.3% among males and 7.0% among females) [8]. Another Egyptian study was done at Al-Azhar University hospitals found that, age above 60 years is among the related risk factors of DFU [9].

Older adults often have a diversity of risk factors making them at-risk for DFU [5]. The older adult population often presents multiple comorbidities, higher prevalence of malnutrition and different metabolic disturbance as DM that are potentially deleterious skin condition. Also, age related changes that occur in the integumentary system such as skin dryness, fragility and decreased blood supply which can accelerate the formation of DFU. Thus, the term "at-risk" foot should be mostly applied to the feet of such patients [5]. In accordance with the IWGDF definition, "At-risk" was

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defined as "Presence of peripheral neuropathy, with or without a foot deformity or peripheral artery disease, or a history of foot ulcer(s) or amputation of (A part of) the foot or leg" [1].

Therefore, the prevention of DFU has long been recognized as apriority by the IWGDF 2015 [1]. Numerous studies have shown that amputation could be reduced by 40 to 80% through the detection of high-risk patients and measures that focused on prevention such as early recognition and management of people at-risk of DFU to improve patient's quality of life. Foot screening is an appropriate way to do that [1, 3, 5-7&10]. Evidences supported that patients with DM may profit from this screening as a prophylactic interventions [10, 11]. The American Diabetes Association (ADA) [2] includes a section on older adults in its annual Standards of Medical Care in Diabetes. It included that screening for DM complications ought to be tailored in older adults particularly the complications which impaired their functional status and quality of life such as DFU and amputations [4].

ADA [2] recommended annual foot screening to identify diabetic patients at-risk for DFU, which lead to amputation. Despite these recommendations, foot screening is not performed routinely. This may related to multiple reasons, including lack of interest, lack of imbursement for routine care and lack of knowledge, skills and time of the providers [12, 13]. There is a poor understanding and underrating of the seriousness of DFU within the professionals. The duty of foot screening in many situations is given to nurses who might have a lack of adequate knowledge and training in this regard, because the role of the podiatrists is still not clearly determined [12, 14-16]. Bangladesh study reported that nurses did not know what tools to use and what exactly to document in screening of diabetic patient's foot, they reported a very unsatisfactory level of knowledge on prevention and management of DFU [17].

It is disappointing that there is a gap between both nurse's knowledge on DFU prevention in clinical practice and scientific research in this area. Health care providers and researchers should combine their attempts to build up an evidence base on prevention of a first DFU. Nurses as a health care providers need to be more competent and active in improving their clinical knowledge and practice through further continuing education and participation in the related training programs [17]. They should be attentive to the importance of foot screening and care management. Educational programs seem to benefit nurses' knowledge regarding foot health and care [5, 18 & 19].

The role of the gerontological nurses in enhancing foot health, looking after the existing foot problems and supporting the elderly in foot self-care is important in every health care setting to promote independent living of the diabetic elderly patients and improving their quality of life [19-21]. The gerontological nurses should be able to prevent an ulcer before it develops especially in elderly patients. If they already come with ulcers, nurses must be able to manage it to prevent further problems such as infection, necrosis, ischemia or gangrene and amputation. Gerontological nurses must be competent by having accurate and comprehensive knowledge as well as ability to perform necessary measures to screen elderly patients who are at-risk, so that preventive measures and risk management can be implemented [5, 17].

Aim of the Study: This study aimed to evaluate the effect of an educational training program on nurses' competency in caring for older adults at-risk for diabetic foot ulcer.

Operational Definition: Nurses' competency in the present study refers to the attainment of knowledge, intellectual capacities and practice skills that provide guide enabling the identification, evaluation and development of the nurse to change their behaviors in the care for older adults at-risk for diabetic foot ulcer.

Research Hypothesis: The nurses who receive the study's educational training program exhibit higher competency (Knowledge and practice scores) in caring for the older adults at- risk for diabetic foot ulcer after the program than before it.

MATERIALS AND METHODS

Design: A quasi experimental research design (One group pretest and posttest) was implemented in this study.

Setting: The study was conducted at the training unit of the Ministry of Health and Population, Smouha, Alexandria.

Subjects: The subjects included 30 nurses who were selected randomly from 10 out of total 16 governmental general hospitals affiliated to the Ministry of Health and Population in Alexandria Governorate. By using equal allocation method 3 nurses were selected from each hospital outpatient clinics. The distribution of the nurses in the selected hospitals by Alexandria districts is illustrated in the Table (a).

Table a: Distribution of the Nurses in the Selected Hospitals by Districts

Alexandria districts	Hospital's name	Number of nurses
Middle zone	El- Ramad general hospital	3
	El- Homiat general hospital	3
West zone	El- Agami general hospital	3
	El- Gomhoria general hospital	3
El-Montaza	Abo-kair general hospital	3
	Sadr El-Maamoura	3
	Shark El-Madina hospital	3
El-Ameryia	El-Ameryia general hospital	3
	New Borg El-Arab general hospital	3
El-Gomrok	Raas El-Teen general hospital	3
Total	10 hospitals	30

The subjects were chosen from these hospitals based on the need of the Ministry of Health and Population, Alexandria region. In order to decrease the risk of DFU, a new clinic for diabetic foot will be established in each selected hospital. The Ministry of Health needs to prepare its nursing staff with the necessary training and education to be competent in early detection, prevention and management of DFU.

Tools:

Tool I: Nurses' Profile Questionnaire: It was developed by the researchers to obtain data about sex, age, marital status, level of nursing education, hospital name, position title, years of experience, previous experience in the diabetic foot clinics and previous participation in any training program regarding diabetic foot.

Tool II: Nurses' Diabetic foot Knowledge Questionnaire: It was constructed by the researchers after thorough review of the related literature [15, 17 & 18]. It was self-administered questionnaire that examined the nurses' knowledge regarding healthy foot, common foot problems, Diabetes Mellitus (DM), differences between DM in adults and older adults, complications of DM, diabetic foot, causes & risk factors, people at-risk to develop DFU, clinical picture of diabetic foot, different means of treatment and the nursing role in the diabetic foot clinic. Each nurse was asked to answer 10 questions reflecting their knowledge. The answers were scored the following; a score of 2 was given to correct and complete answer, a score of 1 was given to correct and incomplete answer and 0 score was given to incorrect answer or don't know. The scores of total knowledge extended from 0 to 20 point. Nurse who scored below fifty percent was categorized as having unsatisfactory level of knowledge, while those who scored ≥ 50% was categorized as having satisfactory knowledge level.

Table b: Recommended Screening Schedule

Score	Recommendations For Screening
0 to 6	Yearly
7 to 12	every 6 months
13 to 19	every 3 months
20 to 25	every 1 to 3 months

Tool III: Elderly Patient with Diabetic Foot Ulcer Case Study: A clinical scenario was created by the researchers after a thorough review of the related literature [11-13, 22] to evaluate the program effect on nurses' practice. It illustrated a clinical case of an older adult with DFU. The nurses should apply individually the Inlow's 60- Seconds Diabetic Foot Screen test [22]. It was a tool designed to assist the nurse in screening persons with diabetes to prevent or treat diabetes related foot ulcer and/ or limb threatening complications. By joining the results of different parameters presented in the Inlow's 60-second Diabetic Foot Screen such as skin, nails, range of motion, sensation (Monofilament testing), vascularity, pulse, footwear, temperature, dependent rubor, erythema and deformities. Once the screen is completed the nurse can determine patients' risk score, recommended screening schedule and care recommended [Table (b)].

The clinical case study was self-administered tool and included 3 questions related to identify score of the case's diabetic foot as regard the previously taught screening tool, screening interval & schedule, the recommended care and the nursing role for this patient. The questions were given 1, 2, &7 grades respectively for complete and correct answer. The total case study scores ranged from 0 to 10 point. Nurse who had case study % score below 50% was categorized as having unsatisfactory level of practice, while those who had case study % score ≥ 50% was categorized as having satisfactory level of practice.

Method:

- Official approval of the Gerontological Nursing Department Council and the Council of the Faculty of Nursing were obtained, after the arrival of a letter of request from the training unit of the Alexandria Health Directorate, Administration for Nursing.
- Tools I, II and III were developed and translated into Arabic language by the researchers after a review of the related literature.
- Illustrated educational booklet guide "Nursing Guide in Caring for Patients with Diabetic Foot" was created by the researchers after reviewing of the current and related literature[5, 10, 11, 13, 18, 20 & 22-24]. It included the content of the study's educational program under two parts;
- Part (1); which included knowledge about healthy foot and skin, common foot problems, DM, diabetic foot, nursing role in the diabetic foot clinic, what is the diabetic foot clinic, nursing care plan for diabetic foot, foot screening and care.
- Part (2); the practical part included explanation of the Inlow's 60- Seconds Diabetic Foot Screen and its application.
- A jury composed of 5 experts in the related fields as gerontological nursing and medical surgical nursing was consulted to examine the content validity of the study tools. All tools verified to be valid.
- A pilot study was done on 5 nurses that were not involved in the study subjects to test feasibility, clarity and applicability of the tools. Necessary amendments were done accordingly.
- Reliability of the tool II was tested using cronbach's alpha test on 5 nurses. It showed acceptable level of reliability 80%.
- The participant obtained the approval from their work hospital to attend the training in the form of work mission.
- The educational program was conducted into 6 sessions, 2 sessions / week for 3 weeks. The sessions were conducted on Sunday and Tuesday each week. Each session started at 9 AM and tile 2 PM. It was divided into 2 parts from 9 AM to 11.30 AM, which included the theory and the knowledge. The researchers allow the participant to take a break for half an hour then the second part of the sessions was completed which included the practical part.
- During the practical part of each session, the participants were distributed into small equal groups that facilitate the group interaction.
- Before beginning the first day of the training program, the researchers distributed self-administered questionnaire (Tool I, II) and (Tool III) for all the study subjects. The researchers checked all questions for completeness.
- Program's content:

First Session: In the 1st session an introduction and welcome was given by the researchers and clarification of the learning objectives of the program. The researchers provided the opportunity for each participant to write down their learning needs and what they expect to achieve through the program. This session included knowledge about; healthy foot and skin, common foot problems, the management for each problem and age related changes in the integumentary system of elderly people. In the practical part of this session, the researchers distributed different colored pictures on the participant for all foot problems and allowed 30 minutes for the participants to distinguish and identify each problem and determine type of management needed. Each group was given the opportunity to discuss and present the answers with guidance from the researchers.

Second Session: The researchers used a power point presentation about DM, definition, simple pathophysiology, causes, risk factors, why older adults are at risk to develop it, types, manifestation in adults and older adults, its complication and management. In the practical part of this session, the researchers invited male elderly patient with DM to attend this session, for sharing his personal perspectives and experiences of his diagnosis and difficulties facing him. The researchers prepared a role play with the assistance of the elderly patient to simulate the process of taking his health history at the diabetic clinic. Demonstration of this process is done by the participant through assessing the older adult's condition and asking him questions to identify his history, chief complains, types of DM, apparent complications, treatment and care needed for him.

Third Session: It included knowledge about diabetic foot, definition, causes, risk factors, people at-risk for DFU, why older adults at-risk, clinical picture, diagnostic tests, different novel ways of treatment and nursing care plan for diabetic foot. In the practical part of this session; another elderly female diabetic patient was invited, she suffered from diabetic foot. She described her experience; the participant assessed her condition and gave her the teaching needed for her condition.

Fourth Session: Using a power point presentation, the researchers illustrated a detailed description for the diabetic foot clinic (physical and human resources) and emphasized on the nursing role in it. In the practical part of this session, the researchers distribute a brochure on the diabetic foot care for each participant. The researchers also displayed a video about diabetic foot clinic and the nursing role in the clinic. This video had a lot of mistakes and errors the nurse do, the researchers asked the participant to detect the errors and missing items in the video according to what they have learned.

Fifth Session: The researchers in this session explained with details the Inlow's 60-Seconds Diabetic Foot Screen, distribute a written copy of it to all participants with instructions and displayed a video to illuminate it step by step. In this session the nurses were educated on how to perform a monofilament examination using recommendations of ADA [2] they performed practical foot screening and examination on each other in small groups, while being observed by the researchers.

Sixth Session: The closing session included evaluation of the training program by distributing the study tool II and III for the participants. Tool III included written case study on elderly patient with DFU. The researchers obtained the participants' opinion to determine the weak and strong points in the program and how useful the program is for their practice. Overall, the feedback from the participants has been very positive. The participants stated that they disseminated what they have learned to their colleagues in their work place, the trainees became trainers for others. Finally attendance certificates and booklet guide were distributed and evaluation forms collected.

- A diversity of teaching and learning strategies were used such as small group discussion and interaction, role play, case studies, videos, power point presentations and brochures.
- The telephone numbers and E- mail addresses were obtained from the participants by the researchers in the first session to develop ways of distant contact and communication. The researchers created face-book and whatsApp groups for continuing education, discussion and problem solving.
- Comparison was done between pre and post- test questionnaire (Tool II) and case study application (Tool III) to determine the program's effect.
- Data were collected during first 3 weeks of August 2015.

Ethical Considerations: A letter about the study was directed to all the selected nurses in their work place, to clarify the purpose of the study, assure them the anonymity and privacy and informing them that their participation was voluntary and the data confidentiality of the research will respected. There is no need for written consent because the nurses' approval is implicit in their reply to the study's questionnaire.

Statistical Analysis: The collected data were coded and analyzed using PC with the Statistical Package for Social Sciences (SPSS version 20) and tabulated frequency and percentages were calculated. Descriptive statistics as frequency, distribution, mean and standard deviation were used to explain different characteristics. The one-way analysis of variance (ANOVA) is used to decide if there are any statistically significant differences between the means of two or more independent groups (F Test). The level of significance chosen for this study was p value equal to or less than 0.05.

RESULTS

Table (1) describes the profile of the study subjects; it was observed that all of them were females, highest percent of them 36.7% aged 40 years and more, while the lowest percent 30% aged less than 30 years with a mean of 36.1±8.5 yrs. The majority of the nurses 80 % were married. Half of them 50% stated that they have Technician Nursing as the professional qualification, followed by 33.3% reported deplume qualification and the least percent 16.7% were have bachelor degree. Regarding the current job position, most of them 83.3 % were nurses and 16.7% were head nurses. 43.3% of nurse reported that they had from 10 to less than 20 years of experience in nursing, 30% reported 20 years and more and 26.7% reported less than 10 years of experience with mean of 16.3±8.6 yrs. Highest percent of them 76.7% reported no previous experience in working in diabetic foot clinic, while the 23.3% reported working in private clinics. No one from the studied nurses received any previous education or training on diabetic foot.

Table (2) illustrates the effect of the educational training program on nurses' knowledge; a progress was observed in the answers of the nurses all over the questions after the program. When asking about the common foot problems, 86.7% of them reported do not know/ incorrect answers before the program, while all of them answered this question correctly after the implementation of the program. As regarding knowledge related to diabetic foot, 60.0% of them do not know or

Table 1: Study Subjects' Profile

Variables	No n = (30)	%
Sex		
Female	30	100.0
Male	0	0.0
Age (Years)		
Less than 30	9	30.0
30-less than 40	10	33.3
40 and more	11	36.7
Mean ± SD	36.1± 8.5	
Marital Status		
Married	24	80.0
Single	6	20.0
Professional Qualification		
Deplume (secondary nursing education)	10	33.3
Technical (Institute of Nursing Technician)	15	50.0
Bachelor (Faculty of Nursing)	5	16.7
Current Job Position		
Nurse	25	83.3
Head nurse	5	16.7
Nursing Experience (years)		
Less than10	8	26.7
10- less than 20	13	43.3
20 and more	9	30.0
Mean ± SD	16.3± 8.6	
Previous Experience in Diabetic Foot Clinic		
No	23	76.7
Yes	7	23.3
Previous Training in Diabetic Foot		
No	30	100.0

Table 2: Effect of the Educational Training Program on Nurses' Knowledge

	Before the program n = (30)						After the program					
	Do not know/ Incorrect answers		Incomplete correct answers		Complete correct answer		Do not know/ Incorrect answers		Incomplete correct answers		Complete correct answer	
Knowledge	No	%	No	%	No	%	No	%	No	%	No	%
Q1 What are the common foot problems?	26	86.7	4	13.3	0	0.0	0	0.0	0	0.0	30	100.0
Q2 What do you know about diabetes mellitus (DM)?	10	33.3	20	66.7	0	0.0	2	6.7	16	53.3	12	40.0
Q3 What is the difference between DM in adults & older adults?	30	100.0	0	0.0	0	0.0	11	36.7	0	0.0	19	63.3
Q4 What are the complications of DM?	19	63.3	11	36.7	0	0.0	3	10.0	14	46.7	13	43.3
Q5 What do you know about diabetic foot?	18	60.0	6	20.0	6	20.0	2	6.7	0	0.0	28	93.3
Q6 What are the causes of diabetic foot?	28	93.3	2	6.7	0	0.0	0	0.0	0	0.0	30	100.0
Q7 What are the risk factors for diabetic foot?	18	60.0	12	40.0	0	0.0	0	0.0	6	20.0	24	80.0
Q8 What are the manifestations of diabetic foot (ulcer)?	25	83.3	5	16.7	0	0.0	0	0.0	11	36.7	19	63.3
Q 9 What are the different approaches of treatment of diabetic foot (ulcer)?	16	53.3	14	46.7	0	0.0	4	13.3	14	46.7	12	40.0
Q 10 What do you know about role of the nurse in the diabetic foot clinic?	7	23.3	23	76.7	0	0.0	0	0.0	0	0.0	30	100.0
Min-max	0-7						15-20					
Mean± SD	3.6±2.3						16.5±1.4					

Table 3: Effect of the Educational Training Program on Nurses' Practice through the Application of Inlow's 60- Seconds Diabetic Foot Screen

	Before the program n = (30)						After the program					
	Do not know/ Incorrect answers		Incomplete correct answers		Complete correct answer		Do not know/ Incorrect answers		Incomplete correct answers		Complete correct answer	
Case study	No	%	No	%	No	%	No	%	No	%	No	%
Q1 Please determine the suitable score of elderly patient's foot according to the table of Inlow's 60- Seconds Diabetic Foot Screen?	30	100.0	0	0.0	0	0.0	0	0.0	5	16.7	25	83.3
Q2 Identify the recommended screening schedule for her diabetic foot?	30	100.0	0	0.0	0	0.0	5	16.7	1	3.3	24	80.0
Q3 What is the role of the nurse for this patient?	7	23.3	18	60.0	5	16.7	0	0.0	11	36.7	19	63.3
Min-max	0-4						2-10					
Mean± SD	1.8±1.4						7.03±2.5					

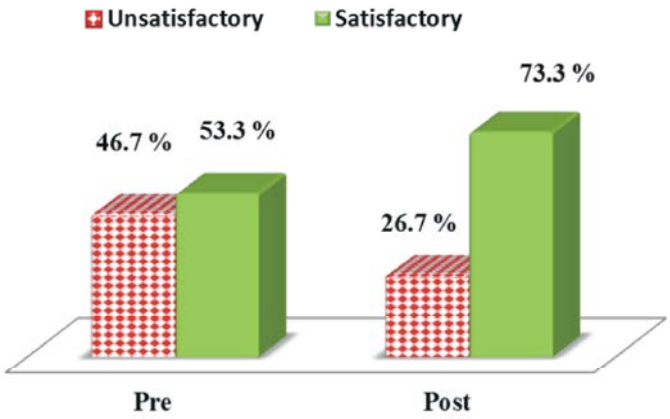

Fig. 1: Total Nurse's Knowledge Score Pre and Post the program

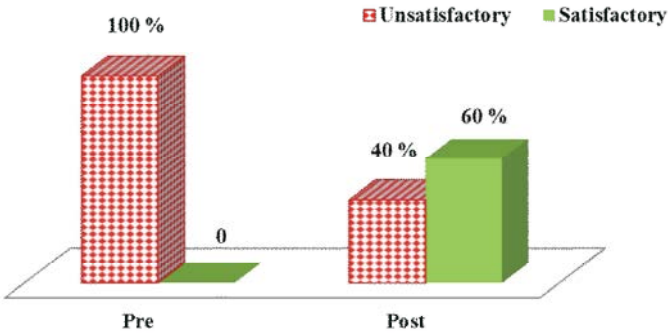

Fig. 2: Total Nurse's Practice Score Pre and Post the Program

Table 4: The Differences in Nurses' Knowledge and Practice Scores by Mean Distribution Pre and Post the Program

	Sum of Squares	df	Mean Square	F	Sig.
Total Knowledge score (Pre versus Post)					
Between Groups (Combined)	66.167	5	13.233	3.151	.025*
Within Groups	100.800	24	4.200		
Total	166.967	29			
Total practice sore (Pre versus Post)					
Between Groups (Combined)	130.539	4	32.635	19.599	.000*
Within Groups	41.627	25	1.665		
Total	172.167	29			

F: ANOVA test

Sig: P value of ANOVA test

*: Significant P value at ≥ 0.05

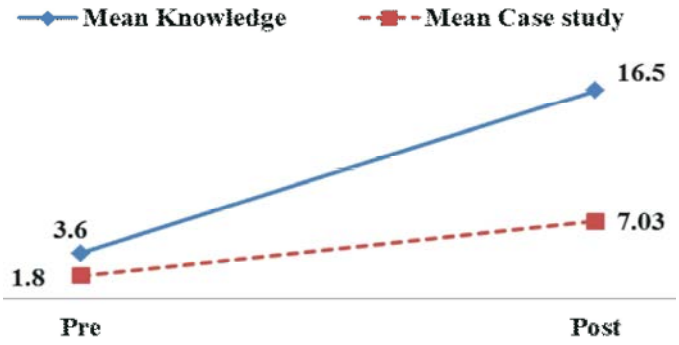

Fig. 3: The Mean Difference of the Nurses' Knowledge and Practice (Case Study) Pre and Post the Program

reported incorrect answer before the program, the knowledge of 93.3% of them was improved after the program in this question. As for the nursing role in the diabetic foot clinic, the entire nurses post the program reported correct answer compared to no one prior the program.

Table (3) clarifies the effect of the program on nurses' practice through case study application of Inlow's 60-Seconds Diabetic Foot Screen on elderly patient with DFU. The program showed positive effect on nurses' practice of foot screen and care after the execution of the program. Regarding determining the risk score before the program, no one can identify it, while 83.3% of them identify it after the program. As regard the capability to categorize the recommended screening schedule according the score of diabetic patient's foot, 80% of them able to determine it post the program compared to no one prior the program. As for the application of the nursing role for case study's patient, 63.3% of them reported correct answer post the program compared to 16.7% prior the program.

Fig. (1) Shows the total nurses' knowledge score pre and post the program. It was observed that more than half of the study subjects 53.3%had satisfactory level prior the program compared to 73.3% post-program.

Fig. (2) displays the total nurses' practice score which revealed their case study application level before and after the program. No one in the studied participants reported a satisfactory practice level prior the program compared to 60% post- program.

Table (4) explains the differences in nurses' knowledge and practice scores by mean distribution before and after implementation of the program. It was found a statistically significant positive relation between total nurses' knowledge score before and after the program with marked improvement (F= 3.151 p= 0.025). Also, their practice through the application of Inlow's 60- Seconds Diabetic Foot Screen on elderly patients with DFU showed significant improvement after the program than before it (F= 19.599 p= 0.000).

Fig. (3) demonstrates the mean difference of knowledge and practice before and after the implementation of the program. It was observed increased in the mean knowledge from 3.6 before the program to 16.5 after the program. Also, the mean practice score increased from 1.8 before the program to 7.03 after the program.

DISCUSSION

Although diabetic foot complication and its related morbidity and mortality are preventable, it becomes a devastating global burden [25]. It is recommended that primary prevention strategies such as screening can be adopted to reduce the occurrence of diabetic foot complications [2, 3 & 26]. While a multidisciplinary approach of diabetic foot problems management is desired, the nurses play a key role in the preventive and control of diabetes complications especially in the elderly people [19, 26]. To deliver a high quality DM care, the nurses need to have up-to-date knowledge and skills. However, the knowledge and practice of diabetic foot problems, in many cases, is in-sufficient [15, 17& 18]. Continuing education and training may improve nurses' awareness and skills of foot care practice including screening, but the research evidence is still preliminary [19, 27].

All the study subjects were females (Table 1), this clearly shows the lack of male interest in the profession and decrease their enrollment in the nursing education. This result comes in accordance with many studies such as Haram *et al*. [15], Sharmistha *et al*. [17] and Davies A. [25]. The mean age of the study subjects was 36.1 ± 8.5 years and the mean years of their nursing experience was 16.3 ± 8.6 years. This result agrees with the study of Waheida *et al*. [28] in Egypt, which revealed that the participants' mean age was 35 ± 13 years. Sharmistha *et al*. [17] in Bangladesh and Haram *et al*. [15] in Oslo contradicted the present finding and revealed that the average years of duration of nurses' practice was 8.03 ± 5.82 and 8.2 ± 8.78 years respectively. All the participants of the present study informed that they did not participate in any training program on diabetic foot before (Table 1). The same result was found in study of Sharmistha *et al*. [17] which disclosed that all subjects did not receive any training regarding prevention and management of DFU before. Also, Waheida *et al*. [28] reported the same result in her study.

The recognition of feet at-risk especially in the elderly patients is the most essential step in preventing diabetic foot complications [6]. The nurses need to be competent in the clinical practice by giving more attention to older people foot health especially who suffered from DM. They need to have adequate knowledge about the disease and its complications especially DFU and the appropriate actions to prevent and/or treat it [27]. Unfortunately, the knowledge of DM and foot problems of nursing staff is poor [25]. The participants of the current study (Table 2) reported unsatisfactory level of knowledge regarding common foot problems, DM, diabetic foot, its causes, treatment and their role for elderly patients with DFU. The same result is found in a study of Davis and Buxton [25] in Ghana, which concluded that the knowledge level of

the nurses in the area of DM and diabetic complications was poor. Also, Haram *et al*. [15] discovered that high percent of the nurses had lack of knowledge regarding diabetic foot, DFU, causes, manifestations and treatment. Sharmistha *et al*. [17] confirmed the current study and showed that nurses who participated in the study had a very low level of knowledge regarding prevention and management of DFU. A study of Mclntosh and Ousey [29] in England opposed the existing study and conveyed that most of the participants reported adequate level of knowledge regarding DFU and its care.

Knowledge of diabetic foot care necessities to be continuously updated. Higher scores in knowledge of diabetic foot practice were explained by participation in continuing education and training program [19, 28]. Limited studies have examined how an educational program for nurses could improve nurses' knowledge of foot care [27]. The current study illustrated higher response rate among the participants after the execution of the program regarding their knowledge (Table 2), their answered improved all-over the questions concerning DM, DFU treatment and nursing role. The results of the current study displayed improvement in their total score of knowledge with a statistically significant difference pre and post the program (Figure 1, Figure 3 and Table 4). Pataky *et al*. [5] study in Geneva approved with the current finding and reported that after application of an educational program, a significant improvement in knowledge was noted in nurses and nursing aids in identifying risk for the foot. Also, Shiu and Wong [26] in China came in accordance with the existing study and noted that nurses who had received prior training had diabetes foot care knowledge score higher than those who did not. An Egyptian study of Waheida *et al*. [28] reinforced the present finding and conveyed that the post test of the educational program demonstrated that all nurses had improved their diabetic foot care knowledge. Christensen *et al*. [30] controverted the present finding and when measuring nurses' knowledge before and after an educational program, they found that the change was not statistically significant; they showed that the nurses still had some knowledge deficiencies.

Some educational programs have been organized for nurses to enhance their foot care skills. After acquisition of an educational program which included clinical skills, nurses presented improvement in their assessment skills and in their talent to identify foot health problems and select appropriate nursing interventions [31-34]. The current study revealed that the study's training program had a positive effect on nurses' practice and application to care for elderly patient with DFU (Table 3). The participants showed noticeable progress in their response rate pre and post the program (Figure 2), with a statistically significant difference in the total practice score before and after the program (Figure 3 and Table 4). Waheida *et al*. [28] supported the finding of the current study and stated that the skills and practice of the nurses were improved after the diabetic foot care program. McDonald *et al*. [33] in Canada agreed with the existing study and approved that the respondents showed improvement for identifying the high risk foot and appropriate screening intervals after the training program using the Inlow's 60-second foot screen.

The results of the current study approved that the educational training program affected positively on nurses' level of knowledge and practice to be competent for caring with an elderly patient at-risk for DFU. Results may be a starting point for the use and application of foot screening evaluation tool for nurses in the diabetic foot clinic that help in developing preventive measures with regard diabetic foot complications in the older adults.

Limitation of the Study: Unfortunately, the researchers could not evaluate the long term effect of the study's educational program on the nurses' practice in their actual clinical situation. Not evaluating the long term effect was related to that the diabetic foot clinics were not established yet.

CONCLUSION

In conclusion, the nurses exhibited improvement in their competency after receiving the study's educational training program in caring for older adults at-risk for DFU. More than half of the nurses' reported unsatisfactory total knowledge score before the implementation of the program compared to nearly two third of the after it. Also, their level of practice was improved, nearly two third of them showed satisfactory level of practice before the program compared to all of them after it.

RECOMMENDATIONS

- The gerontological nurse should use the Inlow’s 60-Seconds Diabetic Foot Screen as a part of their routine nursing care for diabetic elderly patients in the diabetic foot clinic to detect the cases at risk to develop DFU, provide appropriate care and to relieve the burden of the complication on patients, their families and the society.

- Raising the awareness of the nursing personnel by the staff who received the training program in their work place to upgrade their knowledge and practice especially who work with the diabetic older adults about the importance of the foot assessment, screening and care.
- The researchers will disseminate the booklet of "Nursing Guide in Caring for Patients with Diabetic Foot" to all health care facilities specialized for DM.
- The researchers will keep contact with the responsible person in the Ministry of Health and Population in Alexandria to continue the follow up and evaluation of the nursing staff practice in the real clinical situation after the establishment of the diabetic foot clinic.

Further Research:

- Effect of using Inlow's 60- Seconds Diabetic Foot Screen test on the early detection and prevention of diabetic foot ulcer in older adults.
- Barriers and nurses' attitude in using Inlow's 60- Seconds Diabetic Foot Screen test in the diabetic foot clinic.

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