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Prevention of Needle Stick and Sharp Injuries during Clinical Training among Undergraduate Nursing Students: Effect of Educational Program

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Abstract:
Background: *Nursing students are particularly exposed to occupational hazards such as needle stick and sharp injuries due to limited knowledge and experience. These injuries with sharps may lead to dangerous hazards such as infections with hepatitis B&C and HIV.*
Aim: *This study was conducted to assess the effect of educational program on knowledge and practice of undergraduate nursing students toward prevention of needle stick and sharp injuries during clinical training.*
Design and Setting: *The study was used a quasi experimental design to collect data from the undergraduate nursing students at Faculty of Applied Medical Science and Faculty of Health Science in Dammam University at Hafr Al Batin Governate, KSA.*
Sample: *All available (33) second and third year nursing students who were registered at third year in the Faculty of Applied Medical Science (18)students and (15) students from second & third year at Faculty of Health Science.*
Tools*: Data collection tools consisted of 2 parts; sociodemographic part and assessment of undergraduate nursing student's knowledge and practice regarding needle stick and sharp injuries during clinical training.*
Results: *The program contributed to a significant improvement in the level of nursing students' knowledge and practice regarding needle stick and sharp injuries post intervention educational program.*
Recommendation*: This study recommended that increase sensitization of undergraduate nursing students for prevention and management of NSSIs are essential in preventing the occupational hazards, it is necessary to be included in the nursing training curriculum plan and continuous educational programs are needed to increase awareness of needle stick and sharp injuries.*
Keywords: *Needles stick injury, sharp injury, and educational program.*

I. Introduction

Nursing Students as other health care workers who come into contact with patients' blood and body fluids may be exposed to fatal infections when they perform their clinical activities in the hospital [(1,2)]. According to data from the World Health Organization has estimated that in developing regions, 40%–65% of Hepatitis B virus and Hepatitis C virus infections in health care workers are attributable to per-cutaneous occupational exposure, nurses experienced needle stick and sharp injuries more frequently than other healthcare workers [(3)]. The frequency of such events has been estimated to be about 600,000–800,000 cases annually in the USA [(4)]. In Saudi Arabia some published studies about needle stick and sharp injuries showed that there were a reported 116 cases of NSSIs from Assir central hospital during the period from 1996 to 2000 between health care workers [(5,6)].

Needle-stick and sharp injuries are defined as an accidental skin penetrating wound caused by hollow-bore needles such as hypodermic needles, blood-collection needles, Intra-venous catheter stylets, needles used to connect parts of IV delivery system, scalpels and broken glass [(7)]. Another definition for NSSIs mean the par literal introduction into the body of healthcare workers, during performance of their duties of blood or other potentially hazardous material by a hollow bore needle or sharp instruments, including, but not limited to, needles, lancets, scalpels, and contaminated broken glass [(8)]. Needle stick and sharp injuries can result in the transmission of serious disease to nursing students [(9)] such as HIV, hepatitis B and hepatitis C from contacts with deep body fluids and blood. The risk of being infected following a single needle stick from a source-patient with blood borne infection ranges from as low as 0.3% for human immunodeficiency virus (HIV), and 3% to 10% for hepatitis C to as high as 40% for hepatitis B[(10,11)].

Needle stick injuries most frequently occur during drawing blood, administering an intramuscular or intravenous drug, or performing other procedures involving sharps where the needle can deviate and injure the nursing students during their training [(12)]. For sharp injuries, sutures and use of sharp tools are most common equipment that causes injuries [(13)]. Other important causes of NSSIs were high workload, working hastily,

fatigue and a crowded work environment [14,15], also performing some activities as two-handed recapping, unsafe sample collection, disposal of sharps waste and washing contaminated instruments [13,16]. Needle stick and sharp injuries usually cause some risks such as; bleeding, minor surface scratches and minor visible skin injuries, although the main risk is transmission of viral infections but scalpel-caused wounds need more attention in comparison with needle stick injuries [17].

In the clinical settings, lack of clinical experience and insufficient attention to personal safety put nursing students at high risk for occupational exposure to blood-borne pathogens through needle stick injuries (NSIs) and sharps injuries (SIs) [18, 19]. According to **McCarthy and Britton** who reported that 27% of the nursing students who were studied in the hospital experienced exposure to blood borne pathogens through needle sticks and sharp injuries. They suggested that a high risk for non-sterile occupational injuries existed because these students were doing invasive procedures with minimal knowledge and experience [20]. So pre-clinical undergraduate nursing students often are prepared for the clinical area with the use of simulations in learning or skills laboratory before caring for patients [19].

Nursing students are vulnerable to needle stick and sharp injuries as they start their work of patient care in the hospital from 1st year of their training curriculum because they might have insufficient background to recognize the level of risk that is posed by patients and insufficient knowledge about standard infection control principles for blood-borne pathogens [18,20]. High percentage of the needle stick and sharp injuries can be prevented through the use of safety devices and effective applying of "Universal precautions" as safety measures [8]. Universal precaution is defined as the routine use of appropriate barriers and techniques to reduce the likelihood of exposure to blood, other body fluids and tissues that may contain blood borne pathogens [21].

Nursing students are most suitable candidates for educational training about prevention of NSSIs as they are likely to come across such critical situations in the future, this training strategies include; safety education to improve personal universal precautions, elimination of needle recapping and use of sharp containers for safe disposal which reduced needle stick injuries with additional reductions possible through the use of safer needle devices [22] and reduce patients' risk of exposure to the blood of injured personnel [23]. Thus, it is critically important to conduct this study on nursing students because they have less knowledge and clinical experience and are more at risk of unsafe injection practices.

II. Aim of the study

This study was conducted to assess the effect of educational program on knowledge and practice of undergraduate nursing students toward prevention of needle stick and sharp injuries during clinical training.

Research questions

1-Why needle stick and sharp injuries occur among nursing students?
2-Why needle stick and sharp injuries not reported?
3-What is the importance of needle stick and sharp injuries prevention for nursing students?

III. Design and Setting

3.1 Research design;

A quasi-experimental design with pretest posttest.

3.2 Settings;

This study was conducted at Nursing Department in the Faculty of Applied Medical Science and Faculty of Health Science, Damam University and King Khaled Hospital at Hafr Al-Batin Governate, KSA, during clinical curriculum rotation of undergraduate nursing students.

3.3 Subjects;

All available (33) second and third year of undergraduate nursing students who were registered at Faculty of Applied Medical Science and Faculty of Health Science, Damam University, they were divided as following; (18) nursing students from third year at Faculty of Applied Medical Science and (15) nursing students from second & third year at Faculty of Health Science. Second-year nursing students related to Faculty of Applied Medical Science were excluded because they are not expected to handle sharps during their practical training in the hospital.

3.4 Questionnaire:

The study questionnaires were developed by the researcher to assess undergraduate nursing students' knowledge and practice toward prevention of needle stick and sharp injuries during their clinical training in the hospital before and after educational program; it was consisted of:

Tool I; Knowledge questionnaire sheet was developed by the researcher based on **Hashmi A., etal (2012) [7], Kaur D., etal (2014) [24]**and current related literature [24], it was covered; socio-demographic

characteristics of the undergraduate nursing students namely as: age, year of training, department, training about needle stick injury, training about infection control measures, have a needle stick injury and A structured questionnaire which was developed to gather the knowledge regarding needle stick and sharp injuries before and after educational program; the questionnaires were covered the following items; definitions, transmitted diseases & main area of needle stick and sharp injuries (6) items, causes of NSSIs (10) items, knowledge about infection control measures (5) items, knowledge about sharps disposal containers (7) items and knowledge related to immediate response after NSSIs (6) items. The researcher used "Yes" or "No" *Scoring system of this questionnaire:-* (1) mark was given for correct answer and (zero) for wrong answer, with a total score of (34), the heigher the socre, the heigher the level of knowledge regarding NSSIs.

Tool II- Observational checklist was developed by the researcher based on **Hashmi A., etal (2012) [(7)], Kaur D., etal (2014) [(24)] and Safety Meetings for Health Care Workers (2002) [(25)]**. It was covered (4) procedures related to needle stick and sharp injuries performance as the following; assessment of hazards in work environment perior starting procedures (9) items, preparation of patient and equipment before procedures (8) items, performance during needle and sharp procedures (9) items and performance after needle stick and sharp procedures end (8) items. The researcher used "Done" or "Not done" *The scoring system for performance checklist:-* (1) mark was given for done answer and (zero) for not done answer, with a total score of 34, The heigher the score the better the performance regarding needle stick and sharp procedures.

3.5 Methods of data collection:

The necessary approval was obtained from the Dean of the Faculty of Applied Medical Science in Dammam University at Hafr Al Batin Governate to carry out the study. Oral consent was obtained from every students who included in the study after explanation the aim of the study and assuring them of confidentiality of collected data. Confidentiality was maintained by the use of code number instead of name and the right of withdrawal was reserved. Tools were revised by 3 experts in the field of Medical and Surgical Nursing to ascertain the content clarity and validity of items. Apilot study was conducted on 3 nursing students to ensure the reliability of the tool, applicability of items and identify the obstacles and problems that may be encountered in data collection, this number were excluded from the studied sample. Data collection for this study was carried out in the period from March 2015 to May 2015. Two sheets were used two times, the first time for data collection was at the beginning of the study as a baseline measure before starting educational program. The second time was 7 weeks after program had begun.

Prepration& Intervention phase for the program:-

- The pretest for undergraduate nursing students' knowledge and practice was carried out before the beginning of the study, to detect the needs of the students. knowledge sheet was filled by the students within 25 minutes in the Faculty Lab and observational check list was filled by the reasearcher in the King Khaled Hospital during clinical training within 30 minutes for each students .
- The students were divided in **the faculty sessions**,according to their clinical curriculum plan into two groups; group (1) was included (18) nursing students from third year at Faculty of Applied Medical Science and group (2) was included (15) nursing students from second & third year at Faculty of Health Science. **In the hospital clinical training sessions**, they were divided into (5) groups as following; (7) students in medical unit,(7) students in surgical unit, (10) students in ICUs, (7) students in kidney unit and (2) students in emergency unit, distribution of the nursing students was depended on the capacity of each unit and their clinical rotation plan.
- The instructional material used in teaching was included the booklet prepared by the researcher through literature review[(4,26,27,28,29)] about needle stick and sharp injuries prevention. The subjects in two groups were given 120 min/ lecture and group discussion using a powerpoint presentation for knowledge part, with viewed a 60-minute video about how to use needle and shap instruments by demonstration & redemonstration with using real material for performance part. The educational program was covered in (14) sessions; each session lasts 2 hours, 2 days a week for a period of 7 weeks.
- **1st and 2nd sessions (first week)** two groups were given theoretical knowledge about needle stick and sharp injuries which covered; definitions, transmitted diseases & main area of needle stick and sharp injuries, causes of NSSIs, infection control measures, sharps disposal containers and knowledge related to immediate response after injuries.
- **-3rd ,4th ,5th and 6th sessions(second and third week)** nursing students were exposed to a demonstration and hands-on training using a mannequin in the Faculty lab by the researcher through presentation of techniques for needle and sharp instruments as following; assessment of hazards in workplace, preparation before procedure, performance during procedures and performance after procedures. 3rd & 4th sessions were carried out in the second week for students in group (1) and 5th & 6th sessions were carried out in the third week for students in group (2).

- **In the next 4 weeks (8 clinical sessions)** of the program were given to the nursing students according to previous distribution in the King Khaled Hospital during their clinical practice rotation to train them about how to perform procedures on real situations by the researcher with four demonstrators in the following clinical settings (medical, surgical, ICU, kidney unit and emergency unit).

Post-test evaluation phase;

Post-training, four trained nurse observers, using the checklist, documented students' work place practices with regard to assessment of hazards in workplace, preparation before procedure, performance during procedures and performance after procedures. Students were observed individually for 30 minutes and were awared that they were being watched. After that knowledge sheet were filled by the students within 25 minutes in the faculty Lab.

IV. Methods of data analysis

All data were collected, coded, tabulated and subjected to statistical analysis. Statistical analysis is performed by statistical Package SPSS in general (version 13), also Microsoft office Excel is used for data handling and graphical presentation. Quantitative variables are described by the Mean, Standard Deviation (SD), while qualitative categorical variables are described by proportions and percentages. Descriptive statistics are used to analyze the response to individual items and the respondents' characteristics. Chi-square and P- value test used to test correlation.

V. Results

Figure (1): Shows the distribution of the studied undergraduate nursing students according to their socio-demographic characteristics. As regard to age, the figure shows that the highest percentage of the nursing students (60.6%) were in the age group (20-21) years old. In relation to year of training, the figure shows that the 54.54% of the sample was third year of applied medical science whereas 45.45% were from second and third year at faculty of health science. As regard to department the figure shows that highly percentage of the students were in ICUs (30.3%). Also the figure shows that all students (100%) have no training about needle stick and sharp injuries. And about 54.4 % of them have no training about infection control measures, also the figure shows that more than three quarter of the students have no needle stick and sharp injuries previously.

Table (1): Shows that the comparison of the studied undergraduate nursing students according to their knowledge regarding transmitted diseases and main area of needle stick and sharp injuries from pre to post educational program. The table shows that there was a significant improvement in undergraduate nursing students' knowledge about different items related to transmitted diseases and main area of NSSIs from preprogram to post educational program intervention at $p \leq 0.05$.

Table (2): Shows that there was significant improvement in the knowledge of undergraduate nursing students regarding causes of needle stick and sharp injuries post than pre educational program regarding; lack of knowledge and experience, recapped/bent needle after use, transferring needle and sharp instruments between containers, during sutures, injection and puncture, opening or breaking of an ampoule, during the intervention by instrument and assisting in surgery and increased workload in the morning shift as following; from (36.4, 54.5, 42.4, 66.7, 57.6, 42.6, 21.2%) pretest as compared to (81.8, 93.9, 87.9, 90.9, 87.9, 75.8, 87.9%) respectively post educational program intervention at $p \leq 0.05$.

Figure (2): Shows that the distribution of studied undergraduate nursing students according to knowledge about infection control measures from pre to post program, The figure shows that there was significant improvement in nursing students' knowledge related to different items about infection control measures from 54.5% preprogram to 84.8% post educational program intervention at $p \leq 0.05$.

Table (4): Shows that the comparison of the studied undergraduate nursing students according to their knowledge about sharp disposal containers from pre to post program, The table shows that there was significant improvement in nursing students' knowledge related to sharp disposable containers as following; Sharp containers must be replaced before they are 3/4 full, sharps containers must be readily available in any area where sharps are likely to be used, sharp containers can be placed in a location that is easily accessible during emergency procedure, sharp containers can receive sharps from any direction desired and accept all sizes and shapes of sharp instruments, Not important to Select containers that are closable, puncture resistant and leak proof and ensure that containers are clearly and correctly labeled, that is red or yellow in color as follow from (30.3, 36.4, 24.2, 54.5, 90.9, 69.7%) pretest as compared to (93.9, 81.8, 84.8, 93.9, 12.1, 97%) respectively post educational program intervention at $p \leq 0.05$.

Fig (3): Shows the distribution of studied undergraduate nursing students according to knowledge about immediate response after NSSIs from pre to post program. The figure shows that there was significant improvement in undergraduate nursing students knowledge about different items regarding immediate response after NSSIs from preprogram to post educational program intervention.

Table (5): Shows that the comparison of the studied undergraduate nursing students according to their performance regarding assessment of work environment from pre to post program. The table shows that there was significant improvement in performance regarding; assess risk of NS and sharp injuries for patients' tasks, assess work environment for ensure lightening is adequate, assess patients capacity for cooperation, assess interruptions from visitors to avoid movement during procedures, assess the department policy about report needle stick injuries, assess need for assistance from other nurses and assess presence of all needed needle and sharp equipment as follow; from (18.2, 57.6, 69.7, 42.4, 21.2, 60.6, 87.9%) pretest as compared to (87.9, 84.8, 93.9, 90.1, 87.9, 84.8, 100%) respectively post educational program intervention at $p \leq 0.05$.

Table (6): Shows that there was significant improvement in undergraduate nursing students performance about preparation of patients and equipments prior of the procedure regarding; explain procedure to the patients to gain their cooperation, prepare all equipment in available and within arm's reach, instruct patient to avoid sudden movement during procedure, prepare all infection control measures within arm's reach , check the needle and sharp instrument before use , ensure all sharps are accounted for and visible and replace sharp disposal containers if they are 3/4 full, as follow from (75.8, 87.9, 69.7, 24.2, 66.7, 27.3, 69.7%) pretest as compared to (90.9, 100, 97, 84.8, 90.9, 93.9, 93.9%) respectively post educational program intervention at $p \leq 0.05$.

Table (7): Shows that there was highly significant improvement in undergraduate nursing students performance during procedure regarding; when handling an exposed sharp is aware of other staff location, avoid bringing the hands close to the opening of a sharps container, needles not be recapped, bent or broken by hands, immediately discarded used sharps or needles into a sharps container, the safety cover in the sharps bin not closed between uses, secured needle to avoid spillage during procedure, keep the hands behind the sharp tip with cotton when using the device, use a mechanical device to pick up the sharps instruments as follow from (24.2, 45.5, 45.5, 36.4, 60.7, 54.5, 39.4, 51.5 %) pretest as compared to (72.7, 93.9, 81.8, 84.8, 18.2, 93.9, 81.8, 97 %) respectively post educational program intervention at $p \leq 0.05$.

Table (8): Shows that there was significant improvement in undergraduate nursing students performance Post-procedure regarding; ensure all sharps are accounted for and visible, transport reusable sharps in secured closed container, disposable needles and syringes disposed as a single unit, inspect procedure trays containing waste materials for the presence of sharps that may have been left after the procedure, never pick up broken glass by hand; use forceps, tongs, scoops, or other mechanical means, visually inspect outside waste container for protruding sharps and take suitable action as follow from (18.2, 75.8, 24.2, 87.9, 60.6, 75.8 %) pretest as compared to (100, 90.9, 90.1, 97, 87.9, 90.9 %) respectively post educational program intervention at $p \leq 0.05$.

Figure (1): Distribution of studied undergraduate nursing students according to their socio-demographic characteristics.

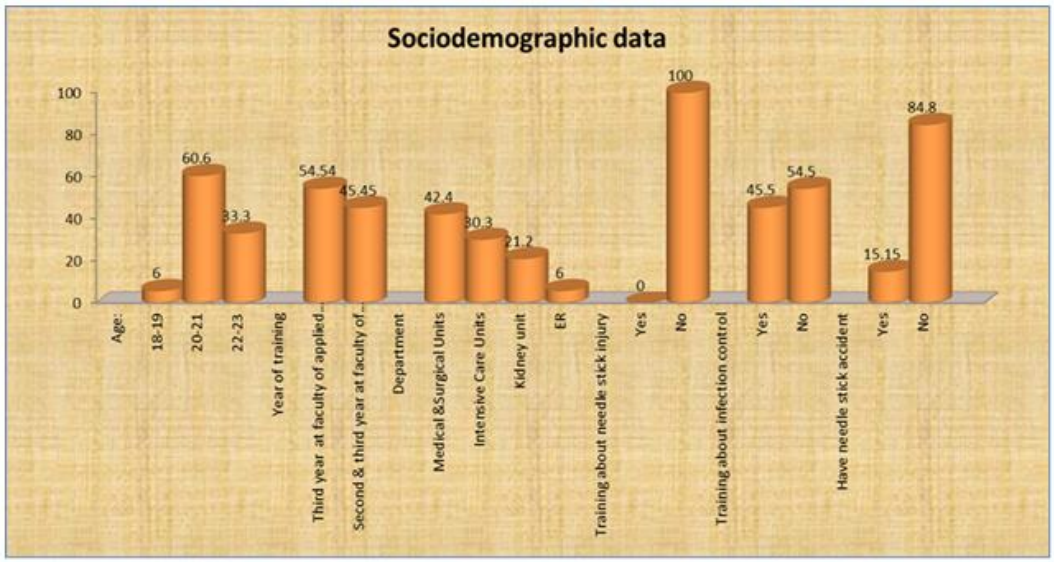

Table (1): Distribution of the studied undergraduate nursing students according to their knowledge regarding transmitted diseases and main area of needle stick and sharp injuries from pre to post program

	Pretest	Posttest	X2

Items	No	%	No	%	P-value
1- Any penetration of the skin by a sharp instrument as needle can be defined as an acute sharp injury.					
Right	10	30.3	30	90.9	**41.02**
wrong	23	69.7	3	9.1	**0.011***
2- Infections which transmitted from needle stick and sharp injuries are life threatening for workers.					
Right	25	75.8	33	100	**36.46**
wrong	8	24.2	0	0.00	**0.012***
3- Operating room and ICUs are the main area where needle stick and sharp injuries occur.					
Right	21	63.6	30	90.9	**28.13**
wrong	12	36.4	3	9.1	**0.001***
4- Surgical & medical, emergency units and procedures room are from area where needle stick and sharp injury occur.					
Right	28	84.8	32	97	**42.16**
wrong	5	15.2	1	3	**0.024***
5- Can Hepatitis B, C transmitted by needle stick and sharp injuries.					
Right	32	97	33	100	**38.27**
wrong	1	3	0	0.00	**0.002***
6- HIV may be transmitted by needle stick and sharp injuries.					
Right	23	69.7	33	100	**37.19**
wrong	10	30.3	0	0.00	**0.020***

*Significant or P≤0.05

Table (2): Distribution of the studied undergraduate nursing students according to their knowledge regarding causes of needle stick and sharp injuries from pre and post program

Items	Pretest		Posttest		X2 P-value
	No	%	No	%	
1- Lack of knowledge and experience.					
Right	12	36.4	27	81.8	**26.41**
wrong	21	63.6	6	18.2	**0.001***
2- Recapped/bent needle after use.					
Right	18	54.5	31	93.9	**28.17**
wrong	15	45.5	2	6.1	**0.010***
3- Transferring needle and sharp instruments between containers.					
Right	14	42.4	29	87.9	**31.46**
wrong	19	57.6	4	12.1	**0.021***
4- During cleaning					
Right	30	90.9	33	100	**23.17**
wrong	3	9.1	0	0.00	**0.011***
5- During sutures, injection and puncture.					
Right	22	66.7	30	90.9	**37.16**
wrong	11	33.3	3	9.1	**0.128***
6- Obtain fluids and sample tissue with Lack of assistant					
Right	30	90.9	33	100	**23.17**
wrong	3	9.1	0	0.00	**0.011***
7- Opening or breaking of an ampoule.					
Right	19	57.6	29	87.9	**36.17**
wrong	14	42.4	4	12.1	**0.240***
8- During the intervention by instrument and assisting in surgery.					
Right	14	42.4	25	75.8	**29.43**
wrong	19	57.6	8	24.2	**0.001***
9- Increased workload in the morning shift					
Right	7	21.2	29	87.9	**31.25**
wrong	26	78.8	4	12.1	**0.001***
10- Lack of protective measures.					
Right	30	90.9	33	100	**23.17**
wrong	3	9.1	0	0.00	**0.011***

*Significant or P≤0.05

Fig (2): Distribution of studied undergraduate nursing students according to their knowledge about infection control measures from pre to post program.

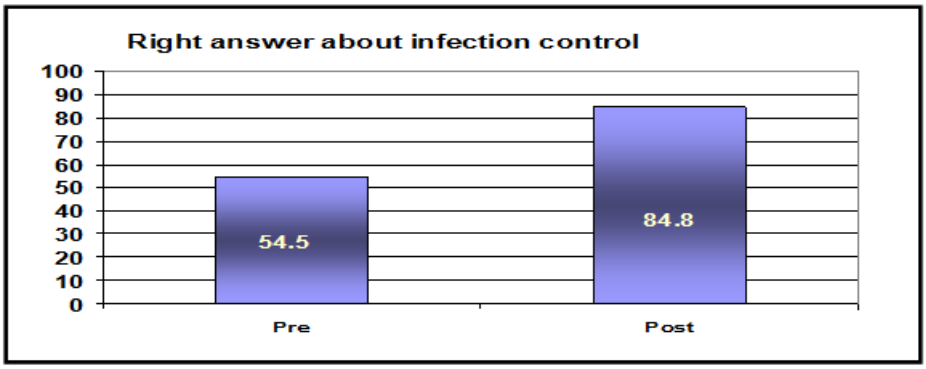

Table (4): Distribution of the studied undergraduate nursing students according to their knowledge regarding sharp disposal containers from pre to post program

Items	Pretest		Posttest		X2 P-value
	No	%	No	%	
1- Sharp containers must be replaced before they are 3/4 full.					
Right	10	30.3	31	93.9	**63.27**
wrong	13	69.7	2	6.1	**0.001***
2- Sharp disposable containers must be readily available in any area where sharps are likely to be used.					
Right	12	36.4	27	81.8	**26.41**
wrong	21	63.6	6	18.2	**0.001***
3- Needle and Sharp instruments must be put into the sharp container immediately and not left protruding from the container or left on top or lying around outside of the container.					
Right	27	66.7	33	100	**19.24**
wrong	6	33.3	0	0.00	**0.002***
4- Sharp containers can be placed in a location that is easily accessible during emergency procedure.					
Right	8	24.2	28	84.8	**20.46**
wrong	25	75.8	5	15.2	**0.001***
5- Sharp containers must receive sharps from any direction desired and accept all sizes and shapes of sharp instruments.					
Right	18	54.5	31	93.9	**28.17**
Wrong	15	54.5	2	6.1	**0.010***
6- Not important to Select containers that are closable, puncture resistant and leak proof.					
Right	30	90.9	4	12.1	**37.89**
wrong	3	9.1	29	87.9	**0.028***
7- Ensure that sharp containers are clearly and correctly labeled, that is red or yellow in color.					
Right	23	69.7	32	97	**67.45**
wrong	10	30.3	1	3	**0.000***

*Significant or P≤0.05

Fig (3): Distribution of studied undergraduate nursing students according to knowledge about immediate response after needle stick and sharp injuries from pre to post program.

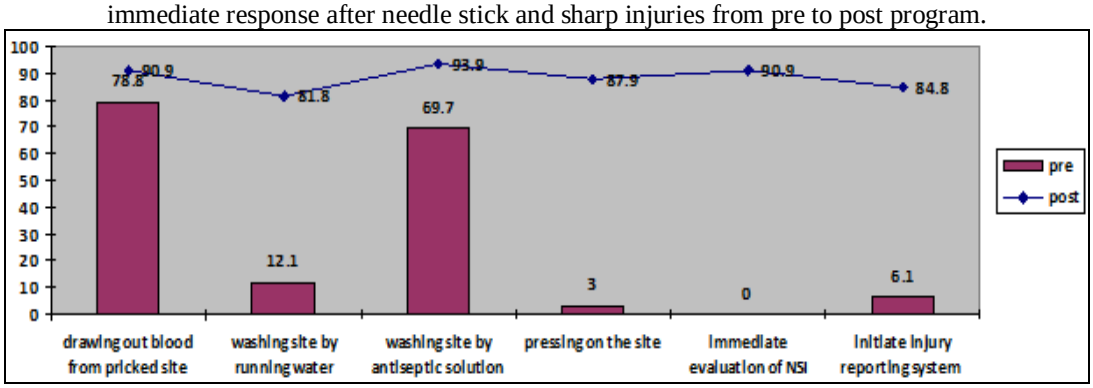

Table (5): Distribution of the studied undergraduate nursing students according to their performance regarding assessment of work environment from pre to post program

Items	Pretest		Posttest		X2 P-value
	No	%	No	%	
1-Assess the risk of needle stick and sharp injuries for patients' tasks.					
Done	6	18.2	29	87.9	**36.47**
Not done	27	81.8	4	12.1	**0.002***
2-Assess the work environment for Ensure lighting is adequate.					
Done	19	57.6	28	84.8	**54.20**
Not done	14	42.4	5	15.2	**0.020***
3-Assess patient's capacity for cooperation.					
Done	23	69.7	31	93.9	**27.19**
Not done	10	30.3	2	6.1	**0.014***
4-Assess the availability of equipment of infection control measures.					
Done	29	87.9	33	100	**155.28**
Not done	4	12.1	0	0	**0.001***
5-Assess interruptions from visitors to avoid movement during procedures.					
Done	14	42.4	30	90.1	**29.27**
Not done	19	57.6	3	9.1	**0.023***
6-Assess the department policy about report needle stick injuries.					
Done	7	21.2	29	87.9	**39.16**
Not done	26	78.8	4	12.1	**0.017***
7- Assess the need for assistance from other nurses.					
Done	20	60.6	28	84.8	**25.14**
Not done	13	39.4	5	15.2	**0.002***
8-Assess measures in place to eliminate exposure to such hazards.					
Done	33	100	33	100	-
Not done	0	0	0	0	-
9-Assess presence of all needed needle and sharp equipment.					
Done	29	87.9	33	100	**155.28**
Not done	4	12.1	0	0	**0.001***

*Significant or P≤0.05

Table (6): Distribution of the studied undergraduate nursing students according to their performance about preparation of patient and equipment prior of the procedure from pre to post program

Items	Pretest		Posttest		X2 P-value
	No	%	No	%	
1-Explain procedure to the patients to gain their cooperation.					
Done	25	75.8	30	90.9	**45.18**
Not done	8	24.2	3	9.1	**0.001***
2-Prepare all equipment in available and within arm's reach.					
Done	29	87.9	33	100	**47.16**
Not done	4	12.1	0	0	**0.012***
3-Do not exposes sharps/needles until moment of use and keep pointed away from user.					
Done	30	90.9	33	100	**17.46**
Not done	3	9.1	0	0	**0.001***
4-Instruct patient to avoid sudden movement during procedure.					
Done	23	69.7	32	97	**67.45**
Not done	10	30.3	1	3	**0.000***
5-Prepare infection control measures equipment within arm's reach.					
Done	8	24.2	28	84.8	**20.46**
Not done	25	75.8	5	15.2	**0.001***
6-Check the needle and any sharp instruments before use.					
Done	22	66.7	30	90.9	**34.16**
Not done	11	33.3	3	9.1	**0.012***
7-Ensure all needle and sharps are accounted for and visible.					
Done	9	27.3	31	93.9	**46.72**
Not done	24	72.7	2	6.1	**0.002***
8-Replace sharp disposal containers if they are more than 3/4 full.					
Done	23	69.7	31	93.9	**34.16**
Not done	10	30.3	2	6.1	**0.024***

*Significant or P≤0.05

Table (7): Distribution of the studied undergraduate nursing students according to their performance during procedure from pre to post program

Items	Pretest		Posttest		X2 P-value
	No	%	No	%	
1-Use appropriate personal protective equipment and aseptic technique before starting procedure.					
Done	30	90.9	33	100	**33.16**
Not done	3	9.1	0	0	**0.023***
2-When handling an exposed sharp they aware of other staff location.					
Done	8	24.2	24	72.7	**32.27**
Not done	25	75.8	9	27.3	**0.011***
3-Avoid bringing the hands close to the opening of a sharps container.					
Done	18	45.5	31	93.9	**42.16**
Not done	15	45.5	2	6.1	**0.047***
4-Needles not be recapped, bent or broken by hands.					
Done	15	45.5	27	81.8	**46.27**
Not done	18	54.5	6	18.2	**0.011***
5-Immediately discarded used sharps into a sharps container.					
Done	12	36.4	28	84.8	**43.27**
Not done	21	63.6	5	15.2	**0.024***
6-The safety cover in the sharps bin not closed between uses.					
Done	20	60.7	6	18.2	**41.30**
Not done	13	39.3	27	81.8	**0.004***
7- Secured needle to avoid spillage during procedure.					
Done	18	54.5	31	93.9	**42.16**
Not done	15	45.5	2	6.1	**0.047***
8-Keep the hands behind the sharp tip with cotton when using the device					
Done	13	39.4	27	81.8	**32.26**
Not done	20	60.6	6	18.2	**0.011***
9-Use a mechanical device to pick up the sharps instruments.					
Done	17	51.5	32	97	**36.79**
Not done	16	48.5	1	3	**0.014***

*Significant or P≤0.05

Table (8): Distribution of the studied undergraduate nursing students according to their performance Post-procedure from pre to post program

Items	Pretest		Posttest		X2 P-value
	No	%	No	%	
1-Ensure all sharps are accounted for and visible after ending.					
Done	6	18.2	33	100	**36.45**
Not done	27	81.8	0	0	**0.003***
2-Transport reusable sharps immediately in secured closed container					
Done	25	75.8	30	90.9	**41.25**
Not done	8	24.2	3	9.1	**0.012***
3- Disposable needles and syringes disposed as a single unit.					
Done	8	24.2	30	90.1	**37.16**
Not done	25	75.8	3	9.1	**0.021***
4-For non-reusable sharps, visually inspect disposal container to ensure device will fit.					
Done	33	100	33	100	-
Not done	0	0	0	0	-
5-Inspect procedure trays containing waste materials for the presence of sharps that may have been left after the procedure					
Done	29	87.9	32	97	**37.16**
Not done	4	12.1	1	3	**0.014***
6-Never pick up broken glass by hand; use forceps, tongs, scoops, or other mechanical means.					
Done	20	60.6	29	87.9	**41.27**
Not done	13	39.4	4	12.1	**0.022***
7-Contaminated glass (i.e., broken or unbroken culture tubes or broken flasks) discarded immediately into a sharps container					
Done	17	51.5	28	84.8	**54.20**
Not done	16	48.5	5	15.2	**0.020***
8- Visually inspect outside of waste containers for protruding sharps and take suitable action.					
Done	25	75.8	30	90.9	**41.25**
Not done	8	24.2	3	9.1	**0.012***

*Significant or P≤0.05

VI. Discussion

A needle stick and sharp injury is puncture of the skin by a needle or sharp instruments that may have been contaminated by contact with an infected patient or fluid. All health care personnel who including emergency care providers, laboratory personnel, surgeons, interns, medical students, nursing staff and students are at risk of acquiring needle stick and sharp injuries during their routine work **(12).** Present study was carried out to assess the effect of educational program on knowledge and practice of undergraduate nursing students toward prevention of needle stick and sharp injuries during clinical training.

The present study revealed that the majority of the nursing students were 20-21years/old and highly percentage of them 30.3% were carried out their clinical training in the intensive care units, these factors may increase risk rate of needle stick and sharp injuries between nursing students due to limited clinical experience and special care which was needed for patients in ICUs. This was in agreement with **Ilhan M.N., etal. (2006**) **(30)** who said that most common factors that increase risk for needle stick and sharp injuries are age when was less than twenty four years, having less than four years of nursing experience & training and when nurses are working in the critical units as operation room or intensive care units.

The study findings of the present study revealed that more than three quarters of the nursing students have no previous training about needle stick and sharp injuries; this may be due to short training hours in the lab and hospital during clinical training and increase workload in the morning shift in the hospital which is the time of students training. This was in a line with **Al-Momani S.M., etal. (2013) (2)** who clarified that there is still insufficient attention paid to the prevention of needle stick and sharp injuries for nursing students during their training in the hospitals. Also **Al tawil F. A. M. (2013) (19)** said that Preclinical, nursing students must be prepared for the clinical area with the use of simulations in a learning or skills before performing practice procedures in the hospital.

The present study revealed that poor knowledge of undergraduate nursing students about needle stick and sharp injuries and they were needed training programs. These results were consistent with the findings **Yang Y., etal. (2007) (31)** who said that, training nursing students about prevention and management of needle stick and sharp injury was found to be very effective in enhancing their knowledge about it and the incidence of needle stick and sharp injuries could be decrease between them.

Related to nursing student's knowledge about area where injuries more occur as in Medical & Surgical wards, Operating room, ICUs and transmitted diseases as HCV, HBV, and AIDS, findings of the present study indicated that there was improvement in their knowledge after participation in the program. This may be due to nursing students may be acquired limited knowledge about transmitted disease through infectious disease courses and in our program this knowledge were covered **(Table1)**. This result was in agreement with **Talas M.S. (2009) (32)** and **Blackwell L., et al. (2007) (33)** who concluded that needle stick and sharp injuries more occur in Surgical & Medical departments, Critical care areas and Operating rooms. In the same line with **Deisenhammer S., et al. (2006) (34)** said that, students' knowledge about the transmission risks of HIV, hepatitis B and C through a needle stick and sharp injuries with a contaminated needle was poor before education and improved after participation in program.

Regarding nursing student's knowledge about causes of NSSIs, the present study indicated that there was improvement in their knowledge after participation in the program related to; lack of knowledge and experience, recapped/bent needle, transferring needle and sharp instruments between containers, during sutures, injection and puncture, breaking of an ampoule, during intervention by instrument & assisting in surgery and increased workload in the morning shift **(Table2).** This may be due to that nursing student may have insufficient background knowledge about needle and sharp procedures and also inadequate supervision during clinical practice. This was in agreement with **Fredrich M., etal. (2005)(35) and ChengH.C., etal. (2012) (36)** who said that almost half of the injuries occurred during injection and recapping. Recapping of used syringes is responsible for 29% of injuries causes so nurses must be advised through training program not to recap the needles to prevent these injuries.

In addition to **Zafar A., etal. (2008) (37)** said that more than half of the needle stick and sharp injuries (52.8%) occurred while drawing the blood samples or injecting the medicine. This finding indicates the importance of education, planning and careful handling of syringes while performing these simple procedures. In other study done by **Baghcheghi N., etal. (2011)(14)** said that most common causes of needle stick and sharp injuries in various studies were high workload, working hastily, fatigue and crowded work environment. Also **Pili J. P., etal. (2013) (38)** reported that the highest rate of NSSIs occurred in the morning shift (58%), where nurses perform basic and heavy works for patients.

Regarding nursing student's knowledge about infection control measures **(figure2)** and sharp disposable container **(table 4)**. The findings of the present study revealed that significant improvement in most of their knowledge after participation in the program. This could be indicated that there was lack of knowledge regarding infection control and sharp disposable container in their nursing courses. This result was in agreement with **Wu C. et al., (2009) (39)** who reported that application of such programs are beneficial in promoting nursing students knowledge of infection prevention and recommended that infection control programs should be

included in nursing school curriculums. In the same line **Vaz k., etal. (2010)** [(40)] reported that it is important that all new employed nurses particularly the young and inexperienced, should be taught the correct techniques for handling/disposing sharps and using protective clothing/devices. **Also Pournaras S., et al. (1999)**[(41)] reported that syringes and sharps may not have been disposed appropriately during emergency situation and nurses need to be educated about clearing sharps after such uses **Santhna L.P., etal. (2008)**[(42)].

Regarding knowledge about immediate response after NSSIs, the present study revealed that significant improvement after participation in educational program related to; washing site by running water, pressing on the pricked site, immediate evaluation of needle stick injury and initiate injury reporting system. This may be due to unaware of the students about the importance of immediate response and reporting after injury. This result was in agreement with **Cervini P. & Bell C. (2005**) [(43)] who said that knowledge deficit regarding reporting practices seemed to be a major reason that nursing students do not report an injury. In other study done by **Hashemi A., et al., (2012**) [(7)] reported that executing proper in-service education programs along with establishing protocols for implementing new healthcare workers following needle stick injuries may help them to receive proper treatment. Also **Baghcheghi N., et al. (2011)** [(14)] reported that, the most common actions performed after a needle stick injury were applying pressure and washing the area with soap.

The present study findings showed that poor practice of nursing students about needle-stick and sharp injuries before educational program and most of them were needed training programs. Most probably the low level of preprogram performance might be due to inadequate training for NSSIs in hospital, and carelessness of students. These results was consistent with the findings of **Simon L.P.(2009)** [(44)] and **Hambridge K. (2011)** [(45)] who stated that training nursing students is very important in preventing needle stick and sharp injuries as they are most vulnerable group exposed to these injuries, which could be prevented and managed by training of them.

Regarding performance about assessment of hazards in work environment, the present study revealed that significant improvement after participation in educational program related to; assess risk of NSSIs for patients' tasks, assess work environment for ensure lightening is adequate, assess patients' capacity for cooperation, assess interruptions from visitors, assess the department policy about report of NSSIs, assess need for assistance and assess presence of all needed equipment (**table 5).** This was in agreement with **Gamede P. S. (2012)** [(46)] who stated that nurses must conduct risk assessments to identify hazardous practices and processes in the work place to prevent injuries. This also was supported by **Kebede G., et al. (2012)** [(47)] who recommended that effective training, ongoing awareness on the risk of hazards, preventive measures such as engineering control are essential to reduce the risk of such injuries between health care workers. Also **Serinken M. (2009)** [(48)] stated that insufficient training between health care workers has been cited as a significant factor for needle stick and sharp injuries**.**

Present study results showed that the majority of nursing students demonstrated post educational program improvement in their performance regarding preparation before starting procedure related to; explain procedure to the patients, prepare all equipment within arm's reach, instruct patient to avoid sudden movement during procedure, prepare all infection control measures within arm's reach, check the needle and sharp instrument, ensure all sharps are accounted for and replace sharp disposal containers if they are 3/4 full **table (6)**. This was in agreement with **Porta C., etal. (2010)** [(49)] who stated that health care workers should prepare their worksites by select products and strategies to correct the problem and clarify accurate needle stick injury rates, address non-hospital setting risks and evaluate comprehensive interventions to minimize the risk.

In addition to **Foley M. & Leyden A.M. (2003)** [(50)] **and American Nurses Association (2002**) [(29)] mentioned that important preparation between health care workers to prevent NSSIs include; no re-capping needles, placing sharps containers at eye level and at arms' reach, checking sharps containers on a schedule and emptying them before they're full, establishing the means for safe handling and disposing of sharps devices before beginning a procedure. Also **National Institute for Occupational Safety and Health (1999)** [(4)] reported that from prevention strategy that prevent NSIs include; modification of hazardous work practices, administrative changes to address needle hazards in the environment, safety education and awareness.

As regard to performance of nursing students during procedure, the study revealed that improvement in students' performance post educational program related to; aware of other staff location during work, avoid bringing the hands close to the opening of a sharps container, needles not be recapped, bent or broken by hands, immediately discarded used sharps or needles into a sharps container, safety cover in the sharps bin not closed between uses, secured needle to avoid spillage during procedure, keep the hands behind the sharp tip with cotton when using the device, use a mechanical device to pick up the sharps instruments **(table 7)**. This was in agreement with **Zungu L.I., etal., (2008)** [(51)] who said that methods suggested for reducing the occurrence of NPIs between nursing students during clinical practice include the proper use of safety equipment like gloves for all standard procedures, proper disposal of used needles and sharps, proper segregation of hazardous medical waste.

In addition to **Mahmoud H. G., etal. (2013)**[(9)] said that commonly recommended preventive strategies for reducing occupational injuries between nursing students include; education, risk reducing devises such as

single use needles, reduction of unnecessary injections, provision of personal protective equipment, introduction of safety guidelines and reporting mechanisms, and creating a compliance enabling environment**.** Also **Haiduven D.J., etal. (1992) [(52)] and Jagger J. (1996) [(53)]** said that effective needle stick injury prevention measures during procedure include; work practice controls such as educating workers about hazards, implementing universal precautions, eliminating needle recapping, and providing sharps containers that are within sight and arm's reach. This also was supported by **Bagdey P., etal. (2014) [(54)]** who reported that needle stick injuries often occur during unnecessary handling of a used needle .Training should be taken to place used needles in puncture-resistance containers.

As regard to performance of nursing students post procedure, the study revealed that improvement in students' performance post educational program related to; ensure all sharps are accounted, transport reusable sharps in secured closed container, disposable needles and syringes disposed as a single unit, inspect procedure trays containing waste materials for the presence of sharps after the procedure, never pick up broken glass by hand; use forceps, tongs, scoops, visually inspect outside waste container for protruding sharps and take suitable action **(table 8).** This was in agreement with **Wilburn SQ. (2004) [(55)]** who said that the lack of adequate containers for sharps disposal was rated by the majority of respondents (78.4%) as the most important cause for the occurrence of NPIs**.**

Also **Centers for Disease Control & Prevention (1997) [(56)] and Jagger J. (1996) [(53)]** said that primary prevention of NSIs is achieved through the elimination of unnecessary needles, education, universal precautions, elimination of needle recapping, and use of sharps containers for safe disposal, with additional reductions possible through the use of safer needle devices. Also **Hanrahan A. and Reutter L. (2010) [(57)]** stated that initial efforts to prevent sharps injuries focused on placing rigid, disposal containers at the site where sharps were used and instructing new health care workers to refrain from the practice of recapping. In addition to **Kondaguli P.Y. (2010) [(58)]** stated that Practices such as documenting needle stick injury, screening the patient, management after needle stick injuries etc. that should be followed after NSIs are not practiced in most health care settings in India. The preventive measures which are to be taken should be known to every student nurse and other health care workers.

VII. Conclusion

In conclusion; this study revealed that undergraduate nursing students had poor knowledge and practice regarding needle stick and sharp injuries during clinical training. Educational intervention had a positive impact on knowledge and practice of undergraduate nursing students' toward needle stick and sharp injuries. This educational intervention significantly reduced the incidence of NSIs/SIs and increased the report rate of such events.

Recommendation

- The findings of this study suggest that nurse educators must reconsider current curriculum design, course content, and teaching methods concerning nursing student knowledge and practice regarding needle stick and sharp injuries.
- Nursing students in both baccalaureate and associate degree programs must be included in nursing training curriculum about NSSIs and continuing educational programs are needed to increase their awareness of NSSIs.
- In the light of these results, it is essential that nursing and midwifery students should be protected from professional risks like other health care professionals through trained about how to avoid blood-borne pathogens by using infection control measures.
- It also indicated that the hepatitis B vaccination for nursing students should be encouraged and recommended since it was shown that a low percentage of nursing students had received their complete series of hepatitis B vaccine.
- Also replication of the study on a larger probability sample from different geographical areas should be done to achieve more generalizable results.
- Safely manage sharp wastes must be included in training program about NSSIs as collecting contaminated sharp wastes immediately after use (without recapping the needle), and using punctureproof sharp containers that will not leak liquids.

Limitation of the study;

- The size of the sample was limited because the number of the nursing students who were registered in the Faculty of Applied Medical Science was small and the data were collected from only two class (second and third year) which may not represent all students in the Faculty, where other classes were excluded because they are not expected to handle sharps during their practical work in the hospital curriculum.

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