

The Effect of Needle Stick Injury Educational Program on Nursing Interns' Competencies

Ohoud J Aljaloud¹, Hend A Elshnawie¹, Rima S Al-Garni¹

¹ Fundamentals of Nursing Department, Faculty of Nursing, Imam Abdulrahman bin Faisal University. Saudi Arabia.

Address for Correspondence: Ohoud Aljaloud, Fundamentals of Nursing Department, Faculty of Nursing, Imam Abdulrahman bin Faisal University. Saudi Arabia

DOI: <https://doi.org/10.5281/zenodo.7656566>

Published Date: 20-February-2023

Abstract: Needle Stick Injuries (NSI) has become a global concern due to the risk of bloodborne disease transmission. Nursing interns are the most vulnerable group to NSI in the clinical setting. Although this seems to be a common problem among nursing interns, only a few studies have investigated this issue. This study aimed to assess the outcomes of implementing a needle stick injury educational program on nursing interns' competencies concerning the prevention of needle stick injury incidence. A quasi-experimental study was conducted in Saudi Arabia. The sample included 68 nursing interns, who were conveniently selected. The data for this study were collected using three tools: a socio-demographic characteristics tool; a self-administered questionnaire to assess knowledge and perception about NSI; and a checklist to assess interns' practice regarding NSI. Data were collected before the educational program (pre-test) and three times after the program (2, 4, and 6 weeks). The data were analyzed using measures of central tendency; differences in demographic variables were tested using the Mann-Whitney U test and Kruskal-Wallis H test; and the correlation between study variables was analyzed using the Pearson correlation test. The study found that there was a significant increase in the competencies of the participants after implementing an educational program for the prevention of NSI. Moreover, the results revealed that there was a significant positive correlation between knowledge and perception, knowledge and practice, and perception and practice for the participants. Furthermore, there was no correlation between the participants' competencies and their socio-demographic characteristics. In conclusion, implementing an educational program regarding NSI prevention is effective in improving nursing interns' competencies concerning the prevention of NSI incidence and post-exposure interventions.

Keywords: needle stick injuries; sharp injuries; knowledge; perception; practice; competencies; educational program; interns.

I. INTRODUCTION

Needle-stick injuries (NSI) have become a global concern due to the risk of blood-borne disease transmission. NSI can transmit up to 60 bloodborne pathogens; however, the most common hazardous pathogens are Hepatitis B (HBV), Hepatitis C (HCV), and Human Immunodeficiency Virus (HIV) [1, 2]. Furthermore, psychological effects are other consequences of NSI, such as anxiety, fear, depression, post-traumatic stress disorder, and low self-esteem [2]. Moreover, the annual economic burden of the NSI includes the cost of medical evaluation, treatment, follow-up, and absence from work [3].

It is estimated that every year, there are approximately three million NSI injuries among healthcare providers worldwide [1, 4]. However, nursing interns are the most vulnerable group to NSI [5]. It is claimed that nursing interns accounted for more than 50% of the reported cases [6]. This could likely be justified by the fact that nursing interns have an insufficient clinical practice, inadequate knowledge, and limited awareness of personal safety [2]. Additionally, they are not familiar with the steps to follow after NSI.

Mengistu et al. stated that the main causes of NSI are a lack of safe injection practice education and two-hand needle recapping [1]. Moreover, understaffing, long working hours, heavy workloads, and a lack of sharp containers increase the chances of NSI [7]. However, the most potent predisposing factor for NSI was not having attended any previous training

on NSI [8]. Underreporting is one of the main barriers to NSI prevention. More than 85% of interns do not report their injuries [9]. Furthermore, they were unaware of the necessity to report, did not have enough time, or did not know where to report [8].

An educational program aimed at NSI prevention improves the competencies of nursing interns [4]. According to Alwabr et al., nursing interns have insufficient knowledge of post-exposure prophylaxis of bloodborne infection [10]. They were unable to name a single principle of post-exposure prophylaxis for bloodborne infections. Therefore, NSI prevention programs are the primary focus to raise awareness levels and improve nursing interns' practices to prevent exposure to NSI [11]. Furthermore, Alwabr revealed that most participating interns had poor practice and inadequate knowledge of injection safety measures [10]. The study argued that the low level of practice was due to a lack of policies and training on NSI prevention measures [10]. Moreover, nursing interns' risk-reduction practices were enhanced after the educational program [4]. Additionally, Adejumo and Dada argued that nursing interns who have a positive perception and good knowledge of injection safety have better practice than those with negative perceptions and low levels of knowledge [12].

According to Nawafleh et al., who claimed that NSI is very prevalent among Arab nursing interns, 40% of the participants have been exposed to NSI [9]. It is worth noting that more than two-thirds of the nursing interns stated that they did not do post-exposure tests after the injury [8, 9]. as today's nursing interns are the profession's future professionals. Therefore, it is very important that they be up to date on all aspects of needle stick injury prevention. Hence, the current study aims to assess the effect of implementing an NSI educational program on nursing interns' competencies in preventing NSI incidence and post-exposure interventions.

II. MATERIALS AND METHODS

2.1. Study Design

In order to achieve the study's aim, a quasi-experimental design with an educational program intervention was implemented. This included a pre-test, an NSI prevention educational program, and three post-test evaluations that were conducted at weeks 2, 4, and 6.

2.2. Setting and Sample

The study was conducted at a university hospital in Saudi Arabia (bed capacity: 550), which is utilized for nursing students' training, including interns. The internship period of the Bachelor of Nursing program involves a 12-month exposure to different healthcare specializations. The trainee is assigned to a nursing preceptor to provide direct patient care and implement a therapeutic regimen under direct supervision. A convenient sample of 68 nursing interns was recruited. The inclusion criteria involved nursing interns with a minimum of 3 months of experience during their internship and who were willing to participate in the study. However, nursing interns on leave were excluded.

2.3. Data Collection Tools

Based on a review of the literature, three instruments were used to collect the study data, as follows:

1. Socio-demographic Characteristics Tool

This tool was developed by the author and addresses the socio-demographic attributes of nursing interns, which included sex, age, internship duration, their grade point average (GPA) in the bachelor program, attending any previous educational training on NSI, any previous sustained NSI, and whether it has been reported or not.

2. Knowledge and Perception Self-Administered Questionnaire

The nursing interns' knowledge and perception regarding NSI were assessed using an instrument developed by Zia et al. [13]. The tool scored 0.6 Cronbach's alpha. Furthermore, the validity of the content was checked by five experts, and only minor changes were made. The time needed for each nursing intern to fill out the questionnaire was 5-8 minutes. This instrument was subdivided into two sections:

- Section one: knowledge part

includes 13 items to assess the knowledge of nursing interns regarding NSI prevention. It addressed topics about the NSI preventive method and post-exposure interventions. Responses to these questions used a Likert scale that ranged from 0–1 (agree, disagree, or not know).

Scoring system:

The total knowledge score was 13. Each correct answer was assigned a score of 1, and the wrong answer was assigned a score of 0. The score was converted to a percentage. Participants were classified according to their achieved percentages. The participant's percentage was classified into three levels: high knowledge if the percentage was > 91%. Moderate knowledge if the percentage was between 81 and 90% and deemed low knowledge if it was < 80%.

• Second Section: Perception Part

It comprised 13 items that assessed the nursing interns' perceptions regarding NSI preventive methods and the health consequences of NSI. The response was recorded on a Likert scale of 1–5 (strongly agree = 5, agree = 4, uncertain = 3, disagree = 2, strongly disagree = 1).

Scoring system:

The total score for perception was 13. Each positive perception was assigned a score of one, and the negative perception was assigned a score of zero. These scores were converted into a percent score. Positive perceptions were assigned to total percentages greater than >91%, fair perceptions to percentages between 81 and 90%, and negative perceptions to percentages less than <80%.

3. Nursing Interns' Practice Observational Checklist

The researcher developed the third tool based on a review of the literature regarding procedural steps of work practices to prevent sharps injuries throughout the use and handling of a device published by the Centers for Disease Control and Prevention (CDC) [14]. This tool included 18 items to assess nursing interns' practice regarding NSI: six items before the beginning of the procedure, five items during the handling of the sharps, two items during clean-up, and five items during disposal of the sharps. A pilot study was conducted to assess the usability of the checklist with a group of nursing interns (n = 5) who volunteered to participate in this study and met all the inclusion criteria. All five interns were excluded from the study sample. The results of the pilot study indicated that all the checklist statements were clear. The time needed for the researcher to observe each intern's practice and fill out the checklist was 8–10 minutes.

Scoring system

Each statement was graded as satisfactory, unsatisfactory, or not done, with a score of 2 indicating that the procedure was performed correctly, a score of 1 indicating that it was performed incorrectly, and a score of 0 indicating that it was not performed at all. The total score for practice was 100 points. These scores were converted into a percentage. The overall practice score was divided into three levels: good practice, average practice, and poor practice. Good practice if the total score was >91%. Average if the score was between 81 and 90%, and deemed poor if it was < 80%.

2.4. Ethical considerations

Ethical approval was obtained from Imam Abdulrahman bin Faisal University, Office of the Vice President for Research and Higher Studies. Each participant signed an informed consent form before enrolment in the study, and the research purpose was explained. Both autonomy and confidentiality were preserved. The current study did not expose the study participants to any form of harm or risk. It helped determine the interns' injection safety practices.

2.5. Study methods

The educational program was conducted in four phases (assessment, planning, implementation, and evaluation). All stages were completed sequentially, as follows:

1. Assessment:

This phase was conducted to assess nursing interns' needs and develop an educational program regarding their competencies in NSI prevention. All nursing interns training at the university hospital who met the inclusion criteria were invited to participate in this study. First, all participants' socio-demographic characteristics were documented using Tool 1 (Socio-Demographic Characteristics Tool). Next, knowledge and perception were assessed using Tool 2 (the Knowledge and Perception Self-Administered Questionnaire). Finally, the practice of NSI prevention was assessed by the researcher using Tool 3 (the Nursing Interns' Practice Observational Checklist).

2. Planning phase:

The researcher developed the program content according to the assessment phase results and literature review. A group of experts revised the validity of the content of the program at the College of Nursing. The program strategy was determined (teaching method, media use, and learning activities). The program involved the following topics:

- Safety-engineered devices
- Practice that increases the NSI
- Safe handling and disposal of sharps
- Containerization
- Potential hazard of NSI
- Steps to be taken after NSI
- Post-exposure prophylaxis
- Post-exposure follow-up

3. Implementation phase:

The training was conducted through virtual lectures using PowerPoint presentations and audio-visual materials. A total of 68 nursing interns attended the lecture, which included videos related to the skills regarding safe injection practice and pictures of the types of needles and sharps. All participants were divided into six groups, and each group consisted of 10–12 nursing interns according to their shift schedule. The duration of this phase was one week, and the duration of each session was 30–40 minutes for each group.

4. Evaluation phase:

After attending the educational program, all nursing interns ($n = 68$) were assessed for their competencies regarding NSI prevention three times (2, 4, and 6 weeks) post-test using Tool 2, which assesses the knowledge and perception of nursing interns, and Tool 3, which assesses the participants' practice regarding NSI.

2.6. Statical analysis

After the data was collected, it was coded, categorized, tabulated, and analysed using SPSS version 23.0. All continuous data were tested for normal distribution, and it was found that they were not normally distributed, so the data were summarized by a median with range. Categorical data are presented as frequencies with percentages. A significant difference in demographic variables was tested using the Mann-Whitney U test and the Kruskal-Wallis H test. Furthermore, a p-value less than 0.05 was considered significant. The correlation between nursing interns' knowledge, perception, and practice was tested using the Pearson correlation test with a statistical significance level of $p < 0.05$.

III. RESULTS

3.1 Socio-demographic characteristics

It was found that 79.4% of the participants were female. In terms of age, most of them (88.2%) were between the ages of 21 and 23. In terms of GPA, less than a quarter (16.2%) of the participants had GPAs between 4.5 and 5.0, while 5.9% of participants' GPAs were between 3.30 and 3.49. Moreover, all the participants (100%) have a Bachelor of Science in Nursing. Additionally, more than half of the participants (58.8%) received educational training on NSI prevention before enrollment in the study. Finally, about 17.6% of participants have sustained NSI during their clinical practice. However, only 2.9% of them reported their injury to their supervisor (Table 1).

3.2. Level of knowledge regarding the prevention of NSI before and during the follow-up period

The study found that before implementing the educational program, more than half of the participants (69.1%) had low knowledge of NSI. Two weeks after implementing the educational program, the majority (91.2%) of the participants' knowledge had improved. Moreover, during the follow-up period (after 4 and 6 weeks), although 55.9% and 51.5% of the participants had good knowledge regarding NSI, respectively, the knowledge score decreased slightly in the third post-test. Further, there was a highly statistically significant relationship ($P < 0.001$) between pre-implementation and the follow-up period after implementation of the program related to knowledge regarding the prevention of NSI (Figure 1).

3.3. Level of perception regarding the prevention of NSI before and during the follow-up period

The results show that before implementing the educational program, more than half (83.8%) of the participants had a negative perception of NSI. Two weeks after implementing the educational program, the majority (94.1%) of the participants' perceptions became positive. However, less than half of the participants have a positive perception score (48.5%) after four weeks. Surprisingly, the percentage score of the participants' perceptions increased again to 66.2%. Furthermore, there was a highly statistically significant ($P < 0.001$) relationship between the perception of NSI prevention before and after six weeks of an educational program (figure 2).

Table 1: Socio-demographic characteristics of studied nursing interns (n=68)

Variables	Category	n = 68	%
Sex	Male	14	20.6
	Female	54	79.4
Age	21- ≤ 23	60	88.2
	24- ≤ 26	8	11.8
Median (Range)		23.0	12 – 25
Grade Point Average	3.30 – 3.49	5	7.35
	3.50 – 3.99	21	30.88
	4.00 – 4.49	30	44.12
Median (Range)	4.50- 5.0	12	17.64
Median (Range)		4.14	3 -5
Nursing Program	Bachelor	68	100
Attending previous educational training on needle stick injury	Yes	40	58.8
	No	28	41.2
If yes, when it was?	6-12 months	23	57.5
	More than 12 months	17	42
Have you ever sustained a needle stick injury?	Yes	12	17.6
	No	56	82.4
If you ever sustained a needle stick injury, did you report it?	Yes	2	16.6
	No	10	83.3

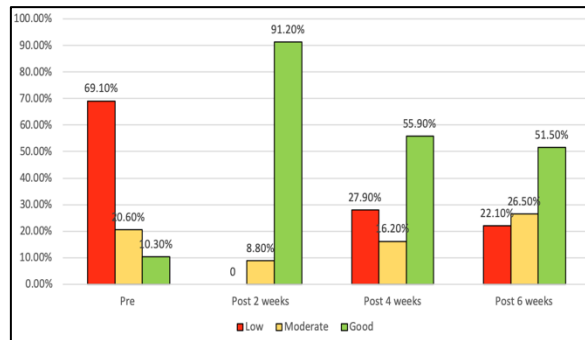


Fig.1: Level of knowledge regarding prevention of NSI before and after 6 weeks of the educational program.

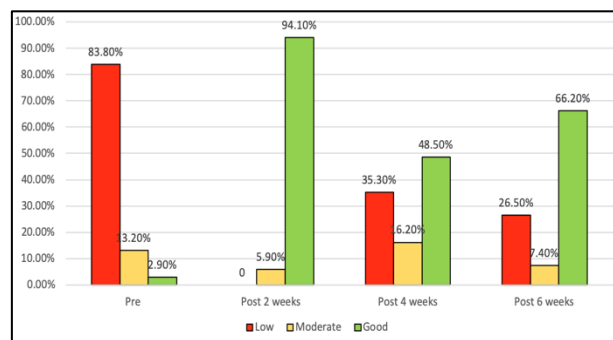


Fig.2: Level of perception regarding prevention of NSI before and after 6 weeks of the educational program.

3.4. Level of the practice regarding the prevention of NSI before and during the follow-up period

The results revealed that before implementing the educational program, most of the participants (98.5%) had poor practices regarding the prevention of NSI. After two weeks of implementing the educational program, all the participants' (100%) practices have improved. However, at 4 and 6 weeks of the follow-up period, more than half of the participants performed good practices (64.7% and 57.4%, respectively). Additionally, there was a highly statistically significant relationship ($P < 0.001$) between pre-implementation and the follow-up period after the implementation of the program related to practices regarding NSI (figure 3).

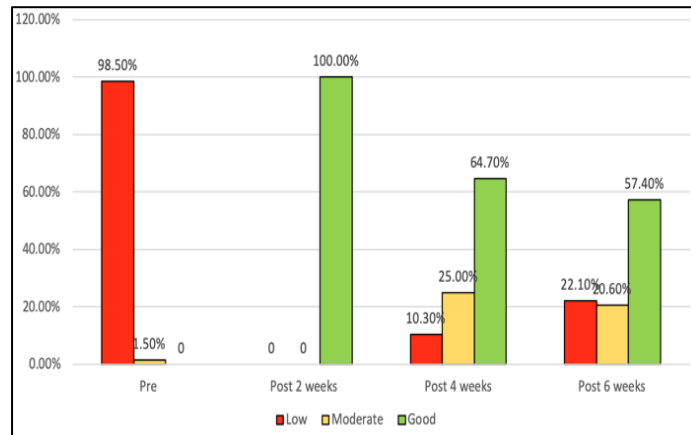


Fig.3: Level of practice regarding prevention of NSI before and after 6 weeks of the educational program.

3.5. Correlation between knowledge, perception, and practice regarding the prevention of NSI post-educational program.

The findings showed that there was a significant positive relationship between knowledge and perception ($r = 0.497$, $p < 0.001$), a significant positive relationship between perception and knowledge ($r = 0.689$, $p < 0.001$), and a significant positive relationship between practice and perception ($r = 0.626$, $p < 0.001$) (Table 2).

TABLE 2: Correlation between knowledge, perception, and practice of the studied nursing interns regarding prevention of needle stick injury post-educational program.

	Correlation co-efficient (r)	P value
Practice & Knowledge	0.497	<0.001**
Perception & Knowledge	0.689	<0.001**
Practice & Perception	0.626	<0.001**

**Statistically highly significant ($p < 0.05$)

3.6. Correlation between socio-demographic characteristics and their knowledge, perception, and practice regarding the prevention of NSI post-educational program

The results showed a statistically significant positive correlation between the participants' knowledge regarding the prevention of NSI and their GPA ($p = 0.008$). However, there was no significant correlation between participant's knowledge of NSI prevention and their age, gender, and previous educational training regarding NSI prevention (Table 3). Moreover, the findings showed that there was no statistically significant correlation between the perception of participants about the prevention of NSI and their gender ($p = 0.981$), age ($p = 0.327$), and receiving previous educational training ($p = 0.474$). Additionally, although the interns with a $GPA \geq 4$ have a greater perception than those with $GPA \leq 3.99$, it was statistically insignificant ($p = 0.163$) (Table 4). Furthermore, there was a statistically insignificant correlation between the practice of participants regarding the prevention of NSI and their gender ($p = 0.613$), age ($p = 0.549$), GPA ($p = 0.675$), and receiving previous educational training ($p = 0.705$) (Table 5).

TABLE 3: Correlation between socio-demographic characteristics of studied nursing interns and their knowledge regarding prevention of needle stick injury post-educational program

Variables	n = 68	Knowledge Score Median (Range)	P value
Gender			
Male	14(20.6%)	92.3(69-92)	0.823
Female	54(79.4%)	88.5(69-92)	
Age.			
21- ≤ 23	60(88.2%)	76.9(69-92)	0.400
24 - ≤ 26	8(11.8%)	92.3(76-92)	
Grade Point Average			
3.30 – 3.49	5(7.35%)	15.4(15-69)	0.008*
3.50 – 3.99	21(30.88%)	69.2(0-92)	
4.00 – 4.49	30(44.12%)	80.7(0-92)	
4.50- 5.0	12(17.64%)	76.9(62-85)	
Have you received educational training on needle stick injury?			
Yes	40(58.8%)	69.2(0-92)	0.302
No	28(41.2%)	76.9(15-92)	

*Statistically highly significant (p<0.05)

TABLE 4: Correlation between socio-demographic characteristics of studied nursing interns and their perception regarding prevention of needle stick injury post-educational program

Variables	n = 68	Perception Score Median (Range)	P value
Gender			
Male	14(20.6%)	100(69-100)	0.981
Female	54(79.4%)	92.3(69-100)	
Age.			
21- ≤ 23	60(88.2%)	92.3(69-92)	0.327
24 - ≤ 26	8(11.8%)	92.3(77-92)	
Grade Point Average			
3.30 – 3.49	5(7.35%)	30.7(30.8-69)	0.163
3.50 – 3.99	21(30.88%)	61.5(31-85)	
4.00 – 4.49	30(44.12%)	69.2(31-92)	
4.50- 5.0	12(17.64%)	69.2(46-77)	
Have you received educational training on needle stick injury?			
Yes	40(58.8%)	69.2(31-85)	0.474
No	28(41.2%)	69.2(31-92)	

*Statistically highly significant (p<0.05)

TABLE 5: Correlation between socio-demographic characteristics of studied nursing interns and their practice regarding prevention of needle stick injury post-educational program

Variables	n = 68	Practice Score Median (Range)	P value
Gender			
Male	14(20.6%)	90.3(75-100)	0.613
Female	54(79.4%)	91.7(75-100)	
Age.			
21- ≤ 23	60(88.2%)	91.6(75-100)	0.549
24 - ≤ 26	8(11.8%)	86.1(77-94)	
Grade Point Average			
3.30 – 3.49	5(7.35%)	56.9(44-67)	0.675
3.50 – 3.99	21(30.88%)	55.6(31-78)	
4.00 – 4.49	30(44.12%)	55.6(22-83)	
4.50- 5.0	12(17.64%)	44.4(28-67)	
Have you received educational training on needle stick injury?			
Yes	40(58.8%)	55.5(28-83)	0.705
No	28(41.2%)	52.8(22-78)	

*Statistically highly significant ($p < 0.05$)

IV. DISCUSSION

Needle-stick injuries (NSI) have become a global concern because of the risk of bloodborne disease transmission. It is prevalent among healthcare providers. However, nursing interns were the most vulnerable group who sustained NSI [15]. The importance of nursing safety from NSI and bloodborne disease transmission is not limited to the nursing interns themselves but also the patients they care for. The current study investigated the knowledge, perception, and practice of nursing interns regarding NSI prevention.

Concerning sociodemographic characteristics, the present study showed that more than half of the participants were female and aged between 21 and 23 years. All participants were enrolled in a Bachelor of Science in Nursing, and their mean GPA score was 4.14 out of 5. Two-thirds (58.8%) of the sample had participated in an NSI prevention educational program before the study's six-month period. Moreover, the majority (82.4%) did not sustain NSI injuries. These findings are in good agreement with a study by Abdul-Wahhab et al., which was conducted in Iraq, which stated that most of the nursing interns had received educational training on NSI prevention before their participation [16].

Concerning the level of knowledge regarding the prevention of NSI for the participants before and during the follow-up period, the findings revealed that, before implementing an educational program, less than a quarter of the participants had good knowledge regarding the prevention of NSI. Two weeks after implementing the educational program, most of the participants' knowledge improved. However, the knowledge score decreased slightly during the follow-up period (post 4 and 6 weeks). The researcher assumed that those who had good knowledge before implementing educational programs might have attended previous educational programs before participating in this study. The present study's findings are consistent with Patel's [17] study in Florida, which stated that less than half of the nursing interns had good knowledge before implementing the educational program. In the post-test, more than two-thirds have good knowledge. Additionally, Farotimi et al. from Nigeria disclosed that more than half of the nursing interns had high knowledge in the post-test compared to 0% in the pre-test [4].

Moreover, this study found a statistically significant improvement in knowledge between the pre-and post-test. These findings further support the idea of Eskandari et al., who stated that the nursing interns' post-test knowledge scores were significantly higher than their pre-test scores [18]. Therefore, it is believed that the educational program regarding the prevention of NSI has a positive impact on the percentage of participants with good knowledge. Furthermore, it is suggested that the illustrated pictures and videos efficiently capture nursing interns' attention while increasing their interest and

knowledge because capturing the information is made easier. In addition, it is believed that the decreased level of knowledge in the second and third follow-ups was due to the reflection of basic memory loss. However, the level of knowledge in the second and third follow-ups was still good, implying that the topic was sufficiently motivated to retain the knowledge.

In relation to the level of perception regarding the prevention of NSI for the participants before and after six weeks of the educational program, the present study revealed that, before implementing educational programs, more than two-thirds of the participants had negative perceptions regarding the prevention of NSI. Two weeks after implementing the educational program, most of the participants' perceptions became positive. However, the perception score decreased slightly during the follow-up period (post-4 and post-6 weeks). These findings were in line with the Farotimi et al. study, which found that less than a quarter of the nursing interns had a positive perception before the educational program [4]. After the implementation of the educational program, more than half of the nursing interns have a positive perception.

According to Pouralizadeh et al., the nursing interns' post-test perception scores were significantly higher than their pre-test scores [19]. Similarly, the current study discovered a statistically significant improvement in perception levels between pre- and post-test. Therefore, it is believed that the educational program regarding the prevention of NSI has a positive outcome in terms of the percentage of participants with a positive perception. Furthermore, it is assumed that a positive perception influences good and competent practice.

Additionally, regarding the level of practice in the prevention of NSI for the participants before and after six weeks after the implementation of the educational program, the results revealed that, before implementing the program, most of the participants had a low level of practice. Two weeks after implementing the program, all the participants' practices improved. However, the percentage of participants with good practice scores decreased slightly during the second and third follow-ups. These findings corroborate with previous results from Abdul-Wahhab et al., which showed that before the implementation of an educational program regarding the prevention of NSI, most of the participants had a low level of practice, while after the program, most of them had a good level of practice [16]. Moreover, a study conducted by Bedier et al. showed that after the educational program, most of the participants had a statistically significant increase in practice compared with the pre-test [20]. However, the level of practice declined in the second follow-up compared to the first follow-up. Furthermore, the result of this study found that there was a statistically significant improvement in practice between the pre- and post-tests. This finding was in line with Eskandari et al., who stated that the nurses' post-test practice score was significantly higher than their pre-test scores [18]. These results suggest the usefulness of implementing an educational program to improve nursing interns' practices regarding the prevention of NSI. As a result, it is believed that the educational program for NSI prevention has a positive effect on the percentage of participants who practice good hygiene. However, these results showed that the percentage of participants' good practice scores decreased slightly in the second and third follow-ups, which suggests the need for nursing interns' continuous training programs, practice reinforcement, and regular observation to maintain safe practice.

The present study revealed a statistically significant positive correlation between participants' perceptions and knowledge regarding the prevention of NSI. This finding was supported by Biresaw et al. and Azman et al., who reported a positive correlation between knowledge and perception regarding the prevention of NSI [21, 22]. On the other hand, Mbonera and Chironda reported a weak but significant positive correlation between knowledge and perception [23]. As a result, it is suggested that having good knowledge through an educational program will improve nursing interns' awareness, resulting in a more positive perception.

Moreover, the present study revealed a statistically significant positive correlation between the participants' knowledge and practice regarding the prevention of NSI. These results were in good agreement with a growing body of literature that correlated knowledge and practice in the prevention of NSI [11, 13, 15]. However, this finding was not supported by previous research by Pouralizadeh et al. and Azman et al. [19, 22]. Apart from this slight disagreement, it is believed that good knowledge is translated into good and safe practices; when nursing interns have high levels of knowledge after attending an educational program, it will improve their awareness, reflect on their practice, and help them become more competent.

In addition, the present study revealed a statistically significant positive correlation between the perception and practice of the participants regarding the prevention of NSI. These findings corroborate favourably with Azman et al. [22]. Although a study by Mukhtar et al. stated that the level of perception is not significantly associated with the level of practice in occupational safety and health [24], apart from this disagreement, it is believed that educational programs positively affect nursing interns' perceptions, improving their awareness and reflection in their practice to become competent.

Furthermore, the present study revealed a statistically significant correlation between participants' knowledge regarding the prevention of NSI and their GPA. This result was in line with Valdez et al., who stated that nursing interns' GPA significantly correlates with their knowledge retention [25]. However, there was no significant correlation between participants' knowledge after the educational program and their age, gender, and previous educational training on NSI prevention. Surprisingly, Alwabr [10] argued that there was a significant relationship between nursing interns' gender and their knowledge. Moreover, Pouralizadeh et al. show a significant relationship between participants' knowledge of the prevention of NSI and their age [19].

Additionally, there was no statistically significant correlation between the participants' perceptions of NSI and their socio-demographic characteristics. These findings corroborate with previous results from Durgun and Kaya [26]. However, this finding contradicts a study by Elewa and El Banan [27], who indicate a statistically significant relationship between the nursing interns' perception regarding the prevention of NSI and their gender and receiving previous safety training, while there was no significant relationship with their age.

Furthermore, the findings illustrate no statistically significant correlation between the participants' practice of NSI prevention and their sociodemographic characteristics. These findings are in good agreement with those of Alwabr, Bedier, Mursy, and Mohamad [10, 20, 28]. However, Wen et al. contradict our finding, which stated a statistically significant correlation between the participants' practice and age [29].

A few limitations of this study must be addressed. The data were collected from only one hospital in Saudi Arabia, and the results may not represent the actual situation in other healthcare institutions across the country. The study sample consisted of nursing interns and, therefore, cannot be generalized to other healthcare providers. Moreover, further studies with a larger sample size are recommended.

V. CONCLUSIONS

There is a considerable gap in the NSI literature about the outcomes of the educational program on nursing interns' competencies in Saudi Arabia. This study showed that implementing an educational program on NSI prevention effectively improved nursing interns' competencies. There were statistically significant improvements in participants' knowledge, perception, and practice regarding NSI prevention. Moreover, there was a significant positive correlation between knowledge, perception, and practice before and during the follow-up periods. The present study findings have several implications for nursing practice, education, research, and administration. It is recommended to provide feedback on the nursing interns' performance regarding the safety of injection practices. Strict monitoring of interns while they are working and continuous assessment and correction of performance are essential. In addition, regular continuing education programs and refresher courses on needle stick injury prevention are required to keep them up to date on the latest guidelines and policies on needle stick injury prevention.

Acknowledgments: The authors wish to thank all nursing interns who participated in the study with respective King Fahd Hospital of the University: Nursing office Director for supporting the project and extending facilities.

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