Original Article

Occupational Exposures during Clinical Practice of Candidate Health Professionals: Needlestick Injuries and Occupational Knowledge Levels

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Abstract

Background: Due to limited opportunities for clinical experience and insufficient knowledge levels, students in health programmes are at high risk of needlestick injuries. The aim of this study is to identify needlestick injuries experienced by medical faculty, nursing and laboratory programme students during clinical practice, and to assess the knowledge and attitude of injured or uninjured students about occupational risks.
Methods: The study was carried out with 452 students from the Faculty of Medicine, School of Health and Associate Degree Programmes of a university interning in hospitals. A total of 435 students were questioned about needlestick injuries they experienced during their clinical practice.
Results: It was determined that 206 (47.4%) students had needlestick injuries during clinical practice. The mean occupational risk information score of the students was found to be 18.76±5.64. In the study, it was determined that the highest knowledge score (22.78±4.52), was obtained from the medical faculty students, and the highest needlestick injuries were found in the nursing department (66.0%). There was a significant difference between needlestick injuries and service, age, school, weekly hours of clinical practice, and level of knowledge. Injuries occurred more often among young and inexperienced students who have less knowledge about occupational risk factors ($p<0.05$).
Conclusions: It was found out that students experienced needlestick injuries frequently, and that their level of knowledge and attitudes towards protective practice about occupational risks were insufficient. This study is important in terms of revealing the significance of training before clinical practice in order to decrease the frequency of needlestick injuries among students.

Keywords: Needlestick injuries, nurses, students.

Introduction

Occupational injuries are more common among healthcare professionals compared to staff in other professions (Perhats et al., 2012). Employees often experience needlestick / sharp injuries (NSIs) that cannot be ignored in a hospital setting (Karadag, 2010; Yildirim & Ozpulat, 2015). The Centers for Disease Control and Prevention (CDC) predict that there are 600.000-800.000 NSI incidents annually, and 1000 sharps injuries daily in the USA, and also states that half of these injuries are not reported (Katsevman, et al, 2017).

Needlestick injuries are one of the most important occupational risks that healthcare professionals are exposed to (Badiee Aval et al., 2017; Yao, et al, 2013). Highly contagious infections such as HIV, Hepatitis B, Hepatitis C, and Hepatitis D especially may be transmitted through NSIs (Badiee Aval et al., 2017; Katsevman et al., 2017). In a study carried out with healthcare workers infected by Hepatitis B, it was stated that 37% of these professionals caught the disease after a sharps injury or after contact with risky material (Deisamhammer, et al, 2006). The CDC developed the standard/ universal precautions in order to protect professionals from NSIs in 1987. Contagion may be more significant when healthcare workers do not take the necessary standard precautions (Patterson, et al, 2003).

Students in healthcare programmes such as medicine and nursing have greater risk for NSIs due to their insufficient experience in clinical practice (Badiee Aval et al., 2017; Cervini & Bell, 2005; Talas, 2009; Yao et al., 2013). Students in healthcare programmes obtain their clinical practice training at related institutions and face many occupational risks at an early age like every working healthcare professional. Students are especially vulnerable to blood-borne pathogens during their clinical practice (Karadag, 2010). The reason is that the level of knowledge about occupational risks and standard precautions among students whose manual skills are underdeveloped and are eager to learn new procedures is insufficient (Hinkin & Cutter, 2014). Therefore, it is possible that the risk of exposure to blood and body fluids from patients during invasive procedures is relatively high in comparison to other working staff (Talas, 2009).

The number of incidents of NSIs and information about their epidemiology for students in healthcare programmes in Turkey is limited (Karadag, 2010; Talas, 2009). Moreover, there are no prevention procedures or any policies about NSIs after exposure. There is no study carried out about the relationship between occupational knowledge and injuries experienced during clinical practice for students in healthcare programmes. All these reasons reveal the necessity to carry out research about NSIs among students in healthcare programmes. Furthermore, knowing the frequency of NSIs, the level of knowledge about occupational risks, and safe practices of students in healthcare programmes will be an important guide for academics during theoretical briefing and monitoring of students, as well as guiding transformation of preventive measures into practice during clinical practice.

The aim of this study is to determine the following measures for students who are the health care professionals of the future:

1- Define NSIs during clinical practice,

2- Determine objects and activities related to injuries,

3- Determine the level of HBV vaccination

4- Determine the level of knowledge about occupational risks,

5- Define the use of standard precautions among students.

Methods

This research is a cross-sectional study. The study was carried out with students in healthcare programmes of a university doing their clinical practice at a hospital. The study was carried out with students performing clinical practice at a hospital during September-December 2015.

Survey instrument: Research data were collected with a Personal Information Form and Occupational Risk Fields Information Form (ORFIF). The personal information form consists of some questions such as age, gender, class, type of high school, location of practice areas, education about occupational exposure risks, NSIs rates, and Hepatitis B immunisation status. Occupational Risk Fields Information Form (ORFIF): This is a scale developed by Bayhan and Caliskan (2005) in order to assess the level of occupational knowledge of students. There are 40 questions in total, consisting of five-point Likert type questions. Participants were asked to assess their responses as “Strongly Agree, Agree, Neither, Disagree, and Strongly Disagree”. An average knowledge score was calculated through the composite index formed using answers given to 40 information statements about occupational risks for each student participating in the study. The knowledge score was calculated by giving 1 point for each statement and average score was calculated accordingly. Level of knowledge was classified as low for 16 and lower points, moderate for scores between 17 and 21, and good level of knowledge for scores above 22 points, considering the average score.

Ethical considerations: Written consent was obtained from the Non-Invasive Clinic Research Ethical Board of Namık Kemal University, Faculty of Medicine (approval number 2015/55) and from the necessary institutions. Additionally, each student participating in the study was informed on the aim of the study, what was expected of them, their legal rights, and the confidentiality of the data obtained, and those who agreed to participate in the study gave written consent.

Participants: The population of the study consisted of 517 students from the Faculty of Medicine, School of Health (nursing) and Associate Degree Programmes (laboratory) of a university. The criteria for participation in this study were determined as doing clinical practice at a hospital and volunteering to participate in the study. There was no sample selection carried out in the study, and 452 students volunteered to

participate in the research. However, since 17 of these students did not fill in the questionnaire completely, the study was carried out with 435 (84.1%) students. Students were informed about the study and how to fill in the questionnaire forms before conducting the research. Verbal consent was received from each willing participant. The questionnaires were filled out by the students under direct observation and collected immediately. The completion of the data forms took approximately 20-25 min.

Data analysis: Data collected during research were analysed using SPSS 19.0 package software. For the analysis of the data, descriptive (percentage, ratio, arithmetic mean, standard deviation, minimum-maximum), comparative statistical methods (Chi-square Test, Independent Samples T-Test, one-way analysis of variance), and correlation analysis were used. In all tests the significance level was set at 0.05.

Results

The average age of participating students was 21.24±2.1 years (min: 18, max: 29 years of age), and 198 (45.5%) were aged from 20-21, 144 (33%) were 2nd grade students, 335 (77.0%) were female, 263 (60.5%) were students in the School of Health, Nursing Department, 87 (20%) were in Associate Degree Programmes of Health Services (Laboratory), and 85 (19.5%) were students in the Faculty of Medicine. It was determined that 50.8% of the students did their clinical practice at surgical clinics for an average weekly duration of 15.14±1.67 hours (min: 8, max: 40 hours).

Needlestick Injuries

In this study, it was determined that to date 47.4% of the students experienced NSIs at least once during clinical practice, with 22.1% experienced in the last six months. Injuries were usually caused by closing the tip of the needle accounting for 59.2% of all injuries) (Table 1).

Of the students participating in the study, 60.4% stated the main reason for NSIs being the lack of development of procedure skills. It was also found that 23.8% of the NSIs were caused by objects in contact with blood and body fluids of the patients, and that patients did not know whether they had any contagious diseases. It was determined that most of the students (85.4%) cleaned the injured area with antiseptic solution and covered it with a bandage. In addition, it was determined that none of the NSIs were recorded in written form; however, it was also found that 57.7% of the students reported these injuries to hospital staff or to their clinical trainer. According to the statements of students, 73.5% of the students were wearing gloves whenever they treated the patient, 55.4% had always washed their hands before wearing gloves and 88.7% had always dropped their needlepoints into the sharps bin. In addition, all students had vaccination against Hepatitis B ((Table 1).

According to the sociodemographic characteristics of the students, it was found that 66.0% of the NSIs occurred in the Department of Nursing, 57.3% of them in surgical clinics, 38.3% of them at the age of 20-21 year, 24.7% in the second grade of education, and 66.7% occurred among students with clinical practice once a week (8 h). When sociodemographic data of the injured and uninjured students were compared, it was determined that there were statistically significant differences ($p<0.05$) for characteristics, except for gender (Table 2). Accordingly, it was found that NSIs occurred at particularly high level (60.2%) among students who received no training about occupational risks prior to clinical practice ($p<0.05$) (Table 2).

Knowledge of Occupational Risks and Preventive Measures of Students

Of all students, 44.8% and 39.8% of NSI students were trained about occupational risks before starting clinical practice. When trained and non-trained students were compared in terms of NSIs, the rate of injuries was found to be statistically significant ($p <0.05$) for students who did not receive any training about these risks. The average score for level of knowledge on the ORFIF received by students participating in this study was found out to be 18.76±5.64. The lowest score about occupational risks were obtained by students from the laboratory programme (16.88±4.43), whereas the highest scores were received by students of the Faculty of Medicine (22.54±4.52).

Moreover, the highest ORFIF scores were obtained by students who did not experience any NSIs, those aged 22-23 years, practicing at surgical clinics, with a training programme of 17-40 h a week, and vaccinated against Hepatitis B. There was a statistically significant difference ($p<0.05$) between ORFIF knowledge score average of students and their sociodemographic data, except for gender. Total knowledge score was particularly low for students experiencing

NSI. NSI rates were lower for students from the Faculty of Medicine (Table 3).

It was found that there was a significantly positive correlation at poor level between the ORFIF total score of students and age (r=0.350, p=0.002), grade (r=0.490, p=0.000), and training hours of clinical practice (r=0.271, p=0.000). It was determined that ORFIF total score average increased as the grade, age, and clinical training hours of students increased (Table 4).

There was a significantly negative relation at poor level (p<0.05) between students experiencing NSI situations (r=-0.435, p=0.005) and those receiving training about occupational exposure (r=-436, p=0.06). It was determined that as the rate of education increased and clinical training hours decreased, NSIs declined. However, there was no significant correlation determined between NSIs and age, as well as the grade of students (p>0.05) (Table 4).

Table 1. Distribution of students according to NSI characteristics

Characteristic	N	%
Injury so far		
Yes	206	47.4
No	229	52.6
Injury in the last six months		
Yes	96	22.1
No	229	77.9
Injury in the last week		
Yes	43	9.9
No	392	90.1
Cause of injury		
When closing the tip of the needle	122	59.2
When separating the needle from the injector	35	17.0
IV catheter insertion, blood collection	49	23.8
Causes of injuries reported by students		
Procedure skills were underdeveloped	124	60.4
Hurry/stress	57	27.5
Carelessness	25	12.1
Reporting the incident		
Reported	119	57.7
Unreported	87	43.3
Postinjury procedure		
Cleaned with antiseptic solution	176	85.4
Cleaned with soap and water	27	13.1
No attempt	3	1.4
Hepatitis B vaccine	342	78.6
Wearing gloves for every intervention	319	73.5
Hand wash before/after each intervention	386	88.7

Table 2. Situation of experiencing needlestick injuries according to student characteristics (n=435).

Variable	Sub category	Needlestick Injuries		χ2 , p value
		Yes (%)	No (%)	
Gender	Female	166(80.6)	169(73.7)	2.819
	Male	40(19.4)	60(26.3)	0.058
Age	18-19	42(20.3)	26(11.3)	11.984
	20-21	79(38.3)	119(52.0)	0.007
	22-23	69 (33.4)	62(27.1)	
	24 and ↑	16(7.7)	22(9.6)	
Department	Nursing	136(66.0)	127(55.4)	6.264
	Medicine	3(15.1)	54(23.6)	0.044
	Lab. programme	39(18.9)	48(21.0)	
Clinic	Surgical diseases Surgery	118(57.3)	103(45.0)	12.951
	Internal diseases Medicine	63(30.5)	92(40.2)	0.037
	Other	25(12.2)	34(14.8)	
Trained about occupational exposure	Yes	82(39.8)	113(49.3)	9.836
	No	124(60.2)	116(50.7)	0.039
Practice hours/week	0-8	93(45.1)	148(64.6)	7.235
	9-16	62(30.1)	31(13.5)	0.027
	17 and↑	51(24.7)	50(21.8)	

Table 3. Comparison of Occupational Risk Fields Information Form score averages for students according to some variables (n=435).

Variable	Sub category	Information score Mean±SD	t or F, p-value
Total scale score		18.76±5.64.	
Gender	Female	18.88±5.60	t: -802,
	Male	19.40±5.50	0.423
Age	18-19	19.44±3.87	F: 11.008,
	20-21	17.44±5.83	0.000
	22-23	20.72±5.15	
	24 and ↑	20.44±6.07	
Department	Lab. programme	16.88±4.43	F:27.056,
	Nursing	18.56±5.82	0.000
	Medicine	22.54±4.52	

Clinic	Surgical diseases	18.65±5.57	F: 5.776,
	Internal diseases	17.61±5.64	0.003
	Other	15.60±4.45	
Practice hours/week	0-8	17.95±5.33	F: 19.097,
	9-16	18.65±6.09	0.000
	17 and ↑	21.85±4.65	
Trained about occupational exposure	Yes	19.86±5.54	t: 2.904,
	No	18.31±5.52	0.004
Needlestick Injuries	Yes	18.24 ±5.22	t: 3.745,
	No	20.28 ±5.92	0.000
Hepatitis B vaccine	Yes	19.28±5.62	t: 1.990,
	No	17.98±5.3	0.041

t: Student's t-test, F: Anova test

Table- 4: Correlation between needlestick injuries and mean score on Occupational Risk Fields Information Form according to some sociodemographic data of the students.

Variable		ORFIF	NSIs
Age	rs	0.350	0.037
	p	**0.002**	0.436
Class	rs	0.490	**0.000**
	p	**0.000**	0.998
Department / School	rs	0.516	0.320
	p	**0.000**	**0.012**
Clinical practice hours/week	rs	0.271	-0.435
	p	**0.000**	**0.005**
Trained about occupational exposure	rs	0.483	-0.436
	p	**0.000**	**0.006**

NSIs: Needlestick Injuries, ORFIF: Occupational Risk Fields Information Form, rs: pearson's rank correlation coefficients.

Discussion

NSIs frequently occur among health workers, and students who are training to become health professionals are also frequently exposed to such injuries (Badiee Aval et al., 2017; Cervini & Bell, 2005; Hinkin & Cutter, 2014). Students first apply the theoretical knowledge they obtained during education in the laboratory, and then on patients at the hospital. Injury risk increases due to insufficient practice in using sharps and high levels of anxiety. It is an important finding in this study that almost half of the students experienced NSIs during clinical practice. According to the scientific literature, NSI rates vary from 11% to 50% (Cervini & Bell, 2005), and that sharps injuries are in first place (Ghannad, et al, 2012; Bilir, 2013). Badiee Aval et al. reported in their study in 2017 that the incidence of sharps injuries was 32.6% for students in Egypt, 63% for nursing students in the north of India, and that these rates varied between 40% and 85%. Studies carried out in countries with different health systems and health resources have reported contrasting results: 27 to 31% in Nigeria, 87 to 93.2% in Taiwan, and 82% in China. Moreover, the results of NSI reports in the case of students were 48.1% in India, 61.9% in Taiwan, and 71.1% in Iran (Badiee Aval et al., 2017). This rate was found out to be 27.4% (Karatas, Celik & Koc, 2016), 31.6% (Yildirim & Ozpulat, 2015) and 49.0% (Talas 2009) in different studies carried out in Turkey. Similarities among the results support the fact that NSI incidence is quite high among students.

Furthermore, NSIs were found to be 9.9% in the last week of the study. In a study carried out in India about healthcare professionals, it was found that exposure to mucous membranes was 11%, and percutaneous injuries was 30% just in one week, and these findings were regarded to be alarming (Togan, et al, 2015). It is quite striking that these ratios were high for students who spend less time at the hospital than for healthcare professionals. NSIs pose a great risk in terms of blood borne infections. Even small amounts of fluid penetrating after injury can cause serious illnesses. According to the scientific literature, after NSIs the HIV transmission rate is 0.3%, Hepatitis B transmission rate is 30%, and Hepatitis C transmission rate varies from 2% to 6% (Togan et al., 2015; Yao et al., 2013). Thus, events like NSIs may result in permanent impairment, devastating and threatening consequences for careers. A trainee student at Yale University in the 1980s is one of the most significant examples of the devastating consequences of occupational exposure to HIV through NSIs (Cervini & Bell, 2005). It is pleasing that students are vaccinated high.

It was determined in the study that the majority of students experiencing NSIs were nursing students. In a study carried out in China, it was stated that NSIs were 56.6% for nurses, 40.6% for doctors, and 32.6% for technicians (Liu et al., 2014). In various studies about healthcare professionals, NSSIs were highest for nurses, followed by research assistants, lecturers, cleaning staff, and students at the faculty of medicine (Ghannad et al., 2012). Clinical practice in Turkey starts in the 1st grade of nursing education, in the 3rd grade for the faculty of medicine, and in the 2nd grade for associate degree programmes.

In this study it is assumed that the probable reasons for NSIs being more prevalent among nursing students is that clinical practice starts in the first grade, and therefore students lack experience of clinical practice, and knowledge about universal precautions as well as occupational risks. When applications expected from nursing students such as parenteral procedures, intravenous interventions or injection are considered, it is an expected situation that NSIs occur more among nursing students. In fact, these interventions must be performed under the inspection of supervisors during clinical practice. However, since there are insufficient numbers of clinical trainers in Turkey, it is probable that such injuries increase among students.

According to the literature, occupational accidents occur mostly among inexperienced, young and uneducated staff (Bilir, 2016; Talas, 2009). The occurrence of NSIs in the first and second grade, in the group aged 18-21 years, among students who received no education about occupational risks, and among students whose ORFIF score is low, is consistent with the scientific literature. However, it is apparent that NSIs increase among 4th grade students. It is believed that this is mainly due to medical faculty students starting clinical practice for the first time at that grade, and nursing students receiving twice as many working hours of clinical practice and internship training. Ghannad et al. (2012) in his study in Iran (2012) stated that NSIs were at high level among uneducated

groups and that the difference is significant. This study is similar to the literature in terms of the high occurrence of NSIs among students starting clinical practice without receiving education about occupational risks.

The decrease in injury cases as the level of education increases can be related to knowledge and experience. Thus, education has a key role since it can be interpreted as a protective factor in reducing NSIs. These findings are important in demonstrating the protection and awareness of the student group in practical training.

In this study, it was found that knowledge scores of students related to occupational risks were at moderate level. In studies focusing on specific topics about occupational risks in the literature, the level of knowledge of the student is often not high. The knowledge levels of students about infection control were found out to be insufficient in different studies conducted by Hinkin and Cutterin 2014 and Mann and Wood 2006. In this current study, the knowledge score of students at the age of 22 and older who were studying in the Faculty of Medicine increased significantly. Hinkin and Cutterin (2014) reported in their study that there were various factors affecting the knowledge level of students, that the knowledge levels of younger students were influenced by university education, and that the level of knowledge of the relatively younger students was more insufficient. The results are compatible with the literature. It is a serious matter that students did not wear gloves every time they treated patients although not stated in the tables. Wearing gloves during the treatment procedure may not prevent NSIs, but wearing double gloves during invasive procedures greatly reduces occupational exposure (Cheung, et al, 2010; Talas, 2009). It was stated in the study carried out by Karadag that only 32.6% of the students always wore gloves before medical interventions (Karadag, 2010).

Cheung et al. (2010) stated in his study that only 19.1% of nursing students always wore gloves, and that 14.7% of the students rarely wore protective eyewear (Cheung, et al., 2010). Stewardson et al. (2002) reported in his study that one third of dental students did not wear masks. The reason was stated to be the insufficiency of clinical experience, and it was suggested that clinical trainers monitor students about wearing gloves.

A probable method to reduce the incidence of needlestick/sharps injuries is to use a needleless system with a safety mechanism. In order to reduce the risk of blood borne pathogenic microorganisms in the United States, needle injury protection systems have been provided at all health facilities in accordance with the Needlestick Safety and Prevention Act (2000) (Adams & Elliot, 2006). However, the cost of needle injury protection devices is about 28 cents higher than standard devices. Moreover, as in other developing countries, the use of safe injectors in Turkey is unfortunately very low due to high costs (Talas, 2009). In the current study, it was found out that more than half of the students were exposed to injuries while re-closing the needle cap. It is apparent that injuries will be reduced by needles having safer systems and being thrown directly into medical waste containers without re-closure.

Considering all these conditions, NSIs among students may be prevented by taking universal precautions against infections transmitted through blood or body fluids, establishing appropriate waste policies, providing immunization, reporting injuries, and giving effective training practice (Karadag, 2010; Talas, 2009).

Following needlestick injuries, the majority of students cleaned the wound site with an antiseptic solution and covered it with a bandage afterwards. In the scientific literature, it is suggested that NSIs not containing any pathogens such as Hepatitis B or C, or AIDS should be cleaned with soap and water, or an appropriate antiseptic solution and be covered with a bandage (Wilburn & Eijkemans, 2004). The majority of students applied an appropriate procedure following an injury.

In this study, none of the injuries were recorded in written form. In many studies about healthcare professionals, it was reported that occupational accidents were not recorded (Cervini & Bell, 2005; Liu et al., 2014). According to the Law on Occupational Health and Safety (No. 6331) enacted in 2012 in Turkey, it became mandatory for all employees to report occupational accidents. However, since this legislation will enter force at a future date, there are no data about occupational accidents among healthcare professionals in Turkey. In addition, the reason for NSIs not being reported may also be concerns among students that their marks for clinical

practice will be affected. Therefore, it is essential that clinical trainers rule out this concern, and emphasize the importance and necessity of reporting these injuries.

In this study, approximately ¾ of the students were vaccinated. In studies conducted in Turkey, it was reported that hepatitis vaccination rate was 35.5%, 49.0% and 83.6% (Karadag 2010; Talas, 2009; Togan et al., 2015, respectively), and 22%, 56.0%, and 81.1% (Choi et al 2017; Bernard, Dattilo & LaPorte 2013; Pathoumthong et al., 2014, respectively) in studies carried out abroad. Vaccination rates are similar to Australia (72.3%) and Taiwan (75.4%), but lower than Brazil (95.5%) and the UK (94% and 100%) (Elliott, Keeton & Holt, 2005). The reason for this difference is the Hepatitis B vaccination being included into the National Vaccination Schedule later. Because of the decision to vaccinate newborn babies within the scope of the Expanded Immunization Program, hepatitis B vaccination rates are expected to increase in the coming years.

In addition, it is remarkable that the rate of vaccination is higher in students educated about occupational risks. For students with high awareness, it is an important finding that the protection behaviours are higher.

Limitations: There are some limitations to the study. The data are based on the statements of the students. Participants may have recall problems in this retrospective survey. However, needle injuries are incidents causing stress and are expected to be remembered by students who experienced it for the first time on the course of their training process. This questionnaire is limited in terms of generalization due to being conducted only in three health-related units of one university.

Conclusion: In this study, it can be said that students experienced high NSIs during their clinical training and did not have enough knowledge about occupational risks. Injuries occurred at higher level in younger, more inexperienced groups who had not been trained prior to clinical practice. This study is important in terms of revealing that the training given to the students prior to clinical practice is effective, but not sufficient, to reduce NSIs, and that other factors should also be investigated. These results will contribute to the literature for preventive approaches to reduce occupational accidents in working environments.

Considering these results, the key path to protect students studying at healthcare programmes in Turkey is education and monitoring. Prior to clinical practice, it is recommended that students be informed and trained about issues such as occupational risk factors, and universal precautions. Training should continue through in-service training programs after graduation. In addition, all occupational injuries of students in the course of clinical practice should be reported to the Infection Control Committee, must be registered, and political regulations should be established. In addition, all trainers should act sensitively about this issue.

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