

Occupational exposure to blood and body fluids among nursing students in clinical internship

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Abstract

Background. During their academic activities, nursing students are required to carry out clinical internships during which they can be exposed to contamination by bloodborne pathogens.

Objective. The study was carried out to determine the prevalence and associated factors of occupational exposure to biological material potentially infected by blood in a population of nursing students.

Materials and Methods. A cross-sectional design was used in

this study and a self-administered questionnaire was provided to students. The research work was conducted from February 20, 2022, to March 15, 2022.

Results. The questionnaire was completed by 119 students. A total of 94 (78.99%) of the participants were female with a mean age of 20.46±1.16 years. 48 (40.34%) exposures were recorded with corresponding incidence rates of 0.4 exposures/person/year. With at least one accidental exposure to blood in 21 (43.75%) students. The OR analysis made by year of study showed that the ratio between the exposure risk was lower than 1 with P>0.05. The comparison between the different nursing specialties showed a significant difference between the students of General Nurses and Family and Community Health Nurses. The variables associated with exposures to blood were: female sex and personal protective equipment.

Conclusions. During their clinical training, nursing students face several types of risks including biological through blood. In order to prevent the occurrence of these incidents, the consequences of which can be fatal, it is necessary to invest in training sessions and our institute should set up a local management unit for following the exposed students.

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Introduction

Occupational blood exposure accident (OBEA) is one of the major public health problems that healthcare workers (HCWs) are encountering worldwide.^{1,2} There are several definitions but according to the Center of disease control, it's defined as a percutaneous injury or a contact of mucous membrane or no intact skin with blood, tissue, or other body fluids that are potentially infectious.³ These preventable injuries expose workers to the risk of being contaminated by several infectious agents during their work such as: Hepatitis B virus (HBV), Hepatitis C virus (HCV), and human immunodeficiency virus (HIV).⁴ It is estimated that the risk of HIV infection after needle stick injury is approximately 0.3%, of HBV infection 30%, and of HCV 3%.⁵ The risk for these infections depends on their prevalence in the patient population and the nature and frequency of exposure.⁶

The World Health Organization estimates that 3 million percutaneous exposures occur annually among 35 million HCWs worldwide. As a result of these exposures, 150,000 HCWs get infected with HCV, 70,000 with HBV, and 500 with HIV each year. More than 90 % of these infections occur in developing countries, particularly in sub-Saharan Africa.^{5,7} The exact number of HCWs exposed to blood is unknown; However, a systematic review done in 21 African countries showed that the lifetime and 12-month prevalence of occupational exposure to body fluids was 5.7% (95% confidence interval, CI: 59.7-71.6) and 48.0% (95% CI: 40.7-55.3), respectively.⁸

These epidemiological data confirm the high risk of exposure

to blood by healthcare professionals. However, we must not forget the students in medical and paramedical training who constitute a population at risk for several reasons, such as: i) nature of tasks performed; ii) handling of biological specimens; iii) lack of experience and skills; iv) hesitation before performing an act; v) close contact with patients. Most of the studies were conducted among health professionals, including physicians, nurses and laboratory technicians but few have focused on nursing students on the African and Mediterranean scale. Prevalence rates of 60.3%, 88.6%, 9.4%, 13.9% and 49% were found in China, Egypt, The United States, Australia and Turkey respectively.^{9,10} To our knowledge, in Morocco, no study has been published to describe the frequency of OBEA among nursing students. It is within this framework that the objective of this study falls, which aims to determine the prevalence and the factors associated with occupational exposure to biological material potentially infected by blood in a nursing student population.

In our institution, the safety of our students is a priority and is taken into consideration during the planning of courses and training. This study is part of an awareness strategy made for second and third-year students in collaboration with the provincial hospital of Meknès in Morocco. The main objective was to make students aware of the seriousness of this accident, to encourage them to declare, and to know the procedure to follow. This study is part of an awareness strategy for the benefit of our institute students and those responsible for clinical internships. Our survey would be the first study in Morocco to estimate the prevalence, describe the circumstances, analyze the student's conduct after the accident, and identify the possible risk factors associated with blood exposure.

Materials and Methods

Study design

A cross-sectional design was used in this study. The research work was conducted from February 20, 2022, to March 15, 2022.

Study area

The research was carried out at the Higher Institute of Nursing Professions and Health Techniques (ISPITS), located in the city of Meknès in Morocco. The institution is one of the oldest nursing training institutes in the country. With the mission of answering the needs of the national health system in terms of initial training and development of paramedical frameworks for the country's public sector.

Study population

According to Cochran's formula, a sample size of 109 was calculated using a 5% margin error (d) and 95% confidence interval (CI). The inclusion criteria were: i) students enrolled in second and third years at ISPITS Meknès, who had benefitted from a hospital internship; ii) students who agreed to participate in the study.

The exclusion criteria were: i) students not enrolled at the ISPITS of Meknès; ii) students not enrolled in the second and third year; iii) students who refused to participate in the study.

Tool of the study

A self-administered questionnaire was provided to students. The questionnaire was made up of 20 questions and it consists of three main parts: i) sociodemographic information; ii) safety measures; iii) event description.

The questionnaire was developed according to several literature reviews. To ensure the integrity of the data, the questionnaire

was explained before its distribution to students who agreed to participate in the study.

Data analysis

The obtained data were entered into Microsoft Excel (Windows 10) and analyzed in the SPSS version 26.0 statistical software package. The data was presented in the form of frequencies, percentages, means, and standard deviations. The chi-square test and Fisher's exact test were used with a statistical significance of $P < 0.05$ at a 95% confidence interval. Adjusted odds ratios were calculated using bivariate and multiple logistic regression to describe the relationship between exposure to blood and body fluids (BBF) and their associated risk factors. Multivariate logistic regression was done to all significant ($P \leq 0.20$) parameters to calculate adjusted odds ratios.

Ethical consideration

Each student was informed of the purpose and nature of the study. Participation was voluntary and anonymous. Therefore, each student had the right to participate or refuse to be included in this study. Oral consent to participate was obtained from students. The confidentiality and anonymity of the data have been respected and were explained in the questionnaire.

Results

A total of 119 valid questionnaires were collected (either overall response rate 55.72%): 48 from the 2nd-year students and 71 from the 3rd-year students. A number of 94 (78.99%) of the participants were female (The sex ratio F/M was 3.76) with a mean age of 20.46 ± 1.16 years (range 19-26 years).

Sociodemographic characteristics of exposed students

A total of 48 (40.34%) exposures were recorded with corresponding incidence rates of 0.4 exposures/person/year. With at least one OBEA in 21 (43.75%) students.

The students were predominantly women (81.25%) and the average age was 20.42 ± 1.03 years (Table 1). In addition, 20 (41.67%) students were in their 2nd year of study. Data analysis showed that 43.75% of the students had experienced at least one accidental exposure to BBF which took place in 81.25% of cases during the day shifts and at times of high workload (56.25%) (Table 1). It is at the level of emergency room services where 56.25% of exposure accidents had occurred, and injection/phlebotomy was the most incriminated procedure with 23 accidents followed by arterial puncture with 12 (Table 1).

Risk exposure per student, year, and specialties

The OR analysis made by year of study showed that the ratio between the risk exposure was lower than 1 with $P > 0.05$. The comparison between the different nursing specialties showed a significant difference between the students of General Nurses and Family and Community Health Nurses (Table 2).

Students' behaviors and attitudes in front of occupational blood exposure accident

The first reaction adopted by the students after the incident was different. A total of 31 (64.58%) of them had started by cleaning the site of the needlestick. Others had instead used an antiseptic or alerted the cell responsible for this type of accident at the hospital

with 20.83% and 12.51% respectively. On the other hand, only one student chose to continue his work (Table 3). Compared to the declaration, it had been done immediately (50%), during the day (12.50%), or even after 24 hours (12.50%). However, 12 (25%) students had not reported this incident. All students had benign biological tests required except the 06 students who had not declared to the responsible doctors (Table 3).

Factors influencing exposure to blood and body fluids

With the Cox regression model, several variables with $P < 0.20$ were analyzed (female sex, emergency room services, personal

protective equipment, day shift, and high hospital workload). The variables associated with blood exposures and body fluids were: female sex and personal protective equipment (Table 4).

Discussion

Although this study was conducted in the ISPITS of Meknès, the results may not be generalized to all Moroccan nursing institutes. This may be considered as a limiting factor in our study. The data collection was based on the administration of a questionnaire

Table 1. Sociodemographic characteristics of exposed students.

Characteristics	Frequency/Mean \pm SD n=48 (40.34%)	Percentage (%)
Gender		
• Female	39	81.25
• Male	9	18.75
Age in years	20.42 \pm 1.03	---
Year of study		
• 2nd year	20	41.6
• 3rd year	28	58.33
Nursing specialties		
• General Nurses (GN)	32	66.67
• Emergency and Critical Care Nurses (ECCN)	12	25.00
• Family and Community Health Nurses (FCHN)	4	08.33
Number of episodes		
• 1 episode	21	43.75
• 2 episodes	15	31.25
• 3 episodes	9	18.75
• >3 episodes	3	06.25
Time of incident		
• Day shift	39	81.25
• Night shift	7	14.58
• Weekend shift	2	4.17
Hospital services		
• Department of medicine	18	37.50
• Department of surgery	3	06.25
• Emergency room services	27	56.25
Procedure		
• Injection/phlebotomy	23	47.92
• Arterial puncture	12	25.00
• Glucometer	4	8.33
• Suturing	3	6.25
• Other	6	12.50
Hospital workload		
• High	27	56.25
• Normal	19	39.58
• Low	2	04.17
Personal protective equipment		
• Yes	10	20.83
• No	38	79.17

Table 2. Frequency and risk exposure estimate per year of study and nursing specialties.

Characteristics	Exposed students (%)	OR [95% CI]	P value
Student year 2 nd vs. 3 rd	41.67 vs. 58.33	0.86 [0.37-1.86]	0.819
Nursing specialties			
GN vs. ECCN	66.67 vs. 25.00	1.36 [0.95-3.51]	0.073
GN vs. FCHN	66.67 vs. 08.33	0.35 [0.22-0.89]	0.03*
ECCN vs. FCHN	25.00 vs. 08.33	1.18 [0.63-2.10]	0.714

GN, General Nurses; ECCN, Emergency and Critical Care Nurses; FCHN, Family and Community Health Nurses; CI, Confidence interval; OR, Odds ratio. P values denoted by * are significant at < 0.05 .

to second and third-year students. The participation rate was 55.72% which is relatively low compared to other studies where the participation rate could reach 85.90% (Australian study), 76.14% (Italian study), and 71% (Turkish study).^{6,11,12} Despite the awareness of students to the interest in carrying out this study after a series of training sessions, a reluctance on the part of the students was felt. This has led us to ask questions such as: were the training sessions effective? Are the students afraid of declaring that they are victims of a BBF? Are they aware of the risk? Should we carry out other preventive measures? And therefore, to conclude that is necessary to use a complementary tool for improving the knowledge of students.

Data demonstrated that exposure to BBF is a serious problem in the investigated population with almost half (40.34%) of the students experiencing at least one OBEA during their clinical internship. This finding seems to be similar to Renat *et al.* who report a prevalence of 40% in the Brazilian population.⁴ Similarly in another study, 44% of Pakistani students had experienced an OBEA in nursing school.¹³ Furthermore, Amira *et al.* and Darouiche reported a higher prevalence with respectively 88.60% and 77.40%.^{14,15} However, the lowest rates were observed in research conducted by Esther's team in Spain and Zungu's team in South Africa with respectively 16.20% and 16%.^{16,17} Other studies have been reported by researchers from developing and developed countries summarized in Table 5.

Nursing studies are essentially based on clinical education in addition to classroom. To apply knowledge, students are required to perform various activities of care such as injections and intravenous needles.^{9,18} However, at this stage students have a lack of clinical experience, incomplete knowledge, stress, and precipitation. Added to it, the no respect for standard hygiene measures, a level weak of awareness about this problem, and a lack of skill in handling needles and sharps safely.^{9,15,18} Researchers have shown that active pedagogies like the simulation method, seem more effective. It aims to prepare and confront students with profession-

al situations in conditions close to reality without a real patient. Therefore, students are engaged to reflect and adapt by facing real situations and improving acquisition skills while preventing errors.¹⁹ The principal key of simulation is "never the first time on the patient".²⁰

Nurses are an integral part of the health system. While performing their duties, they face a variety of occupational health issues.²¹ Studies have shown that nurses are known to be a high-risk subgroup for these incidents and nursing students may have a greater risk than other medical and paramedical students.¹³ This is in view of the direct and daily contact with the patient. In India, Syed Ali Hussein *et al.* reported the highest rate of injuries among nursing students (76.40%) compared to dental students (75.40%) and medical students (48.70%).²² These findings indicate that the risk may be prevented by learning manual procedures before clinical training.¹¹ According to Vaquero-Alvarez *et al.*, a higher level of knowledge and frequency of correctly performing were linked to lower biological accidents.¹⁶

Results showed no difference in exposure between second and third-year students. However, the Italian study reported that the exposure risk in third-year students was less than in their colleagues in the first and second years.⁶ Talas investigated 473 nursing students in Turkey and found a lower rate of OBEA in the second year than in the third and fourth years.¹¹ In India, the maximum OBEA (57.60%) occurred during the first year of the course.² Some researchers found that the probability of ever having an OBEA was inversely related to the years of experience.² The result obtained in our study can be explained by the fact that first-year students were not included in our study. On the other hand, the risk of exposure was assessed in relation to the specialties of the students. We found a significant difference between General Nurses and Family and Community Health Nurses students. This could be explained by the fact that general nurses students practice their internships in the hospital environment, in emergency units, and with a higher number of patients. Unlike students in other special-

Table 3. Students' behaviors and attitudes front of occupational blood exposure accident.

Behaviors and attitudes	Frequency (n=48)	Percentage (%)
First reaction after exposure		
• Wash the site of the needlestick	31	64.58
• Rinse with an antiseptic	10	20.83
• Immediately seek medical evaluation	6	12.51
• keep working	1	02.08
Medical assessment deadline		
• Immediately	24	50
• During the day	6	12.50
• After 24 hours	6	12.50
• No declaration	12	25
Laboratory tests		
• Conducted	42	87.50
• Unconducted	6	12.50

Table 4. Logistic regression analysis of variables associated with occupational blood exposure accident.

Variables	P value	COR [95% CI]	P value	AOR [95% CI]
Female sex	0.07	0.54 [0.15-1.88]	0.03	1.40 [1.05-4.11]
Emergency room services	0.42	0.52 [0.10-2.97]	-	-
Personal protective equipment	0.08	0.89 [0.63-3.05]	0.04	1.58 [0.99-3.52]
Day shift	0.78	0.67 [0.19-3.65]	-	-
High hospital workload	0.95	0.93 [0.18-4.68]	-	-

Table 5. Prevalence of occupational blood exposure accident among nurse students in the literature.

Authors	Country	Percentage (%)
Zhang X, 2018 ⁹	China	60.30
Talas MS, 2009 ¹¹	Turkey	49
Vaquero-Álvarez E, 2020 ¹⁶	Spain	16.20
Syed Ali Hussain J, 2012 ¹⁸	India	76.40
Hajjaji Darouiche M, 2014 ¹⁵	Tunisia	77.40
Lukianskyte R, 2011 ¹⁹	Lithuania	78
Our study, 2022	Morocco	40.30
Mc Carthy GM, 2000 ²⁰	Canada	27
El- Houfey AA, 2013 ¹⁴	Egypt	88.60
Reis RK, 2004 ⁴	Brazil	40
Shiao JS, 2002 ¹	Taiwan	61.90
Zungu LI, 2008 ¹⁷	South Africa	16

ties who are generally assigned to health centers where the number of care acts and patients are generally limited. Most of OBEA occurred in the emergency room services and the department of surgery with a total of 62.50% of cases. The same result was described in Jordanian and Italian studies.^{6,23} Compliance with protective measures by wearing gloves, for example, is an important gesture in preventing the occurrence of these accidents, as has been reported in several manuscripts.²⁴ In Canada, McCarthy and Britton described a less frequent use of barriers by nursing and medical students.²⁴ According to Talas the most frequent site of injury was the hand (98.70%), so the use of double gloves improves the protective barrier from OBEA,¹¹ especially since the highest number of students had been injured by needles.

In addition, we asked students about their behavior after an OBEA, particularly the declaration. A percentage of 25% had not declared the incident either to the administration of the establishment or to the department where the incident took place. Returning to the literature, we find that several studies had raised the same problem with variable rates.^{2,11,14,17,18,25,26} This significant frequency of under-declaration is (at the origin) the cause of an under-estimation and a poor evaluation of the frequency of OBEA in our institute. It is assumed that students do not report their incident because they might think that it is their fault if it happened. But others can trivialize this biological risk because the consequences are not visible as chemical risks. In our study two risk factors were identified. The first is the female sex, this can be explained by the fact that the nursing profession is predominantly constituted by females in our country. The second is related to the wearing of personal protective equipment.

Limitations

This study has several limitations. This survey was conducted in a single institute with a low number of students. The results may not be generalizable to nursing students in other institutions in other cities of the country. Also, the participation rate was 55.72% which is relatively low. Longitudinal studies including more students from several institutions are strongly recommended.

Conclusions

Awareness of the presence of a problem is the first step toward solving it. Nursing students are a non-negligible part of the high-risk healthcare workers of OBEAs. Our study showed a significant frequency of these incidents in our institute. Consequently, it is

necessary to set up training and education actions before the start of hospital internships. But above all to provide them with the necessary equipment to protect themselves. Also, nationwide studies are needed to develop effective interventions to prevent OBEA among Moroccan nursing students.

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