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Age and years in practice as factors associated with needlestick and sharps injuries among health care workers in a Portuguese hospital

Artur Martins[a], Ana C. Coelho[b,*], Manuela Vieira[a], Manuela Matos[c], Maria L. Pinto[b]

[a] Hospital Center of Trás-os-Montes and Alto Douro, Avenida da Noruega, Lordelo, 5000-508 Vila Real, Portugal
[b] Medical Microbiology Laboratory, Department of Veterinary Sciences, CECAV, University of Trás-os-Montes and Alto Douro, 5001-801 Vila Real, Portugal
[c] Center of Genetics and Biotechnology, Institute for Biotechnology and Bioengineering, University of Trás-os-Montes and Alto Douro, 5001-801 Vila Real, Portugal

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ABSTRACT

Health care workers are attributed to the group at highest risk of occupationally acquired bloodborne diseases as the result of contact with blood and body fluids. A cross sectional study was conducted between November 2009 and February 2010 in the North of Portugal, to identify potential risk factors for needlestick and sharps injuries. A questionnaire was provided to 363 health care professionals. Logistic regression was used to identify risk factors associated to needlestick and sharps injuries, calculating odds ratio (OR) and their 95% confidence interval (CI). Sixty-five percent of health care workers (64.5%, 234/363) reported needlestick and sharps injuries in the previous 5 years. Of the injured workers, 74.8% were nurses. Of the total injuries reported, the commonest were from syringe needle unit. The multivariate logistic regression model showed that the strongest risk factor was having more than 10 years or more of work in health services (OR 3.37, 95% CI 1.82, 6.24). Another significantly related factor was being over 39 years-old (OR 1.94, 95% CI 1.03, 3.63). In Portugal, there is a lack of epidemiological evidence related to needlestick and sharps injuries. Considering that patients infected with hepatitis B and C virus are commonly encountered in the hospital environment and that the prevalence of HIV infection in Portugal is one of the highest in Europe, these results should be considered in the design of biosafety strategies at the Hospital Center.

1. Introduction

Health care workers (HCWs) are among those at highest risk of occupational infection from biological factors, as they are exposed to human body fluids daily. Every year, hundreds of thousands of HCWs are at risk of occupationally acquired bloodborne diseases as the result of needlestick and sharps injuries (NSSIs) (Stein et al., 2003; Nagao et al., 2007). NSSIs have been one of the major issues in the protection of HCWs, and vigorous preventive action has been practiced worldwide in recent decades. NSSIs may lead to serious and potentially fatal infections from bloodborne pathogens such as hepatitis B virus (HBV), hepatitis C (HCV), or human immunodeficiency virus (HIV) (Koh, 2010) and other bloodborne pathogens including cytomegalovirus, herpes simplex virus and parvovirus B19 (Wicker et al., 2008). In Europe, Portugal has the second highest HIV incidence rate (251.1 cases per million inhabitants), whereas the HCV prevalence is around 1.5–2.0% (Marques et al., 2011). Percutaneous exposure to HIV results in a seroconversion rate of around 0.3% (CDC, 2001), and the figure for Hepatitis C is estimated between 3 and 10% (Jefferies, 1995; Wicker et al., 2008). The risk of transmission of hepatitis B infection by NSSI is up to 30% for susceptible HCWs without post exposure prophylaxis or sufficient hepatitis B vaccination (Deisenhammer et al., 2006; Wicker et al., 2008). The Centers for Disease Control and Prevention (CDC) estimates that about 600,000–800,000 needlestick injuries are reported annually among U.S. HCWs. It is further estimated that about half of NSSIs go unreported (CDC, 2001)

The Centers for Disease Control and Prevention (CDCs) have strongly supported the prevention of occupational sharps injuries (CDC, 1998, 2001), however, NSSIs still remain a major risk for HCWs (Hofmann et al., 2002; Gillen et al., 2003; Nagao et al., 2007; Colombo et al., 2011).

Activities associated with the majority of needlestick and sharps injuries are injecting medications, recapping needles, handling trash and drawing blood. Other contributing factors were sharps disposal, contact with waste, and patient handling (Quinn et al., 2009).

NSSIs are an important occupational hazard in health care, and the distribution of risk does not occur at random (Aiken et al., 1997). It is important to investigate injury determinants of so as to design effective prevention strategies. In Portugal, there is a lack of epidemiological evidence relating to NSSIs among HCWs. In

* Corresponding author.
E-mail address: accoelho@utad.pt (A.C. Coelho).

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comparison, survey methodology has widely been used to collect epidemiological data in other countries. This study aims to provide some epidemiological aspects of NSSI among HCWs in a general hospital in the North of Portugal.

2. Material and methods

A cross sectional study was conducted in the Hospital of Trás-os-Montes e Alto Douro in Portugal. This is a 387-bed district general hospital serving a population of 300,000 inhabitants. A list of all HCWs routinely working with blood (doctors, nurses, diagnostic technicians, and health care staff such as cleaners/housekeepers) was obtained from hospital administration. The hospital had a total of HCWs: 157 doctors, 512 nurses, 87 diagnostic technicians and 342 health care staffs. Hospital administrative personnel were excluded from the study. The questionnaire was completed by 369 of 400 HCWs surveyed, for a response rate of 92.5%. Six invalid questionnaires were excluded because of incomplete or missing responses, leaving a final total of 363 for analysis.

Permission to perform the study was obtained from the Hospital ethics committee and the procedures followed were in accordance with the Helsinki declaration. A pilot study was carried out at a separate hospital. A questionnaire was developed based on literature reviews (Norsayani and Hassim, 2003; Stein et al., 2003; Nsubuga and Jaakkola, 2005; Nagao et al., 2007; Serinken et al., 2009). The study was conducted between November 2009 and February 2010.

The final questionnaire comprises 23 main questions (available in Portuguese upon request), consisting mostly of fixed-choice items with some checklist multiple choice questions. Some open-ended questions were included, allowing for exploration of possible issues. The information collected included socio-demographic variables such as age, gender, occupation, types of activities leading to exposure accidents, type and number of occurrences, objects and instruments causing the accidents, whether the events were reported or not. The questionnaire also covered preventive measures, attitudes towards infection control and their reported practice, history of occupational exposure, knowledge and occupational education.

The study was introduced to the HCW staff and they were asked to complete a self report questionnaire when they were off duty. Consent was obtained from all respondents. In this study a "sharps or needlestick injury – NSSI" was defined as "a penetrating wound with an instrument that is potentially contaminated with blood or body fluid of another person" including but not limited to needles, lancets, scalpels, and contaminated broken glass used during performance of duties (Prüss-Üstün et al., 2003) and "health care worker" (HCW) was defined as "any person whose activities involve contact with patients or with blood or other body fluids from patients in a health care or laboratory setting, including doctors, nurses, technicians, and cleaners/housekeepers" (CDC, 1998). All participants were informed of the nature and objectives of the survey and their consent was obtained before they filled in the questionnaire individually. Privacy was maintained. Numbers of occurrences and types of NSSIs were recorded. Injuries were compared with the number of years in service in the health care field, socio-demographic variables, and knowledge of biosafety.

Potential risk factors for NSSIs were selected based on reviews of previous literature and developing our own hypotheses from factors that might increase the risk of sustaining NSSIs in Portugal. The assessment of the risk factors was based on self-reported answers to the questionnaire.

2.1. Data analysis

Data was analyzed using the Statistical Package for Social Sciences® (SPSS) for Windows, Version 17.0. The distributions of risk factors among those who had experienced one or more injuries during the last 5 years (to prevent memory bias) and those without any such injuries were calculated. Multivariate logistic regression was used to model the odds (OR) and its confidence interval (95%) of having an NSSI related to the variables. The outcome variable was dichotomized into at least one needlestick or sharps injury during the last 5 years *versus* no such injuries, in order to identify any risk factors associated with the injury. Significant potential risk factors at $p < 0.05$ (two-tailed; alpha = 0.05) in the univariate analysis were then evaluated using stepwise regression to construct a multivariate model (Wald test stepwise p-Wald value to enter $p < 0.05$). The multivariate logistic model was developed using a stepwise approach. Backward elimination followed by a forward selection for each variable at a time was done using a likelihood ratio test at each step with 0.05 (two-tailed; alpha = 0.05) as a significant level for removal or entry. The fit of the models was assessed using the Hosmer and Lemeshow goodness-of-fit test (Hosmer and Lemeshow, 2000). The model was rerun until all remaining variables presented statistically significant values ($p < 0.05$).

Table 1
Descriptive statistics for demographic questions ($n = 363$).

Variables	n	%
Age group		
≤39 years	178	49.0
>39 years	185	51.0
Gender		
Male	85	23.4
Female	278	76.6
Job category		
Doctor	42	11.6
Nurse	250	68.9
Medical laboratory Technician	11	3.0
Cleaner staff	60	16.5
Years in practice		
≤10 years	124	34.2
>10 years	239	65.8
Total of years in the actual service		
≤10 years	241	66.4
>10 years	122	33.6

3. Results

Distributions of socio-demographic characteristics of the study population are presented in Table 1. Among the participants, 234 (64.5%) reported having experienced at least one NSSI in the last 5 years while only 35.5% had not experienced any such injury. Of the injured HCWs, 29.2% (106) sustained one injury, 24.5% (89) had 2–3 injuries, 3.3% (12) had 4–5 injuries and 7.4% (27) sustained 5 or more.

About 32.8% of the respondents had been exposed to biological fluids, and 25.6% had experienced exposition to biological fluids and NSSIs. The majority of the injured HWCs were females (75.2%). Of 234 injured workers, 74.8% were nurses, 13.2% were doctors and 28.1% work in other health services.

The majority (61.1%) had reported their injury to the relevant directors or other authorities in the hospital. The rate of under-reporting was 38.9%. About 123 respondents (33.9%) stated that they had been trained on work-related injuries such as bloodborne pathogens or NSSIs.

The most common device involved in the injury was a syringe needle unit in 153 cases (45.8%), 74 cases (22.2%) occurred when breaking ampoules, 48 cases (14.4%) occurred with a suture needle, 33 (9.9%) involved a scalpel or lancet and 23 (6.9%) occurred with an intravenous catheter. Only 3 (0.9%) occurred with scissors (Table 2).

Despite instructing HCWs not to recap needles this was still a common practice, and 26.1% of the injuries reported were related

Table 2
Data regarding needlestick injuries and other sharps injuries.

Device involved in the injury	*n*	%
Syringe needle	153	45.8
Ampoule	74	22.1
Intravenous catheter	23	6.9
Suture needle	48	14.4
Scalpel/lancet	33	9.9
Scissors	3	0.9
Total	334	100

Table 3
Frequency of procedures related to needlestick or sharps injuries.

Procedures related to injury	*n*	%
Recapping needles	49	26.1
Breaking of ampoules	30	16.0
Disposal of needles in container	26	13.8
Suturing	15	8.0
Patient related (*e.g.* unexpected movement)	5	2.7
Accident from colleague	8	4.3
Cleaning	12	6.3
Intravenous drug injection/putting up IV line/collecting drawing blood	36	19.1
Removing the needle safety cap	7	3.7
Total	188	100

with this procedure. It should be noticed that the hospital provided special containers for sharps and needles, which were allocated to the various locations within the facility. This was followed by manipulating intravenous lines or giving injections (19.1%) such as intravenous drug injection or putting up an intravenous line. Breaking ampoules and disposing of needles in containers were related to 16.0% and 13.8% of the injuries, respectively. Only 8.0% of injuries occurred while suturing and about 6% when cleaning after patient care. An unexpected finding was that 4.3% of injuries were inflicted by another health care worker (Table 3). Injuries were less commonly related to removing the needle safety cap (3.7%) or collisions such as an accident with a colleague (4.3%) or patient because of an unexpected movement (2.7%).

3.1. Risk factors for sharps and needlestick injuries

Possible risk factors for injuries were evaluated. In the univariate analysis 8 variables were found to be statistically significant risk factors of NSSIs: age, years in practice, total of years in the actual service, removing syringe needles after use, disposing needles in a container, self-assessment overrating of biosafety knowledge, training in biosafety, knowing how to act in case of NSSIs and accidental exposure to body fluids. These variables were included in the multivariate model. In order to adjust for confounding factors, a backward stepwise conditional logistic regression was employed using all of the statistically significant variables above.

Multivariate logistic regression analysis of the odds (OR) for sustaining injuries in relation to the potential risk factors listed above is presented in Table 4. Only four variables were found to be significant after the stepwise procedure ($p < 0.05$). It can be seen that the following factors were not significant to the risk of sustaining needle stick injuries ($p > 0.05$) when adjusting for confounding factors and were excluded from the final model: total of years spent in the actual service, removing syringe needles after use, received training on biosafety and self-assessment of knowledge in biosafety as sufficient.

The results showed that the strongest NSSIs risk factor was having 10 or more years of experience in practice compared with less than 10 years (OR 3.37, 95% CI 1.82, 6.24). Another factor significantly related with increased odds for injuries was the age of participants, being higher in HCWs over 39 years-old when compared with workers under 39 (OR 1.94, 95% CI 1.03, 3.63). In this study, those who had the habit of disposing contaminated needles and sharps objects in special containers (OR 0.18, 95% CI 0.08, 0.40) most or all of the time had less probability of having an injury. Surprisingly, those who reported as not knowing how to proceed in case of an accident had lower risk of sustaining a NSSIs (OR 0.33, 95% CI 0.16, 0.67).

4. Discussion

Sharps and needlestick injuries present the single greatest risk to health care workers, primarily due to accidental exposure to infected blood and body fluids (CDC, 2001). There are no studies of NSSIs risk factors in Portugal. To fill this gap, the authors conducted a cross-sectional survey to identify potential risk factors.

This study showed that the majority of HCWs involved in the study were exposed to the risk of bloodborne diseases such as HIV, Hepatitis B and Hepatitis C through NSSIs in their routine activities. A total of 64.5% had experienced at least one injury in the last 5 years and about 33% had had exposure to body fluids. The rate of NSSIs observed in this study was slightly higher than the 17.2% reported by Gessessew and Klashu (2009) in Ethiopia, 23.5% reported by Rampal et al. (2010) in their study carried out in Malaysia, 24.9% reported by Lee and Hassim (2005), also in Malaysia, and 39.4% reported by Hofranipour et al. (2009) in Iran. However, it was is lower than the 74% reported by Maqbool (2002) in a study carried out in Saudi Arabia and 74% reported by Gurubacharya et al. (2003) in Nepal. The rate of NSSIs registered in our study is higher than the reported in Irish interns – 26% (O'Sullivan et al., 2011).

In our study 61.1% of workers had reported their injuries to the relevant directors or other authorities in the hospital. In previous

Table 4
Multivariate logistic regression analysis of odds ratio (OR) for sharp and needlestick injuries in relation to potential risk factors (OR = 1).[a]

Variables	Number respondents	NSSIs (*N*; %)	Wald's *p*	OR	95% CI
Age					
≤39 years	178	90 (50.6)	-	1	
>39 years	185	144 (77.8)	0.000	1.94	1.03–3.63
Years in practice					
≤10	124	50 (40.3)	-	1	
>10	239	184 (76.9)	0.039	3.37	1.82–6.24
Disposal of needles in container					
Never/sometimes	328	223 (67.9)	-	1	
Most/all of the time	35	11 (31.4)	0.000	0.18	0.08–0.40
Know how to act in case of NSSIs					
Yes	320	216 (67.5)	-	1	
No	43	18 (41.8)	0.002	0.33	0.16–0.67

[a] Overall data of the model: .2LL = 40.666; Hosmer and Lemeshow Chi-square = 6.19; $p = 0.52$; d.f. = 7.

investigations underreporting of NSSIs to the workplace monitoring system was estimated to be about 50% (Makary et al., 2007; Kennedy et al., 2009; Quinn et al., 2009). Reporting of injuries to occupational health departments can reduce rates of injury by identifying risk-prone behaviors and practices. Underreporting may lead to inaccurate information regarding the overall risk of exposure to pathogens, and full documentation of exposure injuries would guide improvements in prevention (Nagao et al., 2007). On the other hand, an accurate risk assessment can be performed and post exposure prophylaxis provided if necessary (Wilburn and Eijkemans, 2004).

A good understanding of the circumstances contributing to injuries among HCWs is necessary if effective prophylactic strategies are to be developed.

This study revealed that the occurrence of episodes of NSSIs in female HCWs and in nurses was high, followed by doctors, which is not surprising in view of the nature of nursing work. The preponderance of injuries occurring in nursing staff is a common feature of studies around the world (Lymer et al., 1997; Abu-Gad and Al-Turki, 2001; Trim and Elliott, 2003; Jahan, 2005). This can be explained by the fact that nurses administer most of the injections and are responsible for venipunctures, intravenous fluid administration and other procedures which require the use of needles (Rampal et al., 2010) and the greater amount of time nurses spend in direct patient contact (Gerberding, 1994).

The occurrence of needlestick injuries is significantly related to clinical practice behaviors and attitudes (Yao et al., 2010). In order to reduce the number of NSSIs among HCWS it is important to consider the activities being performed when the accident occurred. Between 22% and 55% of injuries occurred while recapping needles (Trim and Elliott, 2003; Elliott et al., 2005). The current study demonstrates that HCWs frequently recapped contaminated needles after use, a practice that it is strictly prohibited in some countries in order to reduce the risk of transmission of bloodborne pathogens (Yao et al., 2010). It has been suggested that modifying practices such as recapping would decrease the incidence of sharps injuries. This practice has been identified as natural behavior, based on the impulse to remove a sharp and potentially dangerous object from the immediate environment (Elliott et al., 2005). However, this practice was not a potential risk factor for sustaining a NSSI in the multivariate study.

In this study, 3.7% of workers had NSSIs while taking off the cap. Even though HCWs were not at risk of infection from bloodborne pathogens since the needle is sterilized, if the HCW was a carrier of bloodborne pathogens this could be transmitted to patients. Similarly, if patients were the carriers, an open skin barrier due to an NSSI will pose a risk of infection for HCWs (Norsayani and Hassim, 2003).

As needles are the most frequently used sharp instrument, they are the most common NSSI source. In our study needlesticks accounted for 51.6% of injuries, a frequency similar to other studies (Abu-Gad and Al-Turki, 2001; Jahan, 2005). In our study the risk of a needlestick injury was higher during a procedure (46.7%) and after use of the device but before disposal (39.9%). These values were higher than the data found in other studies (National Institute for Occupational Safety and Health, 1998; Jahan, 2005). These results highlight the need for HCWs to stay alert to the possibility of injury until the procedure is completed and the needlesticks or sharps are disposed off (Jahan, 2005). A significant portion of NSSIs occur when manipulating intravenous lines or administering intravenous and intramuscular injections (19.1%). An interesting finding was the percentage of NSSIs resulting from collisions during procedures (7.0%), which included unexpected movements and accidents from colleagues. Situations involving agitated patients, including children, are acknowledged factors of exposure risk (Ribeiro and Shimizu, 2007; Cardoso and Figueiredo, 2010).

In other studies, training has been identified as the crucial factor in predicting the occurrence of needlestick and sharps injuries among HCWs (Nsubuga and Jaakkola, 2005). Surprisingly, in our study those who had not attended any training on prevention and management of NSSIs in their workplace had less risk of sustaining an injury compared with those who had attended some kind of training. Our study showed a significantly decreased risk among those who had the habit of disposing contaminated needles and sharps objects to special containers compared with those who didn't have this mind-set. The improper disposal of used sharps and needles is known to cause needlestick injuries (Wodek, 1997).

The experience seems to be a risk factor in these injuries. Health care workers with 10 or more years of experience in practice were at a higher risk of sustaining NSSIs compared with those with less than 10 years of work experience. The interpretation of these discrepancies is complicated by various studies, which found that injuries gradually decreased over an increasing length of service. Abu-Gad and Al-Turki (2001) reported that 50% of injuries occurred during the first 3 years of practice. Younger workers may put more recently acquired knowledge into practice, while experienced familiarity may contribute to taking fewer precautions and paying less attention at work, which are likely to increase the chance of human error and contribute to risk behaviors. However, the apparent contradiction between age and NSSIs needs further studies, in order to explain what could make the difference, and different hospitals should be compared.

This study had a good response rate, which leads us to believe that our results reflect what was happening among the HCWs quite well. However, some limitations of this study should be considered in the interpretation of the results. First, in any retrospective study recall bias is unavoidable and potentially affects the estimates. Another possible drawback is that accident reports underestimated the actual frequency of occurrence, or participants that had had an NSSI might have been more eager to participate. A further limitation is that our study is small, retrospective and confined to one center, although we have no reason to believe that its findings are not accurate or representative of the wider problem.

5. Conclusions

Considering that patients infected with HBV or HCV are commonly encountered in the hospital environment, that HIV infection is a prevalent infection in Portugal (UNAIDS, 2007), and that NSSIs are an important and continuing cause of exposure to these agents among HCWs, continuing education and specific programs for hospital staff are recommended. Occupational exposure to blood and body fluids among HCWs found in this study is considerable. Age and years in practice can play important roles in the occurrence of NSSIs and should be considered in the design of biosafety strategies for prevention. The findings of this study can increase awareness and reduce the occupational risks from NSSI. However, since the seroprevalence of bloodborne pathogens after injury has not been studied in Portugal, further investigations are needed to identify the risk of HCWs contracting these potentially infections.

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