










RESEARCH ARTICLE

Needlestick and sharps injuries among secondary and tertiary healthcare workers, Saudi Arabia

Anwar M. Makeen¹  | Abdullah A. Alharbi¹  | Mohammed S. Mahfouz¹  |
 Ahmad Y. Alqassim¹  | Ahmed A. Ismail²  | Haider M. Arishi³  |
 Maged A. El-Setouhi¹  | Ronnie D. Horner⁴  | Mohammed A. Muaddi¹ 

¹Family and Community Medicine Department, Faculty of Medicine, Jazan University, Jazan City, Jazan, Saudi Arabia

²Kansas Department of Health and Environment, Topeka City, Kansas, USA

³King Fahad Central Hospital, Jazan Health Department, Jazan City, Jazan, Saudi Arabia

⁴Health Services Policy and Management, Arnold School of Public Health, University of South Carolina, Columbia City, South Carolina, USA

Correspondence

Ahmad Y. Alqassim, Family and Community Medicine Department, Faculty of Medicine, Jazan University 45142, Jazan City, Jazan, Saudi Arabia.
 Email: aalqassim@jazanu.edu.sa

Abstract

Aim: The study aimed to assess the incidence of needlestick and sharps injuries among healthcare workers (HCWs) in the Jazan region of Saudi Arabia, as well as to determine whether there exists an association between hospital level and needlestick and sharps injuries rate.

Design: A cross-sectional survey was conducted among 609 randomly selected HCWs from nine general hospitals.

Methods: A self-administered questionnaire, which covered the structure and process of injection safety, was used for data collection.

Results: The overall needlestick and sharps injuries incidence rate was 24%. The needlestick and sharps injuries rates were 30% and 14% in secondary and tertiary hospitals, respectively. HCWs working in tertiary hospitals were 61% less likely to have needlestick and sharps injuries than those employed in secondary hospitals. This was mainly the impact of better and continuous training. High safety level maintenance and health education provision are vital in such settings.

KEYWORDS

environmental health, healthcare worker, needlestick injury, occupational health, Saudi Arabia, secondary hospital, tertiary hospital

1 | BACKGROUND

Needlestick and sharps injuries (NSSIs) are accidental piercings of the body, sustained in association with the use of devices such as needles, ampoules and lancets that are used in healthcare settings, and they constitute an occupational hazard for healthcare workers (HCWs; Zhang et al., 2009). These injuries may lead to the development of serious diseases among HCWs. Global estimates show that more than 35 million HCWs sustain NSSIs, annually; according

to the Centers for Disease Prevention and Control, in the United States alone, the corresponding value is 385,000 (Deisenhammer et al., 2006; Elmi et al., 2018; Rezaeian et al., 2012). It has been shown that 86% of all infections contracted by HCWs arise from NSSIs (Rakesh et al., 2010). The danger associated with these injuries is strong, as many dangerous pathogens can be transmitted through them, such as the hepatitis B and C viruses and human immunodeficiency virus, for which the disability-adjusted life years between 2000 and 2030 were estimated at 9, 177 and 679, respectively (Elmi

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et al., 2018; Hauri & Armstrong, 2004). While there is a good system in place for the prevention of NSSIs, even one injury can cause serious harm (Hauri & Armstrong, 2004).

The overall attitudes and responsiveness of HCWs are critical to the achievement of patient and worker safety in healthcare settings; thus, their attitudes towards proper hand hygiene, injection safety, patient medical conditions, and adherence to medical guidelines or practice guidelines have a significant impact on the healthcare system (Awosan et al., 2017; Ra'awji et al., 2018). In developed countries, the rate of needle stick injuries has decreased due to the implementation of safe injection practice (Simonsen et al., 1999). However, in developing countries, the occurrence rate of these injuries remains high due to a lack of safe injection training and procedures and a lack of awareness on blood-borne illnesses (Chowdhury et al., 2011; Gosadi, 2020; Pandit & Choudhary, 2008). Among HCW, nurses are exposed to many sharps and a high risk of blood-borne infectious diseases. A recent systematic review and a meta-analysis study revealed that the pooled prevalence of needlestick injuries among nurses was 42.8% (Bouya et al., 2020).

In Saudi Arabia, while many studies have focussed on the rates of NSSIs in hospitals, all of them focussed on a single level of hospital care (Abu-Gad & Al-Turki, 2001; Balkhy et al., 2011; Ghamdi et al., 2003; Ismail et al., 2014; Kennedy et al., 1998; Memish et al., 2002; Paul, 2000; Shanks & Al-Kalai, 1995). A 2014 study by Ismail et al., which evaluated the injection safety procedures followed by HCWs in primary healthcare facilities, revealed a needle stick injury rate of 14% (Ismail et al., 2014). An epidemiological study of all self-reported NSSIs in secondary hospitals in Buraidah, KSA, conducted using a retrospective survey of data from 2 years, revealed that the staff members who sustained NSSIs the most frequently were nurses (66%), physicians (19%), technicians (10%) and non-clinical staff (5.5%; Jahan, 2005). As that study included only reported cases of NSSIs, the actual incidence rate was not determined. In a study performed in a tertiary hospital in King Saud Medical City, Memish et al. (2013) reported an NSSI incidence rate of 13.84%.

Although some studies have compared the quality of healthcare services across hospital levels, including the secondary or tertiary levels, comparisons across hospital levels, in terms of NSSIs, have not been performed till date (WHO, 2017). For the assessment of the true prevalence of NSSIs in the KSA and formulation of policies and strategies to address this serious problem, it is necessary to obtain data on all parameters associated with the issue. We hypothesized that tertiary hospitals in the KSA would have a lower rate of NSSIs than secondary hospitals due to the higher level of training provided. Accordingly, we aimed to assess the incidence of NSSIs among HCWs in secondary and tertiary hospitals in the Jazan region of Saudi Arabia, as well as to determine whether there exists an association between hospital level and injury rate.

2 | MATERIAL AND METHODS

A facility-based observation cross-sectional study was conducted in nine general hospitals of the Jazan region during July 2017. Two

tertiary hospitals, the only mental hospital located in the region and six secondary hospitals from the 17 secondary hospitals were included. Jazan is one of the thirteen regions of the Kingdom of Saudi Arabia (KSA) and is located on the tropical Red Sea coast in southwestern Saudi Arabia. Jazan is considered one of the most populated areas in the Kingdom, with a 1,637,361 population. The HCWs surveyed in this study were physicians and nurses. The region is served with 20 Hospitals employing 1,505 physicians serve the region, and 3,753 nurses (Ministry of Health Saudi Arabia, 2016). As a developing nation, the KSA has a healthcare system that comprises primary, secondary and tertiary hospitals (Gosadi, 2020). The 20 general hospitals comprise 17 secondary, two tertiary and one mental health hospital. A sample size of 681 HCWs was estimated for this study using the incidence of needle stick injuries of 14% (Ismail et al., 2014). For sample size calculation, a 95% confidence interval and an error rate not higher than 2.5% of all HCWs in hospitals in Jazan (5,258) were used. The sample was increased by 5% to account for the non-response rate and distributed among the hospitals using the proportional sample allocation principle. In the final stage, HCWs were selected from each hospital using systematic random sampling. The targeted sample size was calculated using the StatCalc - Epi Info program (Dean et al., 1995).

2.1 | Data collection tools

A self-administered anonymous questionnaire was distributed for data collection. The questionnaire included items on the HCWs' demographic characteristics, frequency/nature of exposure and the risk factors associated with occupational exposure. The questionnaire also included items on socio-demographic characteristics; the safety injection profile in general hospitals in Jazan; the level of safety-related knowledge, attitudes, and practices in HCWs; and beliefs pertaining to injection safety. Three well-trained HCWs conducted the data collection process. The team visited the selected hospitals and invited the potential study participants to participate in this study. They gave them the informed consent copies to read and keep in their records. Those who agreed to participate verbally were included in the study. However, they were instructed that they can withdraw and refuse to answer any question in the study questionnaire.

2.2 | Measurements (variables)

Our study's primary outcome was binary, comprising the presence or absence of NSSIs among each HCW during the previous year, 2017. The primary independent variable was whether each HCW was working at a secondary or tertiary hospital. Other explanatory factors included occupation, nationality, work experience, behavioural characteristics and working environment; all these confounding variables are binary except the variables pertaining to the period of experience in hospitals, and the average number of injections given per week was continuous.

2.3 | Ethical considerations

The appropriate research ethics committee approved the study proposal and instruments. Voluntary informed consent was obtained from all the HCWs enrolled in this study. Before the initiation of data collection, permission was obtained from the directorate of health in the Jazan region. Data were anonymized for participant protection.

2.4 | Statistical analyses

The unit of measure in our study was the number of HCWs in Jazan. We analysed the data through four processes. In the first step, we described the number and percentages of HCWs. In the second, we tested the primary independent variable of interest (Tert-vs.-Sec) separately against each of the other predictor variables using bivariate analysis or the crosstabs procedure and mean for other continuous variables. In the third step, we tested the distribution of characteristics among the injured and non-injured HCWs using bivariate analysis or the crosstabs procedure and mean for other continuous variables. In the final step, in addition to the use of a regression model for the investigation of the relationship, odds ratios and their 95% confidence intervals were calculated. We used Stata software, Version 14, for the data analyses. All tests were two-sided, and a $p < .05$ was considered statistically significant.

3 | RESULTS

A total of 609 out of 681 subjects were accepted to participate in this study (response rate 89.4%). As shown in Table 1, 372 (61.00%) of study participants worked in secondary hospitals and 237 (39.00%) in tertiary hospitals. The majority of the HCWs were nurses (79%), with physicians accounting for the remaining 21%. The mean number of years of experience was 8.5 years; half the sample was of Saudi nationality. The overall NSSI incidence was 24% in the total sample. The HCWs in the secondary hospitals showed higher rates of attendance in continuing medical education (CME) injection safety training than those working in the tertiary hospitals (73% vs. 60%) and were significantly more likely to be aware of the injection safety policy at their hospital (99% vs. 96%). However, the NSSI incidence in the tertiary hospitals was half that in the secondary hospitals (14% vs. 30%). Those working in tertiary hospitals also showed a significantly higher usage rate of new gloves for each injection (97% vs. 93%) and lower incidences of needle disposal along with regular waste (35% vs. 71%).

Table 2 presents a comparison of the characteristics between the injured and non-injured HCWs. We observed statistically significant differences in this regard. A majority of the respondents were nurses, while those of Saudi nationality accounted for a majority of those in the injured group. The overall mean average years of experience among the non-injured HCWs was almost

10 years and that among the injured HCWs was less than 7 years. While a little more than half of the non-injured HCWs attended CME training on injection safety and sharps waste disposal, the injured HCWs were much more likely to participate in injection safety and sharps waste disposal training, at 84% and 79%, respectively, which is a counterintuitive finding. Both groups were aware of the presence of multiple sharps container sizes at their hospitals; however, the level of awareness in the injured group was significantly lower, at only 88%, than that in the non-injured HCWs (93%). While the HCWs in the non-injured group reported disposing needles in regular trash, the corresponding value in the injured HCWs was almost 30% higher, at 71%. Significantly, 77% of the injured HCWs worked in secondary hospitals compared with the 56% in the non-injured group. This finding demonstrates that hospital level has a role in NSSI incidence.

Table 3 shows the results of the cross-sectional analysis that was performed using multiple logistic regression. We found that the HCWs working in tertiary hospital settings were 61% less likely to have NSSIs compared with the HCWs employed in secondary hospitals, when the other variables were kept constant (odds ratio = 0.39, 95% confidence interval = 0.23–0.65; $p < .05$).

4 | DISCUSSION

In the present study, which sought to document the incidence of NSSIs and determine their association with hospital level, the overall incidence rate of NSSIs among the HCWs in the Jazan region, KSA, was 24% (Table 1). The incidence was 14% in tertiary hospitals and 30% in secondary hospitals (Table 1). Our findings demonstrate that HCWs who work in tertiary hospitals are 61% less likely to sustain NSSIs than HCWs employed in secondary hospitals, confirming our hypothesis. One of the factors that may explain why the Jazan region still has such a high NSSI incidence, as shown in Table 2, is that the injured HCWs were less likely to follow proper safety practices in the handling of used needles and disposed needles in regular trash instead of sharps containers (71% vs. 53%). The lack of awareness on the presence of multiple sharps container sizes may explain the failure of safety practices and the higher rate of NSSIs. Although several studies have reported on NSSIs in tertiary hospitals, no studies till date have investigated the subject in secondary hospitals in KSA. Our findings pertaining to tertiary hospitals are similar to those noted in other KSA studies (Memish et al., 2013). A study in China showed an insignificant difference between secondary and tertiary hospitals in terms of the incidence of NSSIs (Gao et al., 2017). Still, due to the differences in healthcare systems, the findings of that study do not apply to KSA. To the best of our knowledge and based on other KSA studies, our study is the first to compare the rates of NSSIs between tertiary and secondary hospitals in the KSA.

Moreover, in an international literature review in Iran, the author revealed that many developing countries have higher rates of NSSIs than KSA, such as Egypt (66%), Pakistan (45%), Turkey (45%) and Iran

TABLE 1 Background characteristics and distribution of characteristics among healthcare workers in secondary versus tertiary hospitals

Characteristics	Number (N = 609)	Per cent or mean	Secondary 372 61.00%	Tertiary 237 39.00%	p-value
<i>Sociodemographic characteristics</i>					
Occupation					
Nurse	482	79%	269 (72.0%)	213 (90.0%)	.000 [*]
Physician	127	21%	103 (28.0%)	24 (10.0%)	
Nationality					
Saudi	307	50.50%	146 (39.0%)	156 (66.0%)	.000 [*]
Non-Saudi	302	49.50%	226 (61.0%)	81 (34.0%)	
Mean work experience (years)		8.5 mean	9.70	6.71	.000 ^{**}
How many injections do you administer during an average week?		34/week	33.47	34.24	.752 [*]
Positive for needle stick injury					
No	463	76.00%	259 (70.0%)	204 (86.0%)	.000 [*]
Yes	146	24.00%	113 (30.0%)	33 (14.0%)	
<i>Training experience in the work environment</i>					
Received training on hire in injection safety					
No	106	17.00%	59 (16.0%)	47 (20.0%)	.208 [*]
Yes	503	83.00%	313 (84.0%)	190 (80.0%)	
Did you attend CME on injection safety?					
No	193	32.00%	99 (26.0%)	94 (39.0%)	.001 [*]
Yes	416	68.00%	273 (73.0%)	143 (60.0%)	
Did you attend CME on waste disposal?					
No	224	37.00%	136 (37.0%)	88 (37.0%)	.887 [*]
Yes	385	63.00%	236 (63.0%)	149 (62.0%)	
<i>Safety measures and awareness</i>					
Is there an injection safety policy in your hospital?					
No	14	2.00%	5 (1.0%)	9 (4.0%)	.049 [*]
Yes	595	98.00%	367 (99.0%)	228 (96.0%)	
Are there different sizes of sharps containers?					
No	9	1.50%	4 (1.0%)	5 (2.0%)	.325 [*]
Yes	584	98.50%	354 (99.0%)	230 (98.0%)	
<i>Safety practices among healthcare workers in hospitals in Jazan</i>					
Do you always wash hands before preparing an injection with alcohol hand rub and/or soap with water?					
No	13	2.00%	9 (2.0%)	4 (2.0%)	.543 [*]
Yes	596	98.00%	363 (98.0%)	232 (98.0%)	
Do you always use a new pair of gloves every time you administer an injection?					
No	32	2.00%	25 (7.0%)	7 (3.0%)	.042 [*]
Yes	577	98.00%	347 (93.0%)	230 (97.0%)	
Do you dispose sharp needles in regular trash?					
No	258%	43.00%	105 (29.0%)	153 (65.0%)	.000 [*]
Yes	344%	57.00%	261 (71.0%)	83 (35.0%)	

*Chi Square test.; **independent t test.

TABLE 2 Distribution of characteristics among the injured and non-injured healthcare workers

Characteristics	Non-injured	Injured	p-value*
Occupation			
Nurse	375 (81.0%)	107 (73.0%)	.046*
Doctor	88 (19.0%)	39 (27.0%)	
Nationality			
Non-Saudi	246 (53.0%)	56 (38.0%)	.002*
Saudi	217 (47.0%)	90 (62.0%)	
Work experience (years)	9.70	6.71	.000**
How many injections do you administer in an average week?	33.47	34.24	.752**
Hospital level			
Secondary	259 (56.0%)	113 (77.0%)	.000*
Tertiary	204 (44.0%)	33 (23.0%)	
Training experience in the work environment			
Received training on hire on injection safety			
No	87 (19.0%)	19 (13.0%)	.108*
Yes	376 (81.0%)	127 (87.0%)	
Did you attend CME on injection safety?			
No	169 (37.0%)	24 (16.0%)	.000*
Yes	294 (63.0%)	122 (84.0%)	
Did you attend CME on waste disposal?			
No	194 (42.0%)	30 (21.0%)	.000*
Yes	269 (58.0%)	116 (79.0%)	
Safety measures and awareness			
Is there an injection safety policy in your hospital?			
No	11 (2.0%)	3 (2.0%)	.821*
Yes	452 (98.0%)	143 (98.0%)	
Are there different sizes of yellow containers?			
No	31 (7.0%)	18 (12.0%)	.029*
Yes	432 (93.0%)	128 (88.0%)	
Safety practices among healthcare workers in hospitals in Jazan			
Do you always wash hands before preparing an injection with alcohol hand rub and/or soap with water?			
No	11 (2.0%)	2 (1.0%)	.463*
Yes	452 (98.0%)	144 (99.0%)	
Do you always use a new pair of gloves before giving injections?			
No	26 (6.0%)	6 (4.0%)	.477*
Yes	437 (94.0%)	140 (96.0%)	
Do you dispose sharp needles in regular trash?			
No	217 (47.0%)	41 (29.0%)	.000*
Yes	243 (53.0%)	101 (71.0%)	

*Chi Square test.; **Independent t test.

(50%) (Amini et al., 2015). We believe that the lower incidence in KSA is the result of the recent efforts driven by the Ministry of Health, which encourages adherence to the Central Board for Accreditation of Healthcare Institutions.

This study is the first study to compare all these factors to determine whether NSSIs occurred at different secondary versus tertiary hospitals in KSA. There are several possible explanations for our

results. In developing countries, healthcare facilities do not prioritize HCW safety and awareness of proper techniques (Sagoe-Moses et al., 2001). Of the factors associated with a higher incidence of NSSIs are unsafe practices, such as the handling of contaminated needles and syringes multiple times (Sagoe-Moses et al., 2001). Infections among HCWs can be prevented with the provision of adequate staff training and awareness. A system of monitoring NSSIs

TABLE 3 Adjusted odds ratio in the multivariable logistic regression models demonstrating NSSI rates by hospital level (secondary vs. tertiary)

	OR	p-value	95% CI
Level of hospital employed in			
Tertiary	0.39	.00	0.23–0.65
Occupation			
Physician	2.22	.00	1.30–3.80
Nationality			
Saudi	1.41	.15	0.88–2.27
Work experience (years)	0.94	.00	0.90–0.97
How many injections do you administer during an average week?	1.01	.01	1.001–1.02
Received training on hire in injection safety			
Yes	0.96	.91	0.49–1.85
Did you attend CME on injection safety?			
Yes	2.34	.01	1.21–4.52
Did you attend CME on waste disposal?			
Yes	1.75	.05	1.00–3.08
Is there an injection safety policy in your hospital?			
Yes	0.63	.53	0.15–2.65
Are there different sizes of sharps containers?			
Yes	0.40	.01	0.19–0.84
Do you always wash hands before preparing an injection with alcohol hand rub and/ or soap with water?			
Yes	2.60	.25	0.50–13.38
Do you always use a new pair of gloves every time you give an injection?			
Yes	1.42	.50	0.53–3.85
Do you dispense sharp needles in regular trash?			
Yes	1.35	.19	0.01–1.36

Note: Multivariable logistic regression.

Abbreviations: CI, confidence interval; OR, odds ratio.

and provision of immunization for infectious diseases should be part of the programme for protecting HCWs in developing countries (Lee, 2009).

We believe our findings will prove useful in the planning of future strategies aimed at reducing the incidence of NSSIs and, therefore, dangerous infections and disability. Our results, which showed differences in the incidence of NSSIs between the two hospital levels, suggest the urgent need for policy change. First, secondary hospitals should follow the same standard practices and procedures that are established by tertiary hospitals. Second, a precise injection and sharps safety policy and proper communication with HCWs must be established for the prioritization of their safety. Attendance in an annual certification programme on occupational safety pertaining to NSSIs and blood-borne pathogens should be made mandatory. HCWs should be trained on prioritizing their safety, and facilities supporting this endeavour should be established. Third, all HCWs should be aware of the threat associated with blood-borne pathogens, such as the hepatitis A and B viruses and human immunodeficiency virus, and the necessity of reporting all injuries immediately,

which would help reduce the impact of an injury on their medical condition. Fourth, vaccines should be made available to all HCWs free of charge, especially for hepatitis A and B.

4.1 | Study limitations

Although the present study is the first to focus on the level of injection safety among HCWs in hospitals in Jazan, it has some significant limitations. First, the study data were obtained based on self-reporting, owing to which the presence of reporting bias cannot be ruled out. For this reason, the outcomes of this study should be interpreted carefully. Second, the study's cross-sectional design is not suitable for the assessment of the factors associated with injection safety since the direct and causal relationships between the investigated variables could not be established appropriately. Finally, we did not obtain data on age or sex, which have value in the comparison of the level of safety among HCWs (Assen et al., 2020).

5 | CONCLUSIONS

In our study, the combined incidence of NSSIs in the Jazan region was 24%, with secondary hospitals accounting for 30% and tertiary hospitals for 14%. Tertiary and secondary hospitals have varied injection safety practices, and HCWs working in tertiary hospitals are less likely to have NSSIs. The maintenance of high safety levels and best practices of care among HCWs is of prime importance, since HCWs are the cornerstone of quality care in the healthcare system and have a significant potential impact on the lives and health of patients. An important finding of our study is that hospitals, whether secondary or tertiary, have proper policy and procedures. A majority of HCWs are aware of these policies and procedures. Yet, the incidence of NSSIs continues to be high in secondary hospitals. Nurses reported a high injury rate and need more professional development for infection control and safe injection practice. Future studies should focus on comparing the incidence of NSSIs between secondary and tertiary hospitals and conduct in-depth examinations of their incidence across different HCW designations, such as physicians, nurses, laboratory technicians, and those from other departments that deal with sharps, to determine which areas have a higher demand for specific guidelines and training to reduce the incidence of injury. Additional research should also investigate the incidence of NSSIs in public versus private hospitals among HCWs in KSA due to the lack of corresponding data currently.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.


AUTHOR CONTRIBUTION

Study design: AM, MM and AI. Data collection: AM, HA, AA.A and ME. Data analysis: AA.A, AY.A and MM. Manuscript writing: AM, AA.A, AY.A and MM.

DATA AVAILABILITY STATEMENT

The data sets generated and analysed during the current study are available from the corresponding author on reasonable request.

ORCID

Anwar M. Makeen  <https://orcid.org/0000-0001-9245-4533>
 Abdullah A. Alharbi  <https://orcid.org/0000-0002-5405-2055>
 Mohammed S. Mahfouz  <https://orcid.org/0000-0002-3155-6381>
 Ahmad Y. Alqassim  <https://orcid.org/0000-0002-0170-1437>
 Ahmed A. Ismail  <https://orcid.org/0000-0002-6337-2341>
 Haider M. Arishi  <https://orcid.org/0000-0002-7556-9176>
 Maged A. El-Setouhi  <https://orcid.org/0000-0002-4572-8439>
 Ronnie D. Horner  <https://orcid.org/0000-0002-9967-216X>
 Mohammed A. Muaddi  <https://orcid.org/0000-0003-0438-1077>

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