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RESEARCH ARTICLE

FACTORS ASSOCIATED WITH NEEDLE STICK INJURY AMONG HEALTHCARE WORKERS IN AL-AHSA, SAUDI ARABIA

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Abstract

Background: Needle stick injuries (NSIs) pose a significant occupational hazard for healthcare workers (HCWs), risking transmission of bloodborne pathogens. This study aimed to identify factors associated with NSIs among HCWs in Al-Ahsa, Saudi Arabia.

Methods: A case-control study was conducted among 380 HCWs (190 cases, 190 controls) in governmental health facilities. Data were collected through a questionnaire addressing participant characteristics, occupational information, and NSI risk factors. Logistic regression analysis was used to identify factors associated with NSIs.

Results: Younger age and less work experience were associated with increased NSI risk. Completion of training programs, including Basic Infection Control Skills License (OR: 0.56, 95% CI: 0.36-0.91), orientation programs (OR: 0.43, 95% CI: 0.29-0.71), and workplace safety training (OR: 0.41, 95% CI: 0.29-0.63), significantly reduced NSI risk. Disposal containers filled above two-thirds capacity increased NSI risk (OR: 1.9, 95% CI: 1.0-3.6). Use of certain devices, such as spinal/epidural needles and arterial catheter introducer needles, was associated with lower NSI risk.

Conclusion: Comprehensive training programs, proper sharps disposal practices, and use of certain safety-engineered devices may reduce NSI risk among HCWs. Targeted interventions for younger, less experienced HCWs are warranted. These findings can inform the development of effective NSI prevention strategies in healthcare settings.

Introduction:-

Needle Stick Injuries (NSIs) are one of the most common occupational hazards that could affect the healthcare workers (HCWs) worldwide, and they are sources of lots of infections(Bouya et al., 2020). Some of these infections that could transmitted by NSIs as a result of contamination of a sharp object from the blood of affected patients are hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV)(Sharew et al., 2017). Studies show that the likelihood of infections through NSIs is between 0.2% and 0.5% for HIV, between 3.0% and 10% for HCV, and 40% for HBV(Cheng et al., 2012). Furthermore, dangerous health conditions ranging from mild

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to severe anxiety can be caused by infectious complications attributed to occupational exposure to NSIs(Yasin et al., 2019).

HCWs that at risk of NSIs are physicians, nurses, laboratory technicians, and those who work in medical waste management(Berhan et al., 2021). The type of needle and other sharp objects used, as well as their safety protocols, can influence the risk of injury to healthcare workers(Kwanzaa et al., 2020). Factors associated with NSIs can be related to practitioner's characteristics, work nature and place, and practice(Mengistu & Tolera, 2020).

Factors related to practitioners are gender, age, type of professional, work experience, marital status, injection safety training, infection prevention training, and attendance to educational class about NSIs. Regarding to work nature and place factors which are work load, working in private hospitals, availability of adequate number of needles, syringes and sharps equipment, availability of safety box, working department/unit, and absence of hospital policies(Matsubara et al., 2017). Then factors that relate to practice which are disassembling of syringe and needle, needle recapping, over use of injection, universal precaution, and personal protective equipment(Mengistu & Tolera, 2020).

A cross-sectional study done included all governmental hospital plus one private hospital in Al-Ahsa region in Saudi Arabia. Data collected over three years from 2016 to 2018 included all reported cases of NSI using EPINet program. Nurses were the most workers that exposed to NSI by 48%, where the most workplace that injuries occurred were patient room by 30%. The most purposes that sharp item was used were injection, to draw venous blood sample, and suturing by 22%, 15%, and 13% respectively(Al Shaikh et al., 2019).

Another cross-sectional study that consists of was conducted in Abha city, Aseer region, Saudi Arabia in 2020. Inserting intravenous canula was the most purpose that NSIs had occurred by 33%, and in patient room by 42.9%. Most of the injuries had occurred during handling/passing devices during or after use (25.3%), disposal (24.2%), and recapping (14.3%)(Alsabaani et al., 2022).

There was no study done about the factors that associated with needle stick injury in Al-Ahsa region. Also, NSIs are common and have serious complications, we would like to identify the risk factors to prevent them in the future. This study was aimed to study factors that associated with needle stick injuries among healthcare workers in Al-Ahsa region of Saudi Arabia.

Methods:-

Study design, Study Setting, and Population:

This is a case-control study conducted in HCWs working in governmental health facilities in Al-Ahsa region of eastern province in Saudi Arabia. Al-Ahsa consists of public sector hospitals and more than 60 Primary Healthcare Centers (PHCs) divided in to four sectors; north, eastern, middle, and southern. Up to 10 thousand HCWs working in the governmental sectors from doctors, nurses, and technicians including laboratory, radiology, operations, dental assistant, and patient care.

Inclusion and Exclusion Criteria:

All HCWs working in governmental healthcare facilities in Al-Ahsa were included in the study, excluding unreported NSIs and reported case in interns or health colleges students. Cases were selected from those who reported to the occupational health department at health cluster in Al-Ahsa to have needle stick injury in 2022 and 2023. Controls selected from who were not reported to had needle stick during the study period were randomly selected and individually matched to the cases according to the gender, job, health institute, and department.

Data Collection:

Data were collected through a questionnaire designed according to occupational health department in Al-Ahsa health cluster's forms which are occupational injury reporting and needle stick incident. The questionnaire consists of general participant's characteristics, occupation information, and the risk factors of NSI. the questionnaire was filled by the participants self-administered and by interview in which they were contacted and consent obtained.

Data Analysis:

The data were collected, reviewed, and then fed to Statistical Package for Social Sciences version 26 (Released 2019. Armonk, NY: IBM Corp). All statistical methods used were two-tailed with an alpha level of 0.05 considering

significance if P value less than or equal to 0.05. Descriptive analysis for categorical data was done comparing General characteristics of study health care workers among groups (cases vs. controls) using Pearson Chi-Square test and exact probability test (for small frequency distributions). To assess significant factors associated with NSIs among HCWs, simple logistic regression analysis was used for unadjusted (crude) relation while multiple logistic regression analysis was applied to assess the most significant adjusted risk factors based on adjusted odds ratio and its 95% confidence interval. Model fitting was assessed using ROC curve for model discrimination and model's predictive accuracy for model calibration.

Results:-

A total of 380 HCWs (190 cases and 190 controls) were included in the study (figure 1). The mean age of cases (HCWs exposed to NSI) versuscontrols was 32.1vs. 34.4 years old with a statistically significant difference (P=.003). Most cases and controls were females (79.5% for each). Also, 95.3% of cases and control work at hospital. Likewise, cases and controls have the same job category distribution mainly nurses (62.1%). As for work years, it was less than 3 years among 61.1% of cases versus 22.6% of controls (P=.001). Also, 41.6% of controls work for more than 8 hours compared to 27.4% of cases (P=.004). Also, 88.4% of cases had break time versus 77.4% of controls (P=.004). Exact of 74.2% of cases had a bachelor's degree compared to 65.8% of controls (P=.071). A total of 7.4% of cases were smokers compared to 5.8% of controls (P=.535). A total of 97.9% of cases completed HBV vaccine in comparison to 95.8% of controls (P=.258) (Table 1).

Table 2. Factors associate with needle stick injury among study health care workers. Considering training factors, all except for having a postgraduate academic training showed a significant protective effect on NSI with the most protective factor was Training in workplace safety and health (AOR=0.41). As for general factors, having have pre-employment training showed a significant risky relation with NSI (AOR=2.7) and also suffering from previous accidents other than NSI showed 3 times more risk for having NSI (AOR=3.5).

Table 3. Factors associate with needle stick injury among study health care workers. About environmental factors, none of the factors showed a significant association with having NSI with all were risky except for poor ventilation (AOR=0.91). The same was for workplace factors where all showed insignificant association with having NSI with all showed risky relation other than "Item left on or near disposal container" (AOR=0.88), and " Item protruding from opening of disposal container (AOR=0.88)". Considering purpose of sharp item use, to place an Arterial/Central line decreased the risk of NSI by about 39% (AOR=0.61), for suturing decreased the risk of NSI by about 50% (AOR=0.5), and for cutting decreased the risk by about 59% (AOR=0.41) with all showed a significant protective effect (P<0.05 for all). Considering circumstances during use of sharp items, disassembling Device or Equipment decreased the risk of NSI by about 49% (AOR=0.51); P=0.008.

Table 4. Factors associate with needle stick injury among study health care workers. Considering type of device, those who used needle had doubles risk for NSI (AOR=2.1). As for type of needle, blood gas syringe use associated with decreased risk for NSI by 48% (AOR=0.52), use of spinal or Epidural needle associated with decreased risk for NSI by 78% (AOR =0.22), Unattached hypodermic needle decreased the risk by 50% (AOR=0.5), Arterial catheter introducer needle associated with decreased risk for NSI by 59% (AOR=0.41), and Central line catheter needle was associated with decreased risk of NSI by 49% (AOR=0.51). With regard to surgical instrument, the most reported instruments with decreased risk for NSI were Trocar (71% less risk for NSI), lance (67% less risk for NSI), Vacuum tube (67% less risk), and Scalpel, disposable (62% less risk). The least protective instruments were Drill bit/bur (18% less risk), and Retractors, skin/bone hooks (24% less risk for NSI). As for Glass item, Glass slide was associated by 78% less risk for NSI, Specimen/test tube was associated with 65% less risk for NSI, Medication/IV bottle associated with 54% less risk, Medication ampule associated with 50% less risk, and Medication vial associated with 48% less risk for NSI.

Discussion:-

Needle stick injuries (NSIs) remain a significant occupational hazard for healthcare workers (HCWs) worldwide, posing serious risks of bloodborne pathogen transmission. This study aimed to assess factors associated with NSIs among HCWs in Al-Ahsa, Saudi Arabia. Our findings highlight several key areas for potential intervention and prevention strategies.

The prevalence of NSIs varies widely across different healthcare settings globally. A 2021 survey of 52 Ministry of Health facilities in Saudi Arabia found 3.2 sharp injuries per 100 occupied beds annually(Abalkhail et al., 2022). This is considerably lower than rates reported in US hospitals, where the Centers for Disease Control and Prevention estimate 385,000 sharp-object injuries occur among hospital workers each year(Alfulayw et al., 2021).

The discrepancy may be partly due to underreporting, which remains a significant challenge in accurately assessing NSI prevalence. Studies have shown that up to 70% of NSIs may go unreported, often due to time constraints, perception of low infection risk, or fear of repercussions (Pervaiz et al., 2018). A study by Abozead et al., (2015). found that 80% of junior doctors failed to report NSIs, with the most common reasons being the perceived low risk of infection and lack of time. This highlights the need for improved reporting systems and education about the importance of reporting all NSIs, regardless of perceived risk.

Our study found that younger HCWs with less work experience were more likely to experience NSIs, consistent with findings from other studies(Keicher et al., 2024). This may be attributed to less familiarity with procedures, higher stress levels, or inadequate training among newer staff. A study by Smith et al., (2006) in Japan found that nurses with less than 4 years of clinical experience were 2.2 times more likely to experience NSIs compared to their more experienced colleagues.

Interestingly, our study did not find significant associations between NSI risk and factors such as gender or job category, which have been reported in some other studies. For instance, Alsadaan et al., (2021)found that nurses were at higher risk of NSIs compared to other HCWs in Saudi Arabia. The lack of such associations in our study may be due to specific workplace practices or training programs in our study setting that mitigate these risks.

One of the most significant findings of our study was the protective effect of various training programs against NSIs. HCWs who had completed Basic Infection Control Skills License (BICSL), orientation programs, and workplace safety training were significantly less likely to experience NSIs. This aligns with numerous studies highlighting the importance of education in NSI prevention.

Wang et al., (2003)found that nursing students who received specific training on bloodborne pathogen prevention had a 71% lower risk of NSIs. Similarly, (Amini et al., 2015)reported significantly lower NSI rates among HCWs who had received infection control training. A systematic review by Tarigan et al., (2015)concluded that educational interventions can significantly reduce NSI incidence, with some studies reporting reductions of up to 60%.

The protective effect of training likely stems from improved knowledge of proper handling techniques, increased awareness of risks, and better adherence to safety protocols. However, the quality and frequency of training programs can vary widely between healthcare institutions. Regular refresher courses and hands-on practical training sessions may be more effective than one-time orientations.

A study by Afridi et al., (2013)in Pakistan found that regular refresher trainings were associated with a 50% reduction in NSI risk. Additionally, incorporating simulation-based training has shown promise in improving skills and reducing NSI risk. (Keicher et al., 2024)reported that simulation-based training resulted in a 34% reduction in NSI incidence among medical students compared to traditional training methods.

Our study identified several workplace factors associated with NSI risk. Notably, disposal containers filled above two-thirds capacity were significantly associated with increased NSI risk. This highlights the importance of proper waste management and regular emptying of sharps containers. Similar findings have been reported in other studies, emphasizing the need for adequate resources and clear protocols for sharps disposal(Hussain et al., 2020).

A study by Chen et al., (2020)found that overfilled sharps containers were associated with a 3.6-fold increased risk of NSIs. The authors suggested that implementing a policy of replacing containers when they are two-thirds full could significantly reduce this risk.

Other workplace factors, such as high patient load, staff shortages, and multiple invasive procedures, have been associated with increased NSI risk in previous studies(Hoboubi et al., 2019; Rai et al., 2021; Razek et al., 2018). While our study did not find statistically significant associations for these factors, they remain important considerations for comprehensive NSI prevention strategies.

Sepandi et al., (2023)found that organizational factors, including workload, staffing levels, and safety climate, were significantly associated with NSI risk. The authors emphasized the need for a systems approach to NSI prevention that addresses these broader workplace factors in addition to individual-level interventions.

The type of device used was significantly associated with NSI risk in our study. Notably, the use of needles was associated with a doubled risk of NSIs compared to other devices. This is consistent with global trends; a recent systematic review and meta-analysis by Bouya et al., (2020) found that hypodermic needles were the most common source of NSIs among HCWs worldwide, followed by IV cannulations and surgical needles.

Interestingly, our study found that certain types of needles and devices were associated with lower NSI risk, including spinal/epidural needles, arterial catheter introducer needles, and unattached hypodermic needles. This may be due to specific safety features of these devices or differences in usage patterns and procedures.

The implementation of safety-engineered devices (SEDs) has shown promise in reducing NSI risk. A Cochrane review by Reddy et al., (2017) found moderate-quality evidence that SEDs can reduce NSIs compared to conventional devices. For example, a study by Tosini et al., (2010) in France reported a 74% reduction in NSIs following the introduction of safety-engineered syringes.

However, it's important to note that the effectiveness of SEDs can vary depending on the specific device and context of use. A study by Guzmán et al., (2019) found that while some SEDs significantly reduced NSI risk, others had little impact or even increased risk due to unfamiliarity or improper use. This highlights the importance of proper training and evaluation when introducing new safety devices.

Regular, high-quality training on infection control, proper device handling, and NSI prevention should be mandatory for all healthcare workers (HCWs). This should include hands-on practice and simulation-based learning. A study by (Hambridge, 2011) found that a comprehensive training program reduced NSI incidence by 32% over a one-year period. The effectiveness of training can be further enhanced by incorporating adult learning principles and interactive techniques. For instance, Wu et al., (2020) reported that simulation-based training resulted in a 34% reduction in NSI incidence among medical students compared to traditional training methods. Regular refresher courses are also crucial, as knowledge and skills can decay over time. Wu et al., (2020) found that regular refresher trainings were associated with a 50% reduction in NSI risk.

Ensuring adequate availability of sharps containers, regular emptying, and clear protocols for disposal can significantly reduce NSI risk. Our study found that disposal containers filled above two-thirds capacity were significantly associated with increased NSI risk, a finding echoed in another research.Szczypta et al., (2024) found that overfilled sharps containers were associated with a 3.6-fold increased risk of NSIs. Implementing a policy of replacing containers when they are two-thirds full could significantly reduce this risk. Grimmond et al., (2010)found that implementing a comprehensive sharps safety program, including improved disposal systems, resulted in a 57% reduction in NSIs over a 5-year period. This program included strategically placing sharps containers at point-of-use locations, using containers with improved design features, and establishing clear protocols for container replacement and disposal.

Implications of the Study:

This study provides valuable insights into the factors associated with needle stick injuries (NSIs) among healthcare workers in Al-Ahsa, Saudi Arabia. The findings highlight the importance of comprehensive training programs, proper sharps disposal practices, and the potential benefits of safety-engineered devices. Healthcare institutions can use these results to guide the development and implementation of targeted NSI prevention strategies. The study also emphasizes the need for continuous education and training, particularly for younger and less experienced healthcare workers who may be at higher risk for NSIs.

Limitations of the Study:

1. The reliance on self-reported data may introduce recall bias, potentially affecting the accuracy of reported NSIs and associated factors.
2. The study was conducted in a single region of Saudi Arabia, which may limit the generalizability of findings to other healthcare settings or geographical areas.

3. Underreporting of NSIs, especially among certain groups of healthcare workers, may have influenced the results.
4. The study did not investigate some potential confounding factors, such as workload intensity or specific workplace policies, which could impact NSI risk.

Although all these limitations, the results of the study are very important and need to be taken into consideration in practice.

Conclusion of the Study:-

This study identifies several key factors associated with needle stick injuries among healthcare workers in Al-Ahsa, Saudi Arabia. The findings underscore the protective effect of comprehensive training programs, including Basic Infection Control Skills License, orientation programs, and workplace safety training. The study also highlights the importance of proper sharps disposal practices and the potential benefits of certain safety-engineered devices. Younger healthcare workers with less experience were found to be at higher risk for NSIs, suggesting a need for targeted interventions for this group. These results provide a foundation for developing and implementing more effective NSI prevention strategies in healthcare settings. Future research should focus on longitudinal studies to establish causal relationships and evaluate the long-term impact of preventive measures.

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Appendix:

Figure 1:- Flowchart of participants recruitment in the study

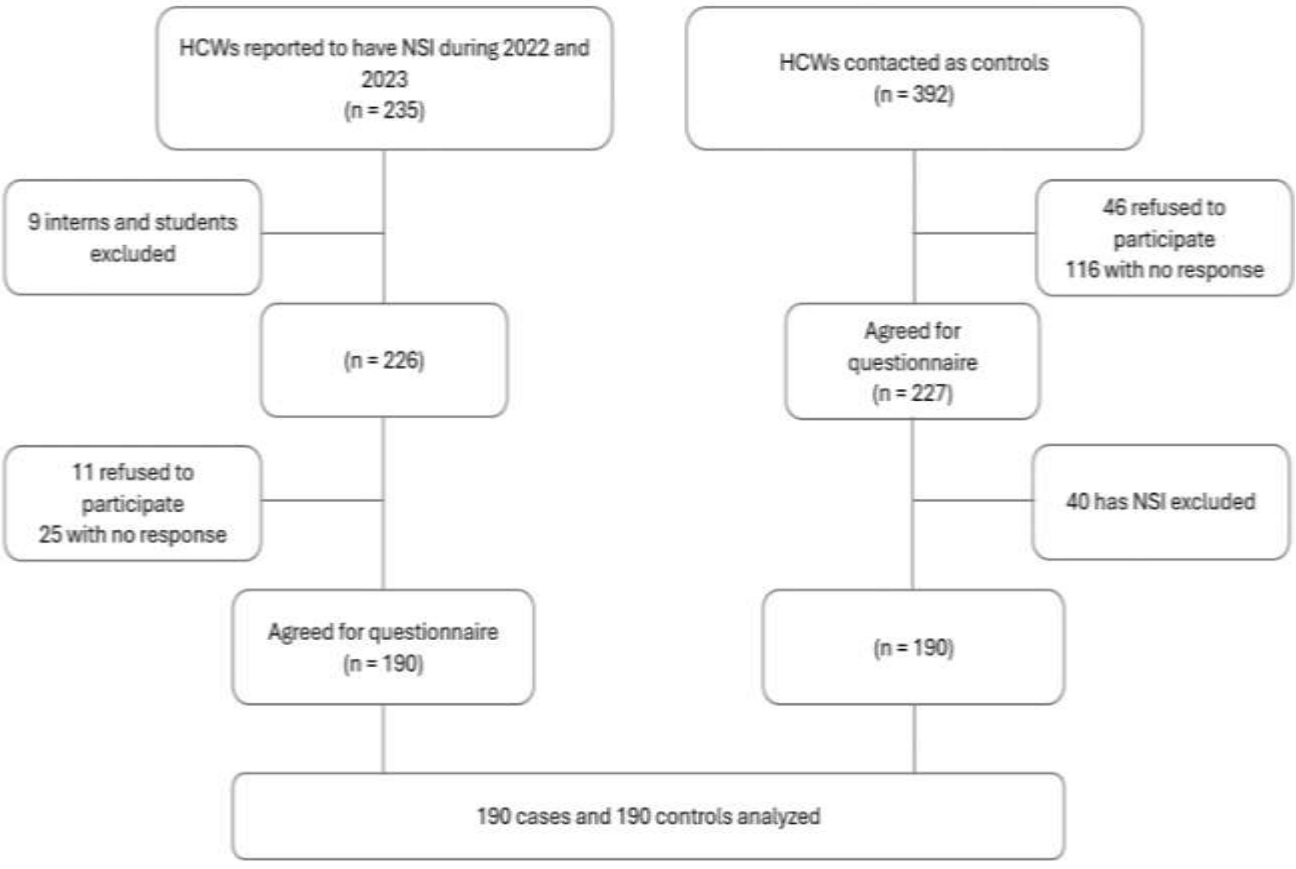

Table 1:- General characteristics of study health care workers groups, Al-Ahsa, Saudi Arabia.

Characteristics		Group				p-value
		Control		Case		
		No	%	No	%	
Age in years	< 30	60	31.6%	92	48.4%	.003*
	30-39	98	51.6%	77	40.5%	
	40+	32	16.8%	21	11.1%	
Gender	Male	39	20.5%	39	20.5%	1.00
	Female	151	79.5%	151	79.5%	
Nationality	Saudi	126	66.3%	151	79.5%	.004*
	Non-Saudi	64	33.7%	39	20.5%	
Work facility	Hospital	181	95.3%	181	95.3%	1.00
	PHCC	9	4.7%	9	4.7%	
Department	Surgery	34	17.9%	36	18.9%	.995
	Critical care / ER	70	36.8%	67	35.3%	
	Dental	13	6.8%	13	6.8%	
	Laboratory	10	5.3%	9	4.7%	
	Others	63	33.2%	65	34.2%	
Job category	Nurse	118	62.1%	118	62.1%	1.00
	Technician	26	13.7%	26	13.7%	
	Doctor	46	24.2%	46	24.2%	
Work years	< 3	43	22.6%	116	61.1%	.001*
	3-5	54	28.4%	31	16.3%	
	6-10	43	22.6%	26	13.7%	
	> 10	50	26.3%	17	8.9%	
Working hours	< 8 hours	111	58.4%	138	72.6%	.004*
	> 8 hours	79	41.6%	52	27.4%	
Break time	No	43	22.6%	22	11.6%	.004*
	Yes	147	77.4%	168	88.4%	
Qualification	Bachelor's degree	125	65.8%	141	74.2%	.071
	Diploma	42	22.1%	25	13.2%	
	Post-graduate	23	12.1%	24	12.6%	
Marital status	Single	61	32.1%	73	38.4%	.431^
	Married	124	65.3%	112	58.9%	
	Divorced	5	2.6%	5	2.6%	
Smoking	Smoker	11	5.8%	14	7.4%	.535
	Non-Smoker	179	94.2%	176	92.6%	
Hepatitis B vaccination	Completed vaccination	182	95.8%	186	97.9%	.258^
	Incomplete vaccination	3	1.6%	3	1.6%	
	Not vaccinated	5	2.6%	1	.5%	

P: Pearson X^2 test ^: Exact probability test

* P < 0.05 (significant)

Table 2:- Factors associate with needle stick injury among study health care workers, Al-Ahsa, Saudi Arabia.

Factors	Group				p-value	OR (95% CI)	AOR (95% CI)
	Control		Case				
	No	%	No	%			
Training factors							
Basic Infection Control Skills License (BICSL)	139	73.2%	113	59.5%	.005*	0.54 (0.35-0.83)*	0.56 (0.36-0.91)*
Infection control course	135	71.1%	116	61.1%	.040*	0.64 (0.42-0.98)*	0.66 (0.48-0.99)*
Orientation Program	11	60.5	75	39.5	.001*	0.42 (0.28-	0.43 (0.29-

	5	%		%		0.64)*	0.71)*
Training in workplace safety and health	103	54.2 %	60	31.6 %	.001*	0.39 (0.25-0.59)*	0.41 (0.29-0.63)*
Undergraduate academic training	65	34.2 %	41	21.6 %	.006*	0.52 (0.33-0.84)*	0.61 (0.41-0.96)*
Postgraduate academic training	54	28.4 %	44	23.2 %	.241	0.75 (0.48-1.20)	0.77 (0.51-1.35)
Self-training	54	28.4 %	37	19.5 %	.041* ^	0.60 (0.37-0.98)*	0.63 (0.41-1.04)
General factors							
Do you deal with contaminated items?	161	84.7 %	164	86.3 %	.662	1.1 (0.6-2.0)	1.4 (0.7-2.2)
Are you satisfied with the work?	172	90.5 %	163	85.8 %	.153	0.63 (0.33-1.19)	0.66 (0.39-1.25)
Did you have pre-employment training?	156	82.1 %	175	92.1 %	.004*	2.5 (1.3-4.8)*	2.7 (1.6-5.1)*
Do you use protective equipment properly?	189	99.5 %	186	97.9 %	.177	0.24 (0.03-2.2)	0.22 (0.02-2.1)
Do you suffer from chronic diseases?	23	12.1 %	26	13.7 %	.646^	1.2 (0.63-2.1)	1.3 (0.66-2.4)
Do you suffer from overwork and lack of concentration	53	27.9 %	59	31.1 %	.500	1.2 (0.74-1.8)	1.4 (0.82-2.2)
Do you use any medicines or sedatives?	26	13.7 %	28	14.7 %	.769^	1.1 (0.61-1.9)	1.3 (0.63-2.1)
Have you suffered from previous accidents other than NSI?	24	12.6 %	59	31.1 %	.000* ^	3.1 (1.9-5.3)*	3.5 (2.1-5.8)*
Are you aware of infection control policy?	183	96.3 %	183	96.3 %	1.000	1.0 (0.34-2.9)	1.0 (0.33-2.8)

OR: Crude odds ratio AOR: Adjusted odds ratio CI: Confidence interval

* P < 0.05 (significant)

Table 3:- Factors associate with needle stick injury among study health care workers, Al-Ahsa, Saudi Arabia, continued).

Factors	**Group**				**p-value**	**OR (95% CI)**	**AOR (95% CI)**
	Control		**Case**				
	No	**%**	**No**	**%**			
Environmental factors							
Poor lighting	20	10.5 %	29	15.3 %	.168	1.5 (0.83-2.8)	1.4 (0.80-2.4)
Poor ventilation	24	12.6 %	22	11.6 %	.753	0.90 (0.48-1.67)	0.91 (0.50-1.71)
Noise	38	20.0 %	44	23.2 %	.454	1.2 (0.73-1.9)	1.1 (0.68-1.8)
Bad workplace arrangement	39	20.5 %	44	23.2 %	.535	1.2 (0.71-1.9)	1.1 (0.70-1.7)
Workplace factors							
Device left on floor, table, bed or other inappropriate place	35	18.4 %	48	25.3 %	.107	1.5 (0.91-2.4)	1.4 (0.90-2.2)
Item left on or near disposal container	30	15.8 %	26	13.7 %	.563	0.85 (0.47-1.5)	0.88 (0.61-1.9)
Item protruding from opening of disposal container	22	11.6 %	19	10.0 %	.620	0.84 (0.44-1.6)	0.88 (0.62-1.8)
Item pierced side of disposal container	12	6.3 %	13	6.8 %	.836^	1.1 (0.48-2.5)	1.1 (0.49-2.4)

Item protruded from trash bag or inappropriate waste container	11	5.8 %	13	6.8 %	.673^	1.1 (0.52-2.7)	1.2 (0.62-2.6)
Inadequate needles, syringes and sharps equipment	36	18.9 %	45	23.7 %	.260	1.3 (0.81-2.2)	1.4 (0.83-2.4)
Inadequate disposal containers	24	12.6 %	32	16.8 %	.247^	1.4 (0.79-2.5)	1.6 (0.82-2.9)
Disposal container filled above two third	19	10.0 %	31	16.3 %	.069^	1.8 (0.95-3.2)	1.9 (1.0-3.6)*
Purpose of Sharp Item use							
Injection, intra-muscular/subcutaneous	142	74.7 %	135	71.1 %	.419	0.83 (0.52-1.3)	0.88 (0.62-1.6)
Heparin or saline flush (syringe)	104	54.7 %	74	38.9 %	.002*	0.52 (0.35-0.79)	0.62 (0.36-0.81)
To connect IV line	115	60.5 %	96	50.5 %	.050*	0.66 (0.44-1.0)	0.69 (0.52-1.03)
To Draw Blood Sample	110	57.9 %	111	58.4 %	.917	1.0 (0.68-1.5)	1.1 (0.71-1.9)
To place an Arterial/Central line	72	37.9 %	53	27.9 %	.038*	0.63 (0.41-0.97)*	0.61 (0.39-0.87)*
Suturing	82	43.2 %	51	26.8 %	.001*	0.48 (0.31-0.74)*	0.50 (0.36-0.82)*
Cutting	88	46.3 %	46	24.2 %	.001*	0.37 (0.23-0.57)*	0.41 (0.29-0.69)*
Drilling	34	17.9 %	22	11.6 %	.082^	0.60 (0.33-1.01)	0.63 (0.39-1.11)
Electrocautery	23	12.1 %	13	6.8 %	.080^	0.53 (0.26-1.1)	0.71 (0.29-1.1)
During use of sharp item							
Multi-step Procedure	86	45.3 %	75	39.5 %	.253	0.78 (0.52-1.2)	0.81 (0.55-1.3)
Disassembling Device or Equipment	45	23.7 %	25	13.2 %	.008*	0.48 (0.28-0.83)	0.51 (0.31-0.88)
Preparation for reuse of reusable instrument	36	18.9 %	34	17.9 %	.791	0.93 (0.55-1.6)	0.91 (0.52-1.4)
Recapping used needle	45	23.7 %	53	27.9 %	.348	1.3 (0.78-1.9)	1.4 (0.79-2.0)

OR: Crude odds ratio AOR: Adjusted odds ratio CI: Confidence interval
* P < 0.05 (significant)

Table 4:- Factors associate with needle stick injury among study health care workers, Al-Ahsa, Saudi Arabia, continued).

Factors	**Group**				**p-value**	**OR (95% CI)**	**AOR (95% CI)**
	Control		**Case**				
	No	**%**	**No**	**%**			
Type of Device							
Needle	168	88.4 %	178	93.7 %	.072	1.9 (0.9-4.0)	2.1 (1.1-4.3)*
Surgical instrument	139	73.2 %	114	60.0 %	.007*	0.55 (0.35-0.84)	0.61 (0.41-0.92)
Glass item	118	62.1 %	94	49.5 %	.013*	0.59 (0.39-0.89)	0.61 (0.41-0.93)
Type of Needle							
Disposable syringe	152	80.0 %	129	67.9 %	.007*	0.52 (0.33-0.84)	0.49 (0.29-0.79)
Pre-filled cartridge syringe	83	43.7	68	35.8	.116	0.71 (0.47-	0.73 (0.52-

		%		%		1.01)	1.09)
Blood gas syringe (ABG)	114	60.0 %	82	43.2 %	.001*	0.50 (0.33-0.76)*	0.52 (0.36-0.82)*
Needle on IV line	112	58.9 %	95	50.0 %	.080	0.69 (0.46-1.0)	0.73 (0.53-1.05)
Winged steel needle	44	23.2 %	38	20.0 %	.454	0.83 (0.50-1.3)	0.82 (0.49-1.3)
IV catheter stylet	64	33.7 %	51	26.8 %	.147	0.72 (0.46-1.1)	0.70 (0.44-1.09)
Vacuum tube blood collection holder/needle	42	22.1 %	31	16.3 %	.152	0.68 (0.41-1.2)	0.69 (0.42-1.2)
Spinal or Epidural needle	22	11.6 %	5	2.6%	.001*	0.21 (0.07-0.55)*	0.22 (0.1-0.68)*
Unattached hypodermic needle	35	18.4 %	18	9.5%	.012*	0.46 (0.25-0.85)*	0.50 (0.29-0.93)*
Arterial catheter introducer needle	29	15.3 %	14	7.4%	.015*	0.44 (0.23-0.86)*	0.41 (0.20-0.81)*
Central line catheter needle	41	21.6 %	23	12.1 %	.014*	0.50 (0.28-0.87)*	0.51 (0.28-0.89)*
Drum catheter needle	18	9.5%	14	7.4%	.460	0.76 (0.36-1.6)	0.73 (0.32-1.4)
Surgical instrument							
Lancet	78	41.1 %	38	20.0 %	.001*	0.35 (0.22-0.56)	0.33 (0.21-0.48)
Suture needle	91	47.9 %	66	34.7 %	.009*	0.57 (0.38-0.87)	0.55 (0.33-0.76)
Scalpel, reusable	52	27.4 %	26	13.7 %	.001*	0.42 (0.25-0.70)	0.44 (0.26-0.75)
Razor Pipette (plastic)	14	7.4%	9	4.7%	.282	0.62 (0.26-1.5)	0.60 (0.25-1.3)
Scissor	99	52.1 %	65	34.2 %	.001*	0.47 (0.32-0.72)*	0.45 (0.30-0.69)*
Electro-cautery device	26	13.7 %	12	6.3%	.017*	0.42 (0.20-0.87)*	0.44 (0.25-0.93)*
Bone cutter	19	10.0 %	11	5.8%	.128	0.55 (0.25-1.2)	0.53 (0.22-1.1)
Bone chip	13	6.8%	9	4.7%	.380	0.67 (0.28-1.6)	0.70 (0.30-1.8)
Towel clip	28	14.7 %	15	7.9%	.035*	0.49 (0.26-0.96)*	0.44 (0.21-0.88)*
Microtome blade	16	8.4%	8	4.2%	.092	0.47 (0.20-1.1)	0.46 (0.22-1.2)
Trocar	26	13.7 %	8	4.2%	.001*	0.27 (0.12-0.63)*	0.29 (0.14-0.72)*
Vacuum tube (plastic)	24	12.6 %	9	4.7%	.006*	0.34 (0.15-0.76)*	0.33 (0.15-0.74)*
Specimen/test tube (plastic)	32	16.8 %	17	8.9%	.022*	0.48 (0.25-0.91)*	0.51 (0.27-1.02)
Fingernails/teeth	7	3.7%	3	1.6%	.200	0.42 (0.10-1.6)	0.40 (0.09-1.4)
Scalpel, disposable	48	25.3 %	23	12.1 %	.001*	0.40 (0.23-0.70)*	0.38 (0.20-0.67)*
Retractors, skin/bone hooks	19	10.0 %	15	7.9%	.472	0.77 (0.38-1.6)	0.76 (0.38-1.5)
Staples/steel sutures	23	12.1 %	16	8.4%	.237	0.66 (0.34-1.3)	0.68 (0.36-1.4)
Wire	21	11.1 %	13	6.8%	.150	0.59 (0.28-1.2)	0.61 (0.31-1.3)
Pin	17	8.9%	9	4.7%	.104	0.51 (0.22-1.2)	0.50 (0.21-1.2)

Drill bit/bur	12	6.3%	10	5.3%	.660	0.82 (0.34-1.9)	0.82 (0.33-1.9)
Pickups/Forceps/Hemostats/Clamps	48	25.3 %	24	12.6 %	.002*	0.42 (0.25-0.73)	0.44 (0.26-0.81)*
Glass item							
Medication ampule	99	52.1 %	69	36.3 %	.002*	0.52 (0.34-0.79)*	0.50 (0.33-0.75)*
Medication vial	81	42.6 %	51	26.8 %	.001*	0.49 (0.32-0.76)*	0.52 (0.33-0.79)*
Medication/IV bottle	88	46.3 %	54	28.4 %	.000*	0.46 (0.30-0.70)*	0.46 (0.31-0.70)*
Pipette (glass)	13	6.8%	8	4.2%	.262	0.59 (0.24-1.5)	0.60 (0.25-1.6)
Vacuum tube (glass)	16	8.4%	13	6.8%	.562	0.79 (0.37-1.7)	0.82 (0.41-1.9)
Specimen/test tube (glass)	29	15.3 %	12	6.3%	.005*	0.37 (0.18-0.75)*	0.35 (0.16-0.68)*
Capillary tube	11	5.8%	5	2.6%	.125	0.44 (0.14-1.3)	0.47 (0.16-1.6)
Glass slide	18	9.5%	5	2.6%	.005*	0.25 (0.09-0.71)*	0.22 (0.06-0.63)*

OR: Crude odds ratio AOR: Adjusted odds ratio CI: Confidence interval

* $P < 0.05$ (significant)