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RESEARCH ARTICLE

The Occurrence and Contributing Factors of Needle Stick and Sharp Injuries Among Dental Students in a South African University

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Abstract:

Background:

Needle stick and sharp injuries are a global public health issue, mainly due to exposure to infectious diseases. Dental students, in particular, are at a high risk of needle stick and sharp injuries attributed to the restricted working space of the oral cavity and the routine use of sharp instruments, among other risks. Despite this growing body of knowledge on needle stick and sharp injuries in the dental setting, data is limited among dental students in South Africa.

Objective:

The study aimed to determine the occurrence and contributing factors of needle stick and sharp injuries among dental undergraduate students in a university in South Africa.

Methods:

A university based cross-sectional study was conducted among 248 dental students in the School of Oral Health Sciences using a census sampling. An anonymous self-administered questionnaire was used to collect data on prevalence, procedures, instruments, reporting, contributing factors, training, protective strategies, and hepatitis B immunization. Data was analysed using STATA 14.

Results:

The response rate was 99% and the mean age of students was 24 years (SD=±4). Male students were 43% (107), while females constituted 57% (141) of the sample. One-hundred and one (41%) students reported being exposed to needle stick and sharps injuries. Most injuries (45%) occurred among students studying Bachelor of Dental and Surgery and among students in the 4th year (57%). The people at the departments of periodontology (39%), and maxillofacial and oral Surgery (25%) experienced most injuries. The main tools causing injuries were the syringe needle (52%) and the scaler (31%) while injecting a patient (34%), and scaling and polishing (26%) were common procedures. Eight (8%) students did not report their injury, even though the use of prophylaxis exposure was minimal (8%). Very few students (5%) were tested for a blood-borne virus after injury, while 23% did nothing with their injury and 43% opted to wash the injury under tap water. Lack of concentration (36%) and anxiety (19%) were reported as major contributing factors to injuries. Two hundred and forty six (99%) students were fully vaccinated against hepatitis B. Two hundred and nineteen (86%) students were aware of full details on the use of universal precautions. One hundred and eighty six (75%) students practiced needle recapping. Being in the 3rd year (AOR = 3.0, 95%CI: 1.4 - 6.3), 4th year (AOR = 5.0, 95%CI: 1.9 - 11) and 5th year (AOR=4.6, 95%CI: 2 -12.5) was significantly associated to injuries compared to students in the 2nd year of the study.

Conclusion:

The needle stick and sharp injuries were prevalent in this study, and factors implicated were lack of concentration and anxiety, as well as, age, academic year of study and training on handling of instruments. The burden of needle stick and sharps injuries among the dental professionals can be reduced by adhering to the current and universally accepted standard precautionary measures against needle stick and sharp injuries.

Keywords: Clinical training, Contributing factors, Needle stick, South African university, Undergraduate dental students, Injuries.

Article History

Received: December 09, 2019

Revised: March 02, 2020

Accepted: March 08, 2020

1. INTRODUCTION AND BACKGROUND

Needlestick and Sharp Injuries (NSIs) are a major public

health issue globally among health care students and professionals [1 - 3]. NSIs are skin wounds caused by

accidental needle pricks during procedures or treatment [4]. Chandrasekhar and Kumar [5] refer to NSIs as an occupational hazard for dental and other Health Care Workers (HCWs). Three million out of 35 million HCWs exposed to bloodborne diseases due to NSIs, worldwide [5, 6]. In African countries, HCWs experience NSIs, on average, four times a year [6, 7]. A high incidence of NSIs per annum among primary care nurses (24%) and junior doctors (69%) has been reported in South Africa [8, 9].

Despite an emphasis on compliance with infection control following NSIs, the risk of occupational exposure to infectious diseases is high among dental students and personnel in training sites and health facilities [2, 3, 10]. This is as a result of the complexity of dental procedures and the proximity to infected patients, predisposing them to the transmission of infections [6]. Contaminated NSIs are a common source of bloodborne diseases such as Human-immunodeficiency Virus (HIV), Hepatitis B Virus (HBV) and Hepatitis C Virus (HCV) [6, 11]. Occupational exposure to bloodborne diseases accounts for 37% of HBV, 39% of HCV, and 4.4% of HIV cases among HCWs [12].

Previous studies have reported numerous factors that contribute to the increased risk of NSIs among HCWs [13 - 16]. In several developing countries, contributing factors such as recapping of needles, knowledge of infectious diseases, compliance with infection control protocols and experience were linked to NSIs [13 - 16]. Further studies reported injections administered, needle recapping and longer working hours as risk factors [13, 14]. In Africa, work experience, working hours, job dissatisfaction, personal protective, infection prevention guideline utilization and infection prevention training were significantly associated with NSIs [17, 18]. Moreover, age, gender, poor compliance with infection-control procedures, and inadequate knowledge of blood borne pathogens were associated with sharp injuries [13, 19 - 21]. Among health care students in developing countries, including South Africa, lack of knowledge about NSIs, institutional clinical training policies and protocols, lack of accompaniment and in-service training, recapping, use of local anesthetic syringes, and scaling and polishing procedures contribute to an increased risk of sustaining NSIs [22, 23]. It is well documented that the highest risk of NSIs among dental students occurs within the surgical departments [2].

To reduce NSIs, in the past decades, precaution and prevention measures such as vaccinating for hepatitis, adoption of standard precaution, improved instrumentation and use of protective equipment have been implemented [7]. Nevertheless, NSIs still occur in alarming rates among various health care students and professionals, affecting them emotionally and psychologically. Despite the risk of NSIs, several studies have highlighted that knowledge and compliance among dental students are inadequate with regard to prevention and management [24, 25]. Dental students are particularly vulnerable to accidental exposure to potentially infected body fluids

because they lack experience and skill in carrying out dental procedures, in addition to the complexity of procedures, proximity and congested oral cavity [2, 26]. There is a dearth of NSIs research on dental students in South Africa. Considering that NSIs remain a potential life-threatening occurrence for health students and professionals, this study determined the occurrence and contributing factors of NSIs among undergraduate dental students at a university in South Africa.

2. MATERIALS AND METHODS

2.1. Study Design And Setting

This was a cross-sectional descriptive study conducted on undergraduate dental students in a South African university. The university has approximately 4500 students and it offers undergraduate and post-graduate degree programmes comprising various schools, including the School of Oral Health Sciences. There are numerous departments within the school, wherein students are exposed to clinical training. The study population comprised second to fifth year dental registered students. The admission records of the School of Oral Health Science had 356 registered dental students in 2018. Of the 356 registered dental students, only 256 students who were in the second to fifth academic year of study were eligible to participate in the study. About 100 students were in their first year of academic study and were excluded from participating in the study because they were not performing clinical practicals that would place them in danger of sharps injuries. Eight students participated in the pilot study, while two students were not available during the time of the study.

2.2. Data Collection

Data were collected through an anonymous self-administered questionnaire developed in English based on previous literature [1, 2, 13]. Content and face validity were achieved by making use of experts in the field. A pilot study was conducted to pre-test the questionnaire and no changes in the content were made thereafter except for clarity of wording, and simplification of layout and style. The researcher distributed the questionnaire to students at the end of a lecture and collected on the same day. Data collected included demographic prevalence, procedures, instruments, reporting, contributing factors, protective strategies, and hepatitis B immunization. The primary outcome variable was incidence or occurrence of needle-stick and sharps injuries. The prevalence of needle-stick and sharps injuries was assessed by asking a question; "have you ever pricked yourself at least once at some point during practical" with the options of "no" and "yes". Needle-stick and sharps injuries were defined as an injury with a needle, scalpel blade, catheter stylet or other pointed object, which was used for any invasive procedure with a patient and contaminated with blood or body fluids [27].

3. DATA ANALYSIS

All questionnaires were verified for completeness, accuracy, consistency and no data was missing. Data were stored in Microsoft Excel and analyzed using STATA version 14. Descriptive statistics for age (mean, Standard Deviation

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(SD), minimum and maximum) and all categorical variables were computed. A comparison of percentages of students by various categories was made using a chi-square test. Bivariate and multivariate logistic regression were used to determine the association between the students' demographic characteristics and occurrence of needle stick and sharps injuries. The multiple regression model was built from variables that had a p-value of <0.2, based on the bivariate analysis. The odds ratio of the variables with a 95% confidence interval was evaluated.

4. RESULTS

4.1. Demographic Characteristics of Dental Students

The study population comprised of 248 dental students who participated in the study. The majority of students were single [221 (89%)] and female [141 (57%)]. The mean age of the students was 24 years (SD=±4), ranging from 18 to 44 years. In South Africa, 18 years is an ideal age to start university education; hence, around the age of 22 years, students are expected to complete their studies. Therefore, two age groups were created; those below 23 years [156 (63%), younger students] and those aged 23 years and above [92 (37%), older students]. Three quarters 179 (72%) of the students were studying bachelor of dental surgery, and of all the students who participated in the study, 36% were in their 3rd year of study (Table 1).

4.2. Sharps Injuries and Demographics and Clinical Practice

Out of the 248 dental students, 41% (n=101) reported to have experienced needle-stick and sharps injuries. Among those who reported sharps injuries, 35 (38%) were older students $p \leq 0.0001$, 80 (45%) studied bachelor of dental and surgery, 23 (57%) were in their 4th academic year of study, while 25 (56%) were in their 5th academic year of study, $p \leq 0.0001$. Seventy-eight (42%) students practiced needle recapping, and 87 (46%) received training on the handling of instrument, $p=0.002$. At univariate analysis, there was an association between sharps injuries and age group ($p=0.005$), the academic year of study ($p \leq 0.0001$) and training on the handling of instruments ($p=0.002$). Injuries were not significantly associated with the degree of study and needle recapping (Table 2).

4.3. Procedures, Instruments and Place Related to Injuries

The majority of dental students (75%) reported recapping of needles. The most common causes of NSIs were while injecting a patient (34%), and scaling and polishing procedures (26%). Syringe needles (52%) and scalers (31%) were the most common instruments causing the sharps injuries. The majority of needle stick and sharps injuries occurred in the departments of periodontology (39%), followed by maxillofacial and oral surgery (25%), and oral health (16%) (Table 3).

4.4. Common causes and reporting of needle-stick and sharps injuries

The majority (92%) of the students who experienced needle-stick and sharps injuries reported the incidence to the

supervisor of the clinic within the School of Oral Health Sciences. The students reported that fear of consequences (29%), long procedures (26%), stigma (15%), and lack of knowledge (19%) were among the main reasons that influence non-reporting of sharp injuries (Table 4). The most commonly reported cause leading to the occurrence of sharps injuries was the lack of concentration (36%), anxiety (19%), lack of experience (13%) and fatigue (10%). Needle-stick and sharps injuries were reported to be 92%.

4.5. Precaution and Prevention Measures

The majority (89%) of the students used universal precautions (*i.e.* wearing gloves and masks and washing hands) to prevent infection from sharps injuries. Almost all (99%) the students were vaccinated for hepatitis. The students received training on the proper handling of instruments (76%) and bloodborne infections (76%). Of the 41% (n=101) of dental students who experienced needle-stick and sharps injuries, 23% did not use any precautionary measures after injuries. The majority (43%) reported that they preferred washing their hands under a tap as a safety protocol, as compared to other measures such as prophylaxis (8%) to avoid possible infections (Table 5).

4.6. Factors Associated with Sharps Injuries

Multiple regression analysis showed significant associations of sharps injuries and academic year of study. Third academic year (AOR = 3.0, 95%CI: 1.4 - 6.3), fourth academic year (AOR = 5.0, 95%CI: 2.0 - 12.5) and fifth academic year of study (AOR = 4.6, 95%CI: 1.9 - 11) (Table 6).

5. DISCUSSION

This study determined the occurrence and contributing factors of needle-stick and sharps injuries among dental students at a university in South Africa. The prevalence of needle-stick and sharps injuries among dental students in this study was 41%. Generally, the prevalence of needle-stick and sharps injuries in dental settings across developing countries has been estimated to range from 20 to 80% [28 - 32]. Similar to the prevalence in the current study, 42% of dental students in Morocco experienced needle-stick and sharps injuries [33]. The prevalence in the current study was lower compared to a study in South African. Moodley and Naidoo [3] reported a prevalence of 76% for needle-stick and sharps injuries among dental students at the Dental Training Institute in Durban, South Africa. In other African countries, such as Nigeria [34] in the medical and dental setting, a higher prevalence of injuries (56.9%) has been reported, while in Kenya, a lower prevalence of 29% of injuries was reported among dental students [35].

Researchers have reported that students are at a higher risk of needle-stick and sharps injuries due to their inexperience in handling clinical instruments pressure occasioned by the need to complete a set number of clinical case requirements for the satisfaction of the supervisor [3, 36]. Literature indicates that multiple injections are usually given over the course of a patient's treatment, placing dental professionals at an increased

risk for needle-stick and sharps injuries [22]. The most common procedures associated with needle-stick and sharps injuries among dental students in the current study were injecting a patient, scaling and polishing, root canal and planning. Furthermore, syringe needles and scalers were the instruments that caused the most needle-stick and sharps injuries. The current study also showed that needle recapping

was common among students. This could probably be due to the naivety of needle recapping consequences instead of following procedures of disposing of hazardous waste material. Similarly, previous studies have indicated the recapping of needles, local anesthetic injections and scaling as the most common causes of needle-stick and sharps injuries among dental students [37, 38].

Table 1. Demographic and academic profile of dental students (n=248).

Variables	Categories	Frequency (n)	Percentages (%)
Age groups	<23 years	156	63
	≥23 years	92	37
Sex	Male	107	43
	Female	141	57
Marital status	Single	221	89
	Married	10	4
	Cohabiting	17	7
Degree of study	Bachelor of Hygiene	35	14
	Bachelor of Dental Therapy	34	14
	Bachelor of Dental Surgery	179	72
Academic year of study	2 nd year	73	29
	3 rd year	90	36
	4 th year	40	16
	5 th year	45	18

Table 2. Association of needle-stick and sharps injuries with socio demographic variables and clinical practice (n=248).

Variables	Categories	All n (%)	No sharps Injuries n (%)	Sharps Injuries (%)	P-value
Age	≤23	156 (37)	103 (66)	53 (34)	0.005*
	>23	92 (63)	44 (48)	48 (52)	
Sex	Male	107 (43)	61 (57)	46 (43)	0.53
	Female	141 (57)	86 (61)	55 (39)	
Degree of study	BOH	35 (14)	23 (66)	12 (34)	0.10
	BDT	34 (14)	25 (74)	9 (26)	
	BDS	179 (72)	99 (55)	80 (45)	
Academic year	2 nd	73 (29)	58 (79)	15 (21)	≤0.0001*
	3 rd	90 (36)	52 (58)	38 (42)	
	4 th	40 (16)	17 (43)	23 (57)	
	5 th	45 (18)	20 (44)	25 (56)	
Needle recapping	No	62 (25)	39 (63)	23 (37)	0.52
	Yes	186 (75)	108 (58)	78 (42)	
Received training on handling instrument	No	60 (24)	46 (77)	14 (23)	0.002*
	Yes	188 (76)	101 (54)	87 (46)	

BOH – Bachelor of Hygiene, BDT – Bachelor of Dental Therapy and BDS - Bachelor of Dental Surgery,

*indicates a significant association with the likelihood of needle stick and sharp injuries.

Table 3. Procedures, instruments, and place related to needle-stick and sharps injuries.

Variables	Categories	Frequency	Percentages
Procedure involved during injury (n=101)**	Injecting a patient	34	34
	Scaling and polishing	26	26
	Tooth extraction	16	16
	Root canal and planning	15	15
	Other	10	10
Instrument (n=101)**	Syringe needle	53	52
	Scaler	31	31
	Other	17	17

(Table 3) cont.....

Department in which injury occurred (n=101)**	Oral health	16	16
	Periodontology	39	39
	Maxillofacial, and Oral Surgery	26	25
	Operative	14	13
	Other	6	6
Needle recapping (n=248)	No	62	25
	Yes	186	75

Table 4. Causes and reporting of needle-stick and sharps injuries.

Causes of sharps injuries (n=248)	Lack of concentration	89	36
	Anxiety	48	19
	Lack of experience	33	13
	Fatigue	25	10
	Lack of training	16	6
	All of the above	22	8
	Other	15	6
Reported sharps injuries (n=101)**	No	8	8
	Yes	93	92
Reasons for not reporting (n=248)	Fear of consequences	71	29
	Long procedures	64	26
	Lack of knowledge	46	19
	Fear of stigma	38	15
	All of the above	10	4
	Other	19	8
Know report process for sharps injuries (n=248)	No	48	18
	yes	200	81

Table 5. Precaution and prevention measures among dental students.

Variables	Categories	Frequency	Percentages
Safety protocol used after needle-stick and sharps injuries (n=101)	Nothing	23	23
	Wash under tap	43	43
	Prophylaxis	8	8
	Medical advice	5	5
	Blood test	5	5
	All procedures	17	17
Use of universal precaution (n=248)	No	28	11
	Yes	219	89
Vaccinated for Hepatitis	No	2	1
	Yes	246	99
Training on instrument handling	No	60	24
	Yes	188	76
Training on blood borne disease (infection control)	No	60	24
	Yes	188	76

Table 6. Multiple logistic analysis: factors associated with needle-stick and sharp injuries (n=248).

NSIs	AOR (95%CI)	P-value
Registered profession	-	-
Bachelor of Hygiene	1[Reference]	
Bachelor of Dental Therapy	0.5 (0.2 – 1.5)	0.23
Bachelor of Dental Surgery	0.9 (0.4 – 2.1)	0.78
Academic year	-	
2 nd	-	1[Reference]
3 rd	3.0 (1.4 -6.3)	0.004*
4 th	5.0 (2.0 – 12.5)	≤0.0001*
5 th	4.6 (1.9 – 11)	0.001*
Needle recapping	-	-

(Table 6) cont.....

Never	-	1[Reference]
Sometime	2.0 (0.6 – 6.0)	0.25
All the time	1.1 (0.5 – 2.7)	0.76

*indicates a significant association with the likelihood of needle stick and sharp injuries

Factors associated with needle-stick and sharps injuries in this study were age, academic year and training on the handling of instruments. Most interestingly, dental students in their 4th year of study were 5 times more likely to sustain needle-stick and sharps injuries while in the third year, they were 3 times more likely and in the fifth year, they were 4.6 more times likely, compared to being in the 2nd year of the study. In the fourth year of dental studies, students complete a significant number of their clinical case requirements and they are, thus, generally considered to be at a higher risk as compared to their counterparts in other years of study [2]. Furthermore, the majority of most needle-stick and sharps injuries in the current study were observed to occur in the Departments of Periodontology, and Maxillofacial and Oral Surgery. Previous studies have reported that the highest prevalence of needle-stick and sharps injuries occurs in the Oral Surgery Department and the Operative Department [2, 39].

In addition, dental students in this study suggested that factors contributing to needle-stick and sharps injuries could be lack of concentration, anxiety, lack of experience and fatigue. Working hastily has previously been reported as the most common reason for needle-stick and sharps injuries, in addition to fatigue, lack of skills, not wearing gloves and lack of supervision in Asia [39]. Furthermore, needle-stick and sharps injuries have been attributed to stress, work overload, carelessness, unskilled handling of the instruments and negligence [40, 41].

Of the 101 students who experienced needle-stick and sharps injuries in this study, 92% of them reported injuries to the supervisor in the clinic within the school of Oral Health Sciences. Variations in underreporting/non-reporting exist in South Africa among health care students and professionals. Moodley and Naidoo [3] observed that 81% of dental personnel and students reported injuries at a dental training site in Kwa Zulu Natal province. Conversely, in Limpopo Province, underreporting was estimated to be as high as 50% among nurses [9]. In Nigeria, 77% of medical and dental students did not report their needle-stick and sharps injuries [34]. Dental students in the current study reported that the main factors contributing to underreporting or non-reporting of needle-stick and sharps injuries were fear of consequences, long procedures, lack of knowledge and stigma. The literature documents the most common reasons for not reporting needle-stick and sharps injuries to be the low perception of injury risk, lack of time, and fear of stigmatization [34, 42].

HBV vaccination among health care students and professionals is an important preventive measure [43]. The current study showed that the vast majority of dental students were vaccinated against hepatitis (99%). In South Africa, HBV transmission is a real threat for all health care personnel in contact with patients (dentists, medical doctors, dental nurses, *etc.*) [44]. A study conducted among dental and oral hygiene students in a South African university reported a 92% HBV

vaccination coverage and completion of vaccination schedule in both clinical (94%) and non-clinical (88%) students.

The current study further showed that the majority of dental students used universal precautions (89%), mostly including the use of gloves and masks, and washing of hands, and were trained for the handling of instruments (76%) and infection control (76%). Most students who experienced a needle-stick and sharps injuries in this study chose to wash the affected area under tap water, as compared to considering the process of accessing post-exposure prophylaxis (PEP) or medical tests. However, the literature indicates a lack of knowledge, low adherence and unavailable PEP in most health facilities among the health care students and professionals in South Africa [23, 45].

5.1. Limitations Of The Study

The study results and conclusion might be subject to response bias from the respondent since students were given questionnaires to complete on their own, which might have led them to discuss responses. It is worth mentioning that no window period and the number of times of needle-stick and sharps injuries was determined in this study, and this might have resulted in underreporting of the occurrence of injuries. The unequal distribution of students in various levels of study could also have influenced the statistical analysis, particularly, the prevalence of sharps injuries. Due to a small quota of students admitted to study dental qualifications in this university, census sampling was used, which has some limitations in terms of inferential statistics. Nevertheless, we believe that the present study shed light on the occurrence of needle-stick and sharps injuries and contributing factors among dental students in this particular institution.

CONCLUSION

A substantial number of needle-stick and sharps injuries were observed among undergraduate dental students at this particular university in South Africa. Needle recapping was prevalent and needle-stick and sharps injuries occurred while injecting to a patient, and scaling and polishing procedures, mostly from syringe needles and scalars. Significant factors associated with needle-stick and sharps injuries were age, the academic year of study and training on handling of instruments, and students in the 4th year of study had a higher likelihood of needle-stick and sharps injuries. Most of the needle-stick and sharps injuries occurred among students enrolled in the Bachelor of Dental and Surgery, and in the Departments of Periodontology and Maxillofacial and Oral Surgery. Reporting of needle-stick and sharps injuries among the students who are mentioned was high even though the use of prophylaxis post-exposure was minimal. The burden of needle-stick and sharps injuries among dental professionals can be reduced by adhering to the current and universally accepted standard precautionary measures against needle-stick and sharps injuries.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

All procedures involving human subjects were approved by the Sefako Makgatho Health Sciences University Research and Ethics Committee, South Africa (SMUREC/H/261/2017:PG). Permission to conduct the study was obtained from the Head of the School of Oral Health Sciences before commencing the study.

HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All human research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2013.

CONSENT FOR PUBLICATION

Written informed consent was obtained from each participant prior to the study.

AVAILABILITY OF DATA AND MATERIALS

The dataset for dental students analyzed during the current study is with the corresponding author [P.M] and can be made available at their choice due to confidentiality issues.

FUNDING

None.

CONFLICT OF INTEREST

The author declares no conflict of interest, financial or otherwise.

ACKNOWLEDGEMENTS

The authors thank the School of Oral of Health Sciences for permission to conduct the study. We also appreciate dental students for full participation in the study.

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