IJCMBS

Original Article

doi.org/ 10.5281/zenodo.15643140 JCMBS 2025; 5(2):93-98

Root Cause Analysis in Sharps Injuries: Fishbone Diagram

Kesici Delici Alet Yaralanmalarında Kök Neden Analizi: Balık Kılçığı Diyagramı

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Abstract

Background: During clinical practice, students are in the high-risk group for occupational needle stick/sharp piercing injuries due to limited clinical experience, inadequate attention to personal safety, and lack of knowledge.

Materials and Methods: In the first part of the qualitative study, Demographic Information Form was used to collect demographic data of the students and in the second part, fishbone diagram was used to determine the root causes of sharps injuries.

Results: The mean age of the participants was 22.30±0.702 years, 80% were female and 20% were male. Of the students, 76.7% were nursing students and 23.3% were midwifery students, and all of them were 4th year vocational education students. 46.7% of the participants practiced in internal units, 30% practiced in surgical units and 23.3% in intensive care unit. It was determined 86.7% of the participants had experienced a sharps injury once. In the root cause analysis of students' sharps injuries according to the fishbone method, four main headings were identified: healthcare workers, material, environment and method.

Conclusions: When the root causes were analyzed, it was found that all of the sharps injuries were preventable. With an effective intervention for these causes, it is expected that the material and moral damages that may be experienced will be minimized.

Keywords: Sharp objects injury, penetrating objects injury, student, root cause

ÖZ

Amaç: Klinik uygulamaları sırasında öğrenciler sınırlı klinik deneyim, kişisel güvenliğe yetersiz dikkat, bilgi eksiklikleri nedeniyle mesleki iğne batması/kesici delici alet yaralanmaları açısından yüksek riskli grupta yer almaktadırlar.

Gereç ve Yöntem: Nitel çalışmanın ilk bölümde öğrencilerin demografik verilerini Demografik Bilgi Formu ile İkinci bölümde kesici delici alet yaralanmalarının kök nedenlerinin belirlenmesi amacıyla balık kılçığı diyagramı kullanıldı.

Bulgular: Araştırmaya katılanların %80'i kadın, %20' si erkek olup yaş ortalamaları 22,30±0,702'dir. Öğrencilerin %76,7'si hemşirelik, %23,3'ü ebelik olup hepsi 4. sınıf işletmede mesleki eğitim öğrencisi idi. Katılımcıların %46,7'si dahili birimlerde, %30'u cerrahi birimlerde, %23,3'ü yoğun bakımda uygulamaya çıkmışlardı. Katılımcıların %86,7'si bir kez kesici delici alet yaralanması yaşamıştı. Öğrencilerin kesici delici alet yaralanmalarının balık kılçığı yöntemine göre yapılan kök neden analizinde; sağlık çalışanları, malzeme, ortam ve yöntem olmak üzere dört ana başlık belirlendi.

Sonuç: Elde edilen kök nedenlere bakıldığında kesici delici alet yaralanmalarının hepsinin önlenebilir nedenler olduğu ortaya çıkmıştır. Bu nedenlere yönelik etkin bir müdahale ile yaşanabilecek maddi-manevi zararların en aza indirilmesi beklenmektedir

Anahtar kelimeler: Kesici alet yaralanma, delici alet yaralanma, öğrenci, kök neden

Highlights

- Final-year nursing and midwifery students face high risk of sharp object injuries during clinical practice.
- Fishbone diagram used to identify root causes: personnel, equipment, environment, and procedures.
- 86.7% of participants reported experiencing at least one sharp object injury.
- All identified causes were preventable, indicating potential for effective interventions.
- Study offers a novel perspective to enhance safety awareness in clinical education

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E-mail: drykoksal@gmail.com **Received:** 13 March 2025 Accepted: 08 June 2025

***Cite as*:** Cengiz Acıl. H. et al. Root Cause Analysis in Sharps Injuries: Fishbone Diagram. JCMBS *2025; 5(2):93-98 doi.org/ 10.5281/zenodo.15643140*

Introduction

The Centers for Disease Control and Prevention (CDC) defines sharps injuries as "a penetrating stab wound from a needle, scalpel, or other sharp object that may result in exposure to blood or other body fluids". The CDC estimates that there are approximately 385000 sharps injuries per year (>1 000 injuries per day) among hospitalized healthcare workers (1).

Needle stick and sharps injuries potentially serious occupational injuries for healthcare professionals, including nursing students (2,3). Korkmaz et al. (2022) found that approximately two out of every five healthcare professionals had at least one needle stick/sharp piercing injury and that these injuries were frequently seen in surgical clinics. Approximately two out of every three people (63.9%) who reported having suffered an injury were nurses (4). The most important causes of needle stick/sharp piercing injuries are due to careless activities such as high labor force, fatigue, rushing, crowded working environment, two-handed capping, unsafe specimen collection, washing contaminated instruments, and disposal of sharps waste (5,6). Reasons such as nursing students' incompletely developed manual skills, limited clinical experience, and lack of attention to personal safety measures cause them to be in a higher risk group than working nurses in terms of sharps injuries (7-10). Therefore, from the first year of nursing education, students are frequently exposed to needle stick and sharps injuries during patient care in the hospital (11).

Needle stick/sharp piercing injuries negatively affect the psychological health, general productivity and quality of life of healthcare workers (12,13). Studies have shown that these injuries have a number of psychological effects such as fear, anxiety, depression and post-traumatic stress disorder (14). However, the estimated prevalence of these cases does not reflect the real scenario, as a significant proportion of them go unreported (15).

When the literature was reviewed, it was seen that the frequency of sharps injuries, knowledge levels and attitudes of healthcare workers were examined. As the original aspect of the study, this study was designed as a descriptive and prospective study to understand the root cause of the problems in sharps injuries by performing "root cause analysis" with "fishbone diagram" and to reveal the measures that can be taken in this direction.

Material and Methods

Study design

This qualıtatıve study was conducted descriptively and prospectively with 44 students who were reported to Sakarya University, Faculty of Health Sciences with a sharps injury between 2021 and 2023. The study sample consisted of 30 students who filled out the sharps injury form by the hospital, reported the sharps injury notification form to the student affairs and volunteered to participate in the study.

Data collection tools

1.Demographic Information Form: In the first part of the questionnaire; the grade level of the participants, their preference for the nursing/midwifery profession, the number of injuries with sharp instruments and the conditions that caused the injury, the clinic where the injury occurred

2. In the second part, a fishbone diagram will be used to identify the root causes of sharps injuries.

Fishbone Diagram

Developing prevention strategies as a result of root cause analysis of situations that threaten patient and employee safety plays a key role in preventing and reducing unexpected events. Measures to be taken in line with these strategies, new technical applications and suggestions on what can be done within the scope of employee safety and patient care and treatment are presented (16). Root cause analysis is defined as "the possible occurrence of an undesirable event, a process for identifying the root causes or influential factors underlying a change in performance". Root cause analysis is a structured approach that is widely used to analyze adverse events. The subject of investigation in root cause analysis is the event and its causes, not the people. The aim of this approach is not to find out who was negligent, but to make improvements in the system by reviewing all incidents (17).

Implementation of the Fishbone Diagram

In step 1, participants are brought together to brainstorm about the problem to be discussed.

In step 2, draw a large fish bone on the board.

In step 3, a sentence expressing the problem is written on the head of the fish.

In step 4, brainstorming is initiated on a category of potential causes.

In step 5, brainstorming continues on other categories.

The fishbone diagram is used to try to find the root cause of a problem and its solutions. In the first stage, a problem or a negative situation is written at the top of the fishbone diagram. In the second stage, the reasons that may cause this problem are tried to be identified and categorized. In the fishbone, basic causes such as human, material,

method, environment are identified. In the third stage, sub-causes are found by the participant(s). In the fourth stage, the most probable causes are ranked in order of importance (18).

Implementation and Ethical Aspects of Research

Permission was obtained from Sakarya University Ethics Committee and Sakarya University Faculty of Health Sciences for the implementation of the study. In the study, the data were applied by the researchers using face-to-face interview method. Students were gathered in a classroom on a common day when they came to school for lessons outside the application and data were obtained with a fishbone diagram.

Statistical analysis

The study data were evaluated using IBM SPSS Statistics 23; frequency distribution (number, percentage) for categorical variables, descriptive statistics (mean, standard deviation, minimum, maximum) for numerical variables and fishbone diagram were used.

Ethical Approval

This study was conducted in accordance with the Declaration of Helsinki and institutional ethical guidelines. The study approved by the Sakarya University Ethics Committee and Sakarya University Faculty of Health Sciences (Date: 15.05.2024. Number: 69/19). Informed consent was obtained from all patients. In the study, the data were applied by the researchers using face-to-face interview method. Students were gathered in a classroom on a common day when they came to school for lessons outside the application and data were obtained with a fishbone diagram.

Results

Eighty percent of the participants were female and 20% were male. The mean age was 22.30±0.702 (Min 21-Max 24). 76.7% of the students were nursing students, 23.3% were midwives, and all of them were 4th grade vocational education students. 83.3% of the students preferred the profession willingly. 46.7% of the participants practiced in internal units, 30% in surgical units and 23.3% in intensive care units. All of the students had received occupational health and safety training before practicing. While 86.7% of the participants had experienced a sharps injury once, 13.3% had experienced it for the second time. In the root cause analysis of students' sharps injuries according to the fishbone method, four main headings were identified: healthcare workers, material, environment and method **(Table 1) (Figure 1).**

Table 1. Results related to participants' demographic characteristics

		n	%
Sex	Male	6	20
	Female	24	80
Age, year	Mean ± SD (min-max)	22.30 ± 0.702 (21-24)	
Student department	Nursing	23	76.7
	Midwifery	7	23.3
Units	İnternal units	14	46.7
	Surgical units	9	30
	İntensive care units	7	23.3

Under the heading of health workers, it was found that students suffered injuries due to the fact that their work was intense due to the scarcity of employees and therefore they were fast and in a hurry.

Under the material heading, it was found that injuries occurred while closing the lid of the syringe in order not to put the used syringe openly in the tray due to the lack of a sharps waste box, similarly, they were injured by the needle left in the tray while using other medicines because the tray was too messy, and they were injured due to the lack of gloves or not suitable for their hands.

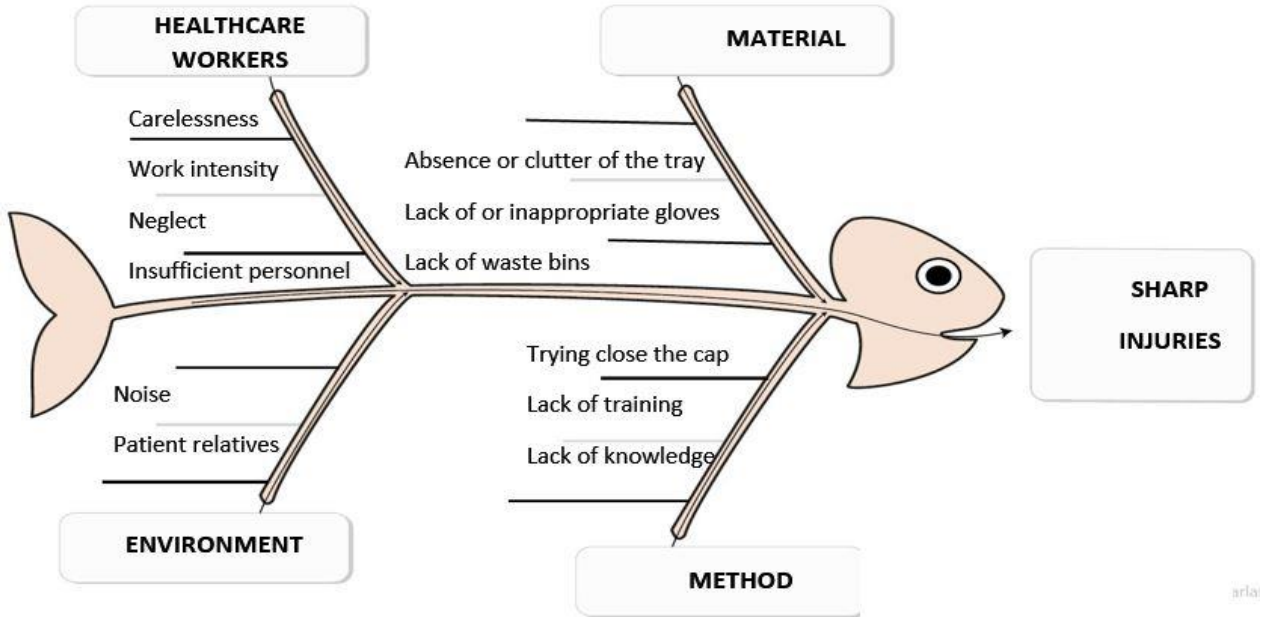

Figure 1. Fishbone Diagram

In the environment-induced sharps injuries, it was observed that the environment was very crowded and noisy due to the patient's relatives, and they were distracted and suffered a needle stick injury.
In another heading method, it was determined that the majority of the students were injured while trying to close the cap of the syringe and that there was a lack of information and education. It was determined that the students knew that they should not close the cap but somehow attempted to close it during the practice **(Table 2).**

Table 2. Main Reason- Sub Reasons

Healtcare workers	**Carelessness, work intensity, neglect, insufficient personnel**
Environment	Noise, patient relatives
Material	Absence or clutter of the tray, lack of or inappropriate gloves, lack of waste bins
Method	Trying close the cap, lack of training, lack of knowledge

Discussion

In the study, it was observed that the majority of the students were injured while closing the syringe cap, while in a similar study (2019), it was found that more than a quarter of nursing students experienced sharps injuries, and these injuries occurred especially while preparing treatment and closing the syringe cap. However, they also stated that a significant majority of the students (93.5%) did not report the injury, and two-thirds (70%) of the students who were exposed to the infectious agent did not make the necessary notification to the infection control committee (19).
In another study (2022), it was found that more than half of nursing students (56.6%) experienced needle stick injuries. Therefore, it is seen that lack of awareness among students is an important risk factor for injuries. It is also understood that students are careless with used and contaminated materials (20). In the study by Çalıkoğlu et al. (2019), it was determined that 21.6% of the participants experienced a needlestick or sharps injury in the last year, 16.7% of these injuries occurred while removing the needle tip from the syringe, 29.2% while trying to reattach the needle cap, 16.7% while filling the syringe and 12.5% while drawing blood from the patient (21).
Another study found that 18% of students had experienced accidental punctures with sharp objects in the last 12 months, with the most common sharp objects being syringe needles and insulin (22).
Palloş et al. (2024) found that 16.8% of students were exposed to sharp object injuries during their undergraduate education and that the injuries mostly occurred during clinical practice (95.7%) and in internal medicine clinics (57.4%). They found that 48.9% of students were injured in their first year and 63.8% were exposed to needlestick and sharp object injuries at least once, and the most common device causing the injury was the syringe needle (63.8%) (23).
Similarly, Smith et al. (2005). found that most needlestick injuries occurred in the nursing laboratory (45%) or teaching hospital (37%), with needle decapping being the most common causative event (24).

All of these studies collectively highlight that nursing students are highly vulnerable to needlestick and sharps injuries, most of which occur during clinical practice, particularly while handling syringe needles. The most common moments of injury include recapping the needle, removing the needle from the syringe, or during treatment preparation. Additionally, the high rate of unreported injuries and the insufficient number of notifications made to infection control units point to significant gaps in post-exposure management. These findings suggest that a lack of awareness among students, insufficient training and supervision, and inadequacies in clinical mentorship are critical risk factors. Therefore, in order to reduce the incidence of sharps injuries, it is essential to strengthen both theoretical and practical training, systematically educate students on the risks and prevention strategies, and encourage a more proactive approach to injury reporting.

Study limitations

This study has several limitations. The data were collected solely from nursing and midwifery students enrolled at a single institution, which limits the generalizability of the findings. Additionally, the study was conducted using a qualitative design and relied on participants' self-reported data. This may have introduced recall bias or response distortion due to social desirability or concerns about potential institutional repercussions.

Conclusion

In conclusion, the root causes of injuries identified according to the fishbone diagram were found to be preventable causes. To reduce such problems, instructors need to train students more efficiently and appropriate interventions are needed to guide and assist students in preventing and managing needle stick/sharp piercing injuries and to help them understand how to use protective equipment. For an effective intervention, it is of utmost importance to identify the possible risk factors that cause needle stick/ sharps injuries, especially among nursing students.

Acknowledgements: *None.*
Ethical Approval: *This Study approval was obtained from the Sakarya University, Ethics Committee (Date: 15.05.2024. Number: 69/19 Informed consent was obtained from all patients.*
Author Contributions: *Concept: H.C.A, D.H.A. Literature Review: H.C.A, D.H.A. Design: H.C.A, D.H.A. Data acquisition: H.C.A, D.H.A. Analysis and interpretation: H.C.A, D.H.A. Writing manuscript: H.C.A, D.H.A. Critical revision of manuscript: H.C.A*
Conflict of Interest: *The author(s) do not have any potential conflict of interest regarding the research. authorship and/or publication of this article.*
Data Availability: *The data used to support the findings of this study are available from the corresponding author upon reques*
Financial Disclosure: *The research was supported as TUBITAK 2209-A Project).*

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