Knowledge, Attitude, and Practices regarding Needle Stick Injuries among Laboratory Professionals with Different Education Levels and Lab Standards

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Original Research Article

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ABSTRACT

Objective: The study aimed to assess the knowledge, attitudes, and practices (KAP) concerning needle stick injuries (NSIs) among laboratory professionals, with a focus on the influence of their education levels and the standards of the laboratories in which they are employed.

Methods: A cross-sectional study was conducted from June 2022 to April 2023, including 600 participants—400 healthcare workers and 200 students—from both public and private sector laboratories and institutes. Data were collected using a structured questionnaire, and statistical analysis was performed with SPSS version 25.0. Chi-square tests were used to assess associations between NSI occurrences and various demographic and workplace factors.

Results: The study identified a 49.1% incidence rate of NSIs among the participants. Significant correlations were found between the occurrence of NSIs and factors such as occupational role, educational level, and laboratory standards. Notably, individuals working in public sector laboratories and those with lower educational qualifications (diploma holders) exhibited a higher prevalence of NSIs compared to their private sector and more highly educated counterparts. The analysis also highlighted that excessive workload and inadequate personal protective equipment (PPE) were major contributors to the frequency of NSIs.

Conclusion: The study's findings emphasize the critical need for enhanced NSI prevention measures, particularly within public sector laboratories and among personnel with lower educational qualifications. The study advocates for the

implementation of targeted training programs, stricter safety protocols, and the provision of adequate PPE to mitigate the risks associated with NSIs.

Keywords: Needle Stick Injuries (NSI), Education Levels, Lab Standards

1. INTRODUCTION

Clinical laboratory workers are subjected daily to occupational hazards that include infections from biological samples and contaminated equipment (1). Among them, needle stick injuries (NSIs) are the most prevalent occupational hazard. NSIs and sharp injuries are described as unintended skin-penetrating wounds resulting from the use of hollow-bore needles, such as hypodermic needles, blood collection needles, and intravenous (IV) catheter stylets, as well as other sharp instruments including scalpels, scissors, suturing tools, and broken ampoules (2, 3). Healthcare workers and laboratory professionals are at risk of these injuries, which occur when sharp objects contaminated with blood or bodily fluids puncture the skin. Such incidents can lead to serious health risks and cause significant psychological distress for both the affected workers and their families (4). The most frequently transmitted pathogens in occupational settings include the Hepatitis B and C viruses (HBV and HCV), along with the human immunodeficiency virus (HIV) (4, 5).

According to estimates by the International Labor Organization, approximately160 million workers suffer from work-related illnesses such as mental health disorders and musculoskeletal conditions, while an estimated 270 million occupational accidents result in around 350,000 fatalities (6). The impact of work-related diseases and injuries has risen significantly, with annual deaths increasing by 26% from 2.3 million in 2014 to 2.9 million in 2019. Additionally, the Disability-Adjusted Life Years (DALYs) attributable to occupational factors have also seen a substantial rise, escalating from 123 million in 2014 to 180 million in 2019, representing a 47% increase (7). Despite improvements in occupational health in many countries, it remains a lower priority in developing nations, where other health issues often take precedence. The lack of prioritization in these regions, including Pakistan is attributed to various socio-economic, political, and cultural challenges, leading to the continued neglect of occupational health and negatively impacting worker well-being (8, 9).

Despite the global concern regarding NSIs among healthcare and laboratory workers, there exists a gap in understanding the impact of educational qualifications and laboratory protocols on the incidence and management of needle stick injuries. Moreover, the knowledge of laboratory professionals regarding NSIs, their practices for managing such injuries, and the laboratory facilities provided to workers after such incidents need to be addressed with a population-specific approach.

A study conducted between November 2018 and January 2019 investigated the prevalence and types of occupational health hazards, with a particular focus on needle stick injuries (NSIs), among 217 medical laboratory workers in Lahore, Pakistan. The findings revealed that 46.8% of the participants had sustained NSIs. Additionally, 28.4% were exposed to non-biological hazards, and 18.4% encountered organic substances. The most frequently reported causes of injuries were ergonomic factors, including operational errors and overcrowded work environments (10). Another study assessed the prevalence of NSIs among healthcare workers in Punjab, Pakistan, finding a 35.25% incidence in the past six months, primarily during sampling and recapping. Reporting rates were low, with only 21.87% of incidents reported. Additionally, post-exposure practices were inadequate, indicating a pressing need for improved NSI management and preventive measures(11).

Needlestick injuries (NSIs) continue to be a major concern among laboratory professionals, yet research on their knowledge, attitudes, and practices remain limited. Understanding these aspects is essential for identifying deficiencies in training, education, and professional practices. This study aims to evaluate the laboratory workers' knowledge, attitudes, and practices regarding NSIs among laboratory workers. It will examine the influence of education on professional attitudes towards NSIs, compliance with safety protocols, the availability of preventive measures, and typical responses to NSI incidents. Such an assessment is crucial for gaining a comprehensive understanding of the current situation, highlighting key issues in NSI knowledge and practices, and facilitating effective injury management through educational improvements and healthcare policy reforms.

2. MATERIAL AND METHODS

2.1. Study Design and Setting

This cross-sectional study was conducted from June 24, 2022, to April 30, 2023, among medical laboratory professionals and students working in both public and private sector labs and institutes. The study aimed to evaluate their knowledge, attitudes, and post-exposure practices regarding needlestick injuries (NSIs).

2.2. Study Population

A total of 600 participants were recruited, comprising 400 healthcare workers (HCWs) and 200 registered students. The HCWs included medical laboratory professionals working in public, private, and state-affiliated laboratories connected to hospitals.

2.3. Sampling and Participant Selection

A simple stratified sampling approach was used. Participants were divided into two strata:

- **Healthcare Workers**: 400 HCWs who had worked for at least one month. Those on probation for less than one month were excluded.
- **Students**: 200 registered students studying medical laboratory programs.

2.4. Inclusion Criteria

- HCWs who had been employed for at least one month.
- Registered students enrolled in medical laboratory programs.

2.5. Exclusion Criteria

- HCWs on probation for less than one month.
- Incomplete or non-consenting participants.

2.6. Data Collection Instrument

A structured questionnaire was developed based on previous literature and expert input. The questionnaire covered the following:

- **Demographics**: Age, job category, work history, hours worked.
- **NSI** Awareness: Prior incidents and influencing factors.

2.7. Ethical Considerations

Institutional Review Board (IRB) approval was obtained before data collection. Informed consent was secured from all participants. Questionnaires were administered by the lead investigator, who also provided verbal assistance to participants with language difficulties.

2.8. Data Analysis

Data were analyzed using SPSS 25.0. Frequencies and percentages were reported for qualitative variables. The Pearson chi-square test was used to assess associations between categorical variables. A p-value ≤ 0.05 was considered statistically significant.

3. RESULTS

This study involved 600 laboratory professionals from different educational backgrounds and workspaces, as described in Table 1. These included laboratory technologists, laboratory technicians, and students from both public and private setups. All the participants were well informed about the research objective and consented to provide their data.

Table 1: Qualification and Occupation of Participants

Qualification	Occupation			Total
	Laboratory Technologist	Laboratory Technician	Student	
2 Years Diploma	0	200	0	200
B.s Hons MLT	169	0	200	369
M. Phil	31	0	0	31
Total	200	200	200	600

Most of the participants were either students or diploma holders, making up 33% and 34% of the total study subjects, respectively. Approximately 28% were graduates with a bachelor's degree in medical laboratory science from public and private universities. Their coursework included training, internships, and research. Only 5% of the participants were MPhil scholars, indicating their lower involvement in laboratory-related jobs (Figure 1).

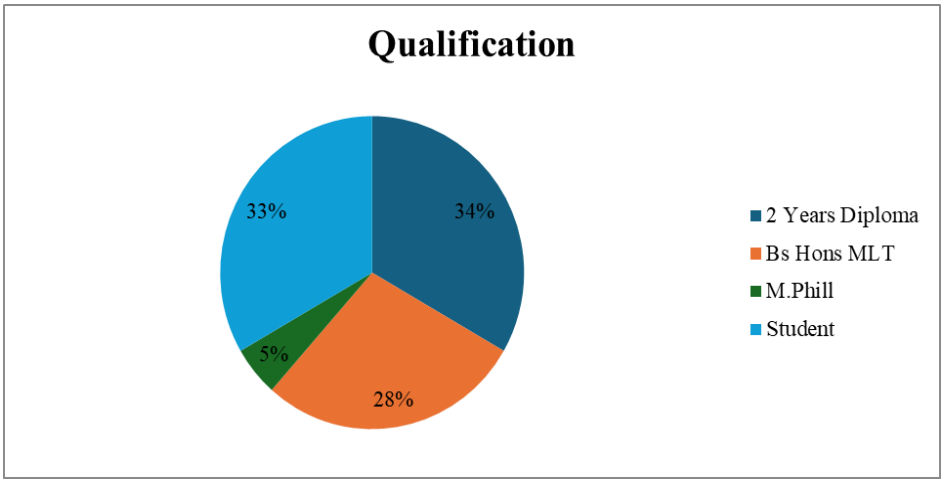

Figure 1: Qualification of the Participants

Of the 600 individuals in the trial, 295 experienced a needle stick injury (NSI). Figure 2 illustrates that the majority of affected professionals worked in public sector laboratories. A significant 70% of all NSIs occurred in government hospital labs, independent public labs, and practice laboratories of government institutes in Pakistan

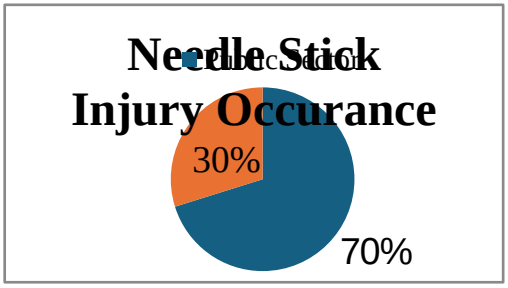

Figure 2: Percentage of Needle Stick Injury Occurrence in Public and Private Sector

The impact of workload on needle stick injuries (NSIs) was assessed based on their frequency and the number of jobs held by participants. Figure 3 indicates that 55% of the population held two jobs, while 45% had one, suggesting that multiple jobs may contribute to an increased risk of occupational injuries.

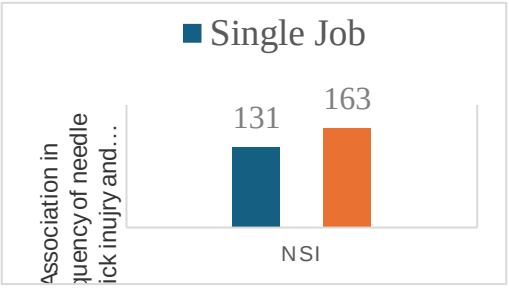

Figure 3:Association of Needle Stick Injury with Employment Status

Chi-square statistics were used to examine the association between the occurrence of needle stick injuries (NSIs) and various categorical variables. The significance of the association was assessed at $p \leq 0.05$. The results indicate a significant association ($p \leq 0.05$) between NSI occurrence and factors such as occupation (technologist, technician, or student), qualification (diploma, BS Hons, or higher), sector (public/private), number of jobs (single or multiple), knowledge of NSIs, knowledge of standard needle disposal, separation of needles from syringes, sharp box disposal, presence of a sharp box, working area at the time of NSI, use of gloves, and workload.

However, NSI incidence was not found to be significantly associated ($p > 0.05$) with gender, needle disposal methods, cause of NSI, or time of NSI, as shown in Table 3-2. These significant associations emphasize the need for targeted interventions to prevent NSIs.

Table 2: Association of Different Parameters with Needle Stick Injury

Variables	**p-value**
Gender	0.475
Occupation	0.000*
Qualification	0.000*
Sector	0.000*
No of jobs	0.022*
Knowledge of NSI	0.000*
Needle disposal	0.716
Knowledge of standard needle discarding	0.000*
Separation of needle from syringe	0.000*
Sharps box disposal	0.000*
Sharps box present	0.000*
Cause of NSI	0.415
Working area at the time of NSI	0.000*
Time of NSI	0.582
Use of gloves	0.000*
Workload	0.000*

The significance of *p* vale is ≤ 0.05.
* Significant results.

A detailed analysis of participants' data on needle stick injuries (NSIs) examined the relationship between workload, mishandling of sharps, overall work-related stress, and NSI occurrence. The findings indicate that most NSIs were associated with workload, which also serves as a direct indicator of an increased patient population and a shortage of healthcare professionals within a single setting. Additionally, mishandling of equipment and work-related stress were found to contribute equally to NSI occurrence, following workload as a primary factor (Figure 4).

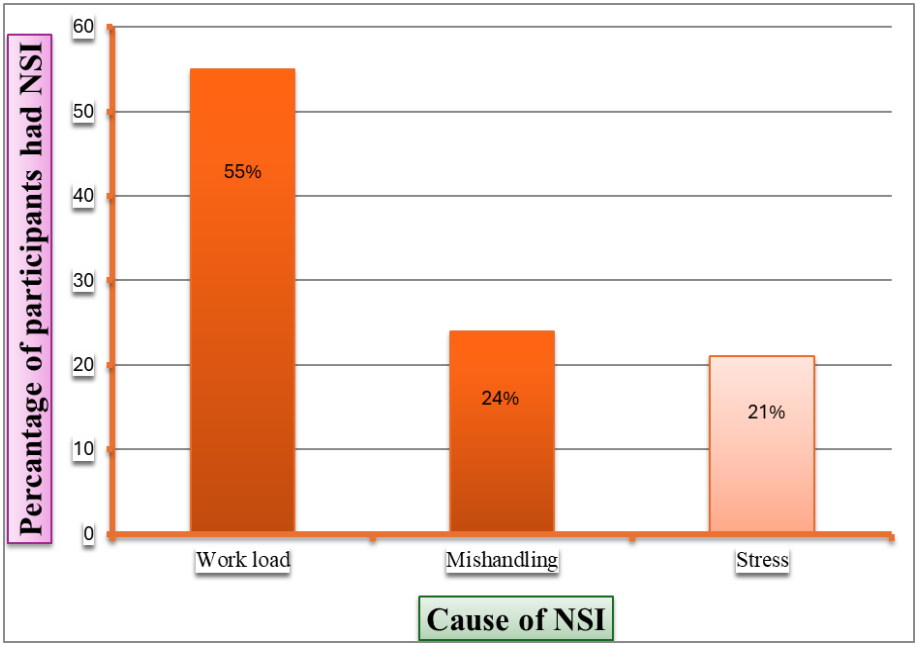

Figure 4: Cause of Needle Stick Injury Occurrence

Another significant factor was the timing of needle stick injuries (NSIs). Since healthcare facilities operate 24/7, NSI occurrence was analyzed based on participants' work shifts. The findings revealed that the majority of NSIs occurred during the morning shift. Although most participants could not recall the exact moment of injury, evening and night shifts had the lowest reported NSI cases. This aligns with the fact that the morning shift handles the highest volume of samples and patient interactions compared to other shifts.

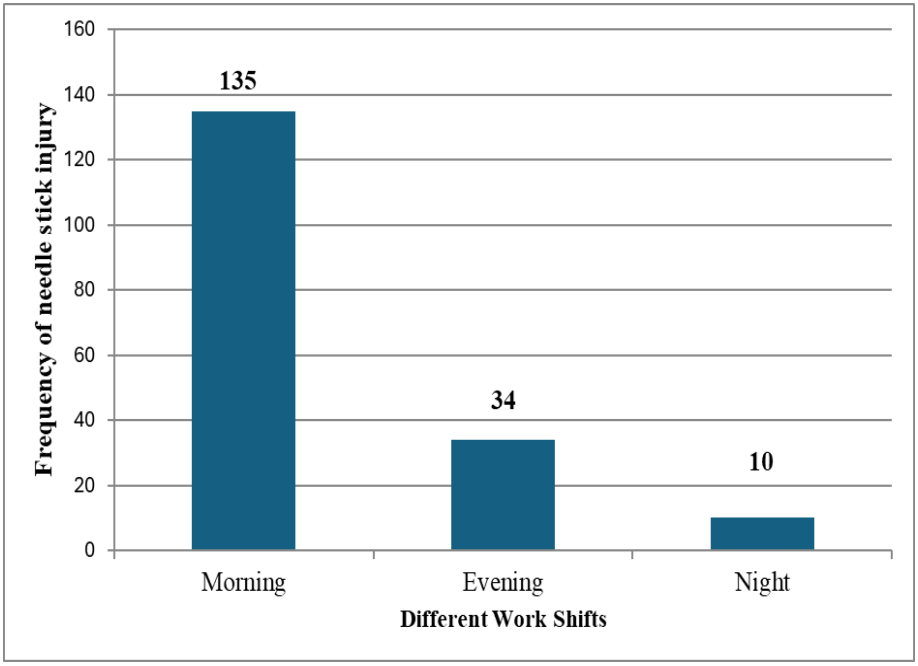

Figure 5: Needle Stick Injury Occurrence Frequency in Different Work Shifts

Lab professionals were employed across various divisions and sections, prompting an analysis of NSI occurrences based on the working area at the time of injury. The findings revealed that the phlebotomy area within the lab experienced the highest number of NSI incidents, followed by the chemistry department, blood bank, hematology department, and indoor sampling, while home sampling had the lowest incidence. The results indicate that most NSIs occurred in the phlebotomy area, where patient samples are collected directly using needles. In contrast, the lowest number of NSIs were observed in home sampling settings, where a trained phlebotomist visited patients at remote locations to collect samples. Among laboratory sections, the highest NSI occurrences were reported in the chemistry department, followed by blood banks and hematology sections (Figure 6).

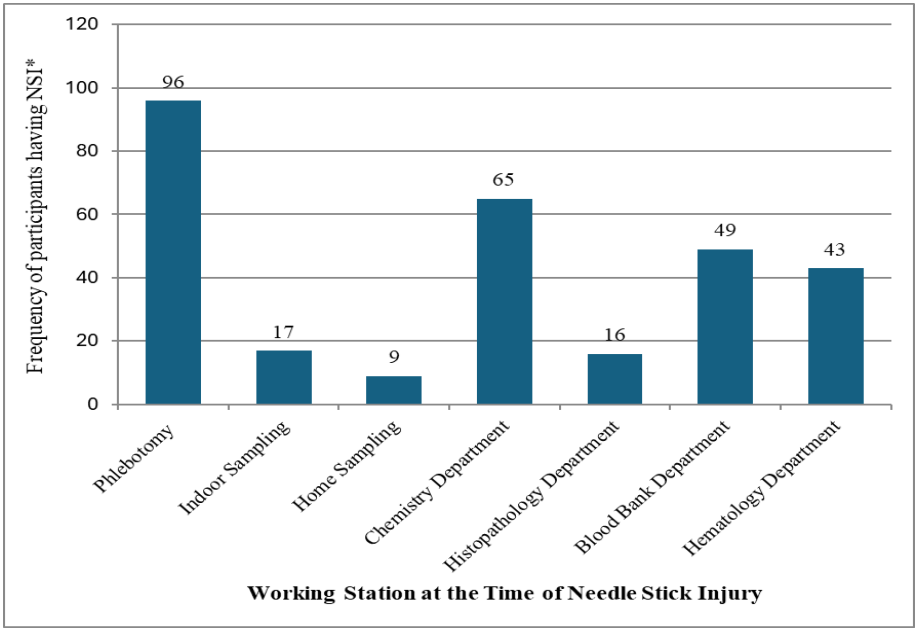

Figure 6: Frequency of Participants and Working Station at the Time of Needle Stick Injury

*NSI stands for needle stick injury.

Further analysis was conducted to assess the impact of education level on the occurrence of needle stick injuries (NSI). The findings revealed a significant difference ($p \leq 0.05$) in knowledge levels between diploma holders and participants with a BS degree or higher, particularly in areas such as NSI awareness, sharps box disposal, glove usage, needle disposal, and knowledge of NSI-transmissible diseases. However, other factors—including standard needle discarding, knowledge of separating needles from syringes, prophylactic awareness post-NSI, NSI reporting, post-NSI testing, and participation in NSI workshops—did not show a significant association ($p > 0.05$), as indicated in Table 3.

Table 3: Knowledge, Attitude, and Practice of Participants Regarding Needle Stick Injury with Different Education Levels

Variables	Diploma	BS and above	*P* Value		
	Yes	No	Yes	No	
	Frequency (%age)	Frequency (%age)	Frequency (%age)	Frequency (%age)	
Knowledge of NSI	41 (20.5%)	159 (79.5%)	259 (64.8%)	141 (35.3%)	0.000*
Use of gloves	126 (63.0%)	74 (37.0%)	293 (73.3%)	107 (26.8%)	0.000*
Needle disposal	176 (88.0%)	23 (11.5%)	357 (89.3%)	43 (10.8%)	0.007*
Knowledge of standard needle discarding	68 (34.0%)	132 (66.0%)	262 (65.5%)	138 (34.5%)	0.432
Knowledge of NSI transmissible diseases	112 (56.0%)	88 (44.0%)	228 (57.0%)	172 (43.0%)	0.000*
Knowledge of separation of needle from syringe	64 (32.0%)	136 (68.0%)	201 (50.3%)	199 (49.8%)	0.442
Sharps box disposal	100 (50.0%)	100 (50.0%)	219 (54.8%)	181 (45.3%)	0.000*
Prophylaxis awareness post NSI	116 (58.0%)	84 (42.0%)	232 (58.0%)	168 (42.0%)	0.156
Reporting of NSI	185 (92.5%)	15 (7.5%)	186 (46.5%)	214 (53.5%)	0.534
Post NSI testing	146 (73.0%)	54 (27.0%)	311 (77.8%)	89 (22.3%)	0.118
Workshop regarding NSI	118 (59.0%)	82 (41.0%)	233 (58.0%)	167 (41.0%)	0.466

* Significant results.

An analysis was conducted to assess laboratory professionals' knowledge, attitudes, and practices regarding needle stick injuries (NSI), comparing public and private sector lab standards. The results revealed a significant difference ($p \leq 0.05$) between the two groups in factors such as NSI awareness, glove usage, knowledge of needle discarding, NSI-transmissible diseases, needle-syringe

separation, sharps box disposal, NSI occurrence, reporting, post-NSI response, availability of sharps boxes, and hepatitis vaccination.

However, other factors—including multiple job roles, needle disposal methods, post-NSI prophylaxis awareness, filing NSI incident reports, post-NSI testing, and participation in NSI-related workshops—did not show a significant association.

Table 3: Knowledge, Attitude, and Practice of Participants from Different Lab Standards regarding Needle Stick Injury

Variables	Public		Private		*p* Value
	Yes	No	Yes	No	
	Frequency (%age)	Frequency (%age)	Frequency (%age)	Frequency (%age)	
Multiple jobs	131 (43.7%)	169 (56.3%)	124 (41.3%)	176 (58.7%)	0.310
Knowledge of NSI	97 (32.3%)	203 (67.7%)	203 (67.7%)	97 (32.3%)	0.000*
Use of gloves	125 (41.7%)	175 (58.3%)	294 (98.0%)	06 (2.0%)	0.000*
Needle disposal	269 (89.7%)	31 (10.3%)	264 (88.0%)	35 (11.7%)	0.343
Knowledge of needle discarding	68 (22.7%)	232 (77.3%)	262 (87.3%)	38 (12.7%)	0.000*
Knowledge of NSI transmissible diseases	194 (64.7%)	106 (35.3%)	146 (48.7%)	154 (51.3%)	0.000*
Knowledge of separation of needle from syringe	154 (51.3%)	146 (48.7%)	111 (37.0%)	189 (63.0%)	0.000*
Sharps box disposal	197 (65.7%)	103 (34.3%)	122 (40.7%)	178 (59.3%)	0.001*
NSI occurrence	207 (69.0%)	93 (31.0%)	88 (29.3%)	212 (70.7%)	0.000*
Prophylaxis awareness post NSI	175 (58.3%)	125 (41.7%)	173 (57.7%)	127 (42.3%)	0.467

Reporting of NSI	107 (35.7%)	193 (64.3%)	264 (88.0%)	36 (11.0%)	0.000*
Response after NSI	222 (74.0%)	78 (26.0%)	251 (83.7%)	49 (16.3%)	0.003*
Filing incident report after NSI	128 (42.7%)	172 (57.4%)	127 (42.3%)	173 (57.6%)	0.887
Sharps box presence	50 (16.7%)	250 (83.3%)	183 (61.0%)	117 (39.0%)	0.000*
Post NSI testing	234 (78.0%)	66 (22.0%)	223 (74.3%)	77 (25.7%)	0.169
Hepatitis vaccination	107 (35.7%)	193 (64.3%)	284 (94.7%)	16 (5.3%)	0.000*
Workshop regarding NSI	173 (57.7%)	127 (42.3%)	178 (59.3%)	122 (40.7%)	0.370

* Significant results.

4. DISCUSSION

Needle stick and sharps injuries (NSIs) are skin-piercing wounds caused by needles or other sharp objects, potentially exposing healthcare professionals and medical students to blood-borne pathogens such as hepatitis B, hepatitis C, and HIV/AIDS (12). NSIs are among the most common occupational health risks for healthcare workers (HCWs), with over 35 million HCWs worldwide experiencing more than two million sharp-related occupational exposures annually (13). The absence of personal protective equipment (PPE) and accidental needle stick injuries further increase the risk of contracting occupational blood-borne infections (14, 15). This study aims to assess the knowledge, attitudes, and practices (KAP) regarding needle stick injuries among laboratory professionals, considering different education levels and laboratory standards.

Out of 600 participants, 295 reported experiencing needle stick injuries (NSIs) in both private and government laboratories, highlighting a high prevalence in healthcare settings. Similar findings have been reported in other countries, including South Korea (70.4%) (16), Ethiopia (60.2%) (17), and Iran (42.5%) (18). This underscores the global nature of the problem, emphasizing the need for enhanced prevention strategies across diverse healthcare environments.

The study identified significant associations between NSI occurrence and factors such as knowledge of standard protocols, biosafety laws, job designation, qualifications, work area, employment status, availability of sharps boxes, and PPE usage. The higher prevalence of NSIs in public sector laboratories and among diploma holders is particularly concerning. Notably, only 20.5% of diploma holders demonstrated adequate knowledge of NSIs, highlighting the urgent need for targeted training programs for laboratory professionals. These findings align with research from Karachi, where NSIs were also prevalent among diploma holders (19). Moreover, existing studies have shown significant improvements in knowledge, attitudes, and practices related to NSI prevention—particularly in PPE use and safe sharps disposal—among individuals who received proper education and training (20, 21).

Although NSI-related workshops are conducted in public sector laboratories, this study found that NSI rates remain high, indicating a need for enhanced training quality and delivery. Strengthening training implementation is crucial for improving adherence to safety protocols. Notably, public institutions reported a higher prevalence of NSIs compared to private institutions, likely due to inadequate resources, long working hours, and insufficient PPE (22, 23). These factors increase the risk of needle stick injuries, as healthcare workers facing resource constraints and extended shifts may be more prone to accidental exposures (24).

The scarcity of gloves in public sector laboratories highlights a significant lack of proper PPE. Additionally, only 16.7% of public institutions had sharps boxes, underscoring critical material shortages in these settings. Although participants demonstrated knowledge of proper needle disposal, the absence of sharps containers hindered safe practices, increasing the risk of NSIs. Multiple studies have reported similar shortages of gloves and other PPE, reinforcing their direct link to the higher incidence of NSIs (25).

Although public laboratory professionals were aware of diseases transmissible through NSIs, only 35.5% had completed their hepatitis vaccination, placing them at higher risk of viral infections. This low vaccination rate is likely due to limited resources and infrequent vaccination campaigns (26). In contrast, a higher proportion of private laboratory professionals had received all three doses of the hepatitis B vaccine, reflecting better safety practices in the private sector (27).

Significant disparities were observed in NSI reporting and incident documentation between public and private institutions. While public sector laboratories conducted more frequent NSI testing (78%), only 35.7% of incidents were properly documented. This aligns with previous studies indicating severe underreporting of NSIs, often due to lack of awareness on reporting procedures or the perception that minor injuries do not require medical attention. (28, 29).

Increased workload emerged as a significant factor in NSI occurrence, with 55% of affected laboratory professionals attributing their injuries to high workload. This underscores the strain on overburdened healthcare systems, particularly in public sector laboratories, where economic constraints, human resource shortages, and rising population demands exacerbate the issue. Similar studies have also linked higher NSI rates to unmanageable workloads, highlighting the urgent need for better staffing policies and resource allocation. (30, 31).

Laboratory professionals with multiple jobs were found to be more susceptible to NSIs, primarily due to job-related stress and insufficient rest. This issue is particularly prevalent in low- and middle-income countries, where limited healthcare budgets force many professionals to work multiple shifts to meet financial needs (32, 33). Additionally, 96% of NSIs occurred in the phlebotomy area, a finding consistent with previous research identifying phlebotomy as a high-risk zone due to frequent needle usage and crowded working conditions (34). The highest incidence of NSIs was reported during early morning shifts, likely due to high patient volume and worker fatigue. This pattern aligns with existing literature, which links heavy workloads in morning shifts to an increased risk of injuries (35).

Preventing needle stick injuries (NSIs) among lab workers requires a multifaceted approach. First and foremost, strategies should focus on managing high workloads to alleviate stress and fatigue among lab personnel, particularly in public sector labs, where NSIs were found to be more prevalent.

To reduce the risk of NSIs among laboratory workers, a comprehensive strategy is needed. NSIs are a top priority, particularly in laboratories, with public sector labs experiencing higher prevalence, underscoring the need to reduce workloads and manage stress. Education and training programs specifically targeting lower-qualified laboratory workers should include proper

PPE use and safe needle-handling techniques. The existing safety mechanisms in public sector laboratories must be enhanced, and the necessary provision of safety instruments must be ensured.

Further, there is a need to introduce sharps injury prevention programs that encourage the use of safety-engineered devices and proper disposal practices. Safety protocols could be reinforced through regular seminars and refresher courses, emphasizing their practical application. Finally, recognizing laboratories with low NSI rates and rewarding them could encourage a culture of safety and drive improvement in all laboratories.

5. CONCLUSION

The study found that the overall needle stick injury (NSI) rate was 49.1% among the studied population. Several knowledge gaps were identified among healthcare workers (HCWs), particularly regarding the risks associated with NSIs and the implementation of preventive measures. Notably, there were no established policies, training programs, or continuing education initiatives focused on NSI prevention techniques, highlighting the need for more structured interventions to enhance awareness and practice.

Significant variations in knowledge, attitudes, and practices were observed across different educational levels and laboratory standards. To bridge these gaps, the study recommends targeted interventions, including workshops, training programs, and policy implementations. Additionally, fostering a safety-oriented culture, conducting regular seminars, and integrating safety-engineered devices were identified as key strategies to reduce NSI incidence among laboratory professionals.

Ultimately, improving knowledge, attitudes, and practices surrounding NSIs requires a multi-faceted approach, considering factors such as educational background, gender variations, and the unique challenges associated with different lab environments.

6. LIMITATIONS

While our study provides compelling data on the diagnostic accuracy of VIA and Pap smear, it is limited by its single center design, which may not reflect all demographics in Pakistan. Furthermore, histopathology was used as the sole

confirmatory method, which may limit generalizability, as VIA results could vary by examiner experience and lighting conditions.

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