

Laboratory employees' awareness, attitudes, and practices about safety precautions*

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Abstract

Background:

Laboratory employees are at high risk for occupational hazards, including biological, chemical, and physical dangers. Insufficient knowledge of safety measures can lead to increased exposure to infections, accidents, and toxic substances. Understanding the awareness, attitudes, and practices of laboratory workers regarding safety precautions is crucial to improving workplace safety and minimizing risks.

Methods:

This study was conducted among 200 postgraduate laboratory technicians . Participants completed a self-administered questionnaire assessing demographic data, knowledge of occupational hazards, and adherence to safety practices. The questionnaire included sections on general administrative measures, personal protective measures, standard operating procedures, and laboratory work environment safety. Data were analyzed using SPSS, and logistic regression was performed to identify predictors of knowledge and safety practices.

Results:

The average knowledge score was 30.8, with fewer than half of participants demonstrating adequate knowledge (47.2%). Compliance with safety practices was generally high, with 77% adhering to general administrative measures and 71.3% following personal protective measures. Knowledge of occupational hazards was significantly associated with age, gender, education, and years of employment ($p < 0.05$). Higher knowledge scores correlated with better safety practices across all domains. Chemical hazards were the most frequently reported occupational risks (55.6%).

Conclusion:

The study revealed that laboratory personnel have inadequate knowledge of occupational health and safety measures. Knowledge levels were influenced by factors such as age, education, and tenure, and were strong predictors of adherence to safety protocols. Addressing these gaps through targeted educational interventions could significantly improve safety practices and reduce occupational risks.

Introduction

Healthcare workers, particularly those in hospital laboratories, face numerous occupational hazards. Individuals handling clinical specimens, such as blood, tissue, or body fluids, are at significant risk of contamination and infection. These samples, along with medical waste, represent major biological threats, often serving as sources of infection for laboratory personnel (Kaplan and Emin, 2018). Beyond infections, exposure to chemicals, gases, and solvents can result in dangerous situations such as fires, toxic exposures, or explosions if safety protocols are not rigorously followed (Nisii et al., 2009). Additional risks include physical injuries like cuts, burns from corrosive substances, and electrical shocks, which are also common in laboratory environments (Tohda, 2016).

Laboratory hazards are broadly categorized into biological, chemical, physical, electrical/mechanical, and psychological risks (Akagbo et al., 2017). The primary source of these occupational dangers stems from improper handling of tasks and insufficient precautionary measures in laboratory settings (Sewunet et al., 2014). Reports indicate that nearly two-thirds of laboratory workers encounter at least one biological hazard, commonly bacteria or parasites (Tait et al., 2018). The likelihood of exposure is exacerbated by inadequate safety infrastructure, such as the lack of biosafety cabinets, safety manuals, and protective equipment.

A critical factor in mitigating these risks is the level of knowledge and awareness among laboratory staff regarding occupational hazards and the appropriate responses in case of incidents (Shekhar et al., 2015). Poor safety awareness and improper handling during sample collection, processing, and disposal significantly increase the risk of exposure to infectious agents (Shafiq et al., 2019).

Promoting occupational safety and implementing preventive measures are essential for maintaining the physical, mental, and social well-being of laboratory workers in all professional settings (Reda et al., 2021). Research has shown that safety practices and knowledge among laboratory technicians can be improved through educational interventions, addressing gaps in their awareness and practices (El-Gilany et al., 2017). Therefore, assessing the knowledge, attitudes, and practices of hospital laboratory staff regarding occupational safety and identifying factors influencing these aspects are critical for reducing workplace hazards (Senthil et al., 2015).

Materials and Methods

The study targeted postgraduate laboratory technicians enrolled. A total of 200 individuals were eligible, An Arabic, semi-structured, self-administered questionnaire was used, divided into three main sections:

1. **Demographic and Occupational Data:**

Information collected included age, gender, education level, marital status, workplace setting (e.g., university or public hospital), work experience, additional private laboratory work, history of Hepatitis B vaccination, and the type and severity of occupational health risks encountered.

2. **Knowledge of Occupational Hazards:**

This section assessed awareness of workplace risks and preventive measures using eight items adapted from previous literature (Alqam, 2013). Topics covered included knowledge about occupational health, recognition of workplace hazards, understanding how exposure occurs, and familiarity with safety protocols. Respondents also evaluated their ability to identify issues, take preventive action, and report problems.

3. **Safety Practices:**

Based on Occupational Safety and Health Administration (OSHA) guidelines (2011), this section assessed safety measures across four domains:

- **General Administrative Measures:** Ensuring only authorized personnel access the laboratory.
- **Personal Protective Measures:** Compliance with seven safety items, such as wearing protective clothing and equipment, maintaining proper hygiene, and avoiding eating or drinking in laboratory areas.
- **Standard Operating Procedures:** Adherence to three critical rules, such as avoiding mouth pipetting and minimizing the generation of aerosols or splashes.
- **Laboratory Work Environment:** Maintenance of a clean workspace, proper decontamination of surfaces, appropriate handling and disposal of contaminated materials, and effective use of disinfectants. Each item was rated on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). Scores of 4 or higher were considered indicative of adequate knowledge or compliance. Aggregate cutoff points for knowledge and practices were determined by summing scores for each domain.

Data Analysis:

Data were analyzed using SPSS software (version 22). Descriptive statistics included means, standard deviations, medians, and ranges for quantitative data, while qualitative variables were reported as frequencies and percentages. The chi-squared test was applied for categorical variables. Binary forward Wald logistic regression was employed to identify independent predictors of knowledge and practice. Variables showing statistical significance in the bivariate analysis were included in the regression model. Adjusted odds ratios (AORs) with 95% confidence intervals were calculated, and a p-value ≤ 0.05 was considered statistically significant.

Results

The average score for knowledge of occupational health was 30.8. Fewer than half of the laboratory technicians surveyed demonstrated good knowledge levels (47.2%). Mean (SD) scores for safety domains were as follows: general administrative measures at 4.06 (0.7%), personal protective measures at 29.7 (3.6%), adherence to standard procedures at 12.2 (2.09%), and maintaining a safe laboratory environment at 21.02 (2.4%). The majority of participants showed high compliance with safety measures, including general administrative guidelines (77%), personal protection (71.3%), standard practices (59%), and laboratory safety (72.5%) (Table 1).

The average age of participants was 35.7 years, with nearly half (48.9%) being male. Approximately two-thirds (62.9%) reported receiving the Hepatitis B vaccine. Most participants (80.3%) had diploma qualifications and were employed in health facilities. Nearly two-thirds (58.4%) had professional experience spanning less than 15 years (results not displayed in tables).

Significant differences in knowledge of occupational health were observed based on age, gender, education level, and years of employment ($p < 0.05$). Higher knowledge scores were associated with individuals aged 35 years or older, males, those with specialized training, and employees with longer tenure. Regression analysis revealed that older participants (≥ 35 years) were 3.8 times more likely to have good knowledge (AOR, 95% CI: 1.9–7.7), and those with advanced education or specialty training were nearly six times more likely (AOR, 95% CI: 5.9, 2.06–17.02) (Table 2).

For safety practices, general measures differed significantly by age and knowledge levels ($p < 0.05$). Compliance with lab safety measures, adherence to standard operating procedures, and use of personal protective equipment also varied significantly with age, education, employment duration, and knowledge levels ($p < 0.05$).

Logistic regression indicated that having good knowledge (≥ 32) significantly improved safety practices in all domains, including general measures, lab environments, standard procedures, and personal protection ($p < 0.05$): AOR, 95% CI: 5.1 (2.2–11.9), 3.9 (1.7–8.7), 5.0 (2.3–10.7), and 3.1 (1.4–7.1), respectively. Additionally, males, individuals with higher education, and those employed for 15 years or more were more likely to follow standard operating procedures ($p < 0.05$): AOR, 95% CI: 2.4 (1.2–5.0), 3.0 (1.2–8.02), and 2.2 (1.0–4.7), respectively. Personal protection practices were particularly influenced by longer employment durations ($p < 0.05$): AOR, 95% CI: 3.06 (1.2–7.4).

The most frequently reported occupational risks were chemical hazards (55.6%), followed by ergonomic (19.7%) and biological hazards (14%). Chemical hazards were identified as the most common moderate-risk hazard (31.5%), followed by biological risks (24.2%). Severe hazards were also predominantly chemical in nature (38.2%), with biological hazards accounting for 5.6% of reports. These findings were based on subjective self-assessment using a Likert scale (1–5) to classify the severity of hazards.

Table (1): Occupational Health Knowledge and Practice of Safety Measures Among Studied Lab Technicians

Aspect	Average Scores	Mean (SD)	Min-Max	Levels	Good No. (%)	Bad No. (%)
Knowledge of occupational hazards (8 items)		30.8 (6.4)	16-40		84 (47.2)	94 (52.8)
Safety measures						
General administrative measures (1 item)		4.06 (0.7)	2-5		137 (77.0)	23 (23.0)
Personal protection (7 items)		29.7 (3.6)	21-35		127 (71.3)	51 (28.7)
Standard procedures (3 items)		12.2 (2.09)	6-15		105 (59.0)	73 (41.0)
Lab work area (5 items)		21.02 (2.4)	15-25		129 (72.5)	49 (27.5)

NB: Level of knowledge and safety was estimated according to certain cutoff points.

Table (2): Factors Associated with Good Knowledge of Occupational Health Hazards, Pattern of Exposure, and Prevention

Factor	Adjusted OR (95% CI)	Test of Significance χ^2	p-value	Good No. (%) (≥ 32)	Overall No. (%)
Knowledge					
Total score	3.8 (1.9-7.7)	28.7	<0.001*	84 (47.2)	178
Age					
≤ 35 (r)	15.1	-----	<0.001*	54 (62.1)	87 (48.9)
>35				30 (33.0)	91 (51.1)
Gender					
Male	5.9 (2.06-17.02)	25.9	<0.001*	54 (37.8)	143 (80.3)
Female (r)				30 (85.7)	35 (19.7)
Education					
Diploma (r)	0.8	-----	0.3	64 (45.4)	141 (79.2)

Specialty training				20 (54.1)	37 (20.8)
Type of hospital					
MOH (r)	27.07	-----	<0.001*	32 (30.8)	104 (58.4)
University hospital				52 (70.3)	74 (41.6)
Duration of employment					
<15 years (r)					
≥15 years					

#: Column percent is considered

##: Row percent is considered

AOR: Adjusted Odds Ratio

r: Reference group

* Statistically significant

Discussion

Medical laboratories are inherently risky workplaces due to the presence of biological, physical, and chemical hazards. Although laboratory personnel often have a general awareness of workplace safety protocols, there are notable gaps in their attitudes and practical application of these measures.

The participants in this study had an average age of 35.7 years, with a little over half (51.1%) being women. Most participants (58.4%) had less than 15 years of professional experience. Similar trends have been reported in prior research, such as Mahmoud and Sabry (2019), who observed that the majority of lab workers in their study were aged between 30 and 40 years. However, discrepancies were noted regarding gender distribution, as other studies have indicated a higher prevalence of male laboratory workers. Conversely, Abode (2013) found that a majority of laboratory workers were women, with most having less than 10 years of experience.

In this study, nearly 80% of the laboratory staff held diplomas, and most worked in academic hospital settings (79.2%). These findings align with prior studies, including Awad (2017), which reported that over half of the surveyed lab workers had secondary education, with a minority holding higher qualifications. Similarly, research from Kenya by Misra et al. (2001) found that a majority of participants had at least a diploma.

Hepatitis B vaccination coverage among participants was approximately 62%, consistent with findings by Fateen et al. (2021), who reported a similar vaccination rate among pathology staff in other healthcare settings.

Knowledge about occupational health among the laboratory workers was moderate, with an average score of 30.8. Less than half (47.2%) demonstrated good knowledge. In a comparable study conducted in India, Zaveri (2012) found poor levels of knowledge, attitudes, and compliance with safety protocols, with only 20.8% of participants exhibiting positive knowledge.

The current study observed good safety practices among laboratory staff. This finding aligns with a study in Yemen by Al-Abhar et al. (2017), which reported that 38% of laboratory personnel had good knowledge and 32% demonstrated good safety practices.

Significant differences in knowledge scores were observed based on age, gender, education level, and employment duration. Older workers (≥35 years), men, those with master's degrees, and those with more than 15 years of experience exhibited higher knowledge scores. These results are supported by Mahmoud and Sabry (2019) and Zenhom et al. (2012), who highlighted that years of experience and participation in training programs positively influence knowledge and performance levels.

Safety practice scores were significantly higher among older participants and males, as well as those with longer employment durations. This may be attributed to males being more involved in technical roles and private laboratory work, which necessitates greater awareness of safety protocols. Conversely, women might take breaks from work, such as for maternity leave, resulting in less practical experience. However, these findings contrast with Netto and Rahmawati (2017), who reported that women exhibited better knowledge and practices related to occupational hazards.

Education and knowledge emerged as significant predictors of good safety practices. Al-Abhar et al. (2017) similarly noted that higher education levels correlate with improved safety knowledge and practices, potentially due to increased exposure to training opportunities. However, some studies, such as Thirunavukkarasu et al. (2021), reported no significant association between safety practices and demographic factors like gender, education, and experience.

Chemical hazards were the most frequently reported occupational risks (55.6%), followed by ergonomic (19.7%) and biological risks (14%). These findings align with studies conducted on research laboratory workers, such as

Papadopoli et al. (2020), who found that over half of participants were exposed to chemical risks. Nasrallah et al. (2022) also reported high exposure rates to chemical hazards, particularly through inhalation, among scientific laboratory workers, with women being more prone to accidents.

The most common moderate-severity occupational hazard reported was chemical exposure (31.5%), followed by biological hazards (24.2%). Severe hazards were also predominantly chemical in nature (38.2%), consistent with findings by Alqam (2013), who identified biological and chemical hazards as the most severe risks in laboratory settings.

Conclusion

Fewer than half of the laboratory personnel demonstrated adequate knowledge of occupational health and safety measures. Knowledge levels were significantly associated with age, education, and employment duration, and were strong predictors of good safety practices.

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