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A Study On The Relationship Between Chemical Safety Awareness And Laboratory Practices

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Abstract

Chemical safety is an essential component of laboratory work, particularly where users handle substances that may be toxic, corrosive, flammable, or reactive. This study examined the relationship between chemical safety awareness and laboratory practices among laboratory users. A quantitative research design was adopted, and data were collected from 270 respondents using a structured questionnaire based on a five-point Likert scale. Descriptive statistics were used to examine the responses, while Pearson correlation and ANOVA were applied to test the hypotheses. The findings revealed a very strong positive relationship between chemical safety awareness and laboratory practices, with a Pearson correlation coefficient of 0.974 and a significance value of 0.000. The ANOVA results also showed a statistically significant association with the adoption of safe laboratory practices (F = 231.953, p = 0.000). The findings highlight the importance of strengthening chemical safety awareness through regular training, appropriate safety procedures, proper chemical handling, and effective laboratory safety practices.

Keywords; Chemical Safety Awareness, Laboratory Practices, Chemical Handling, Safety Behaviour, Laboratory Users

INTRODUCTION

Chemical laboratories are important settings for teaching, research, testing, and industrial development. Laboratory activities frequently involve chemicals that may be toxic, corrosive, flammable, reactive, or harmful to human health and the environment when handled improperly (Tirupati, 2023). Therefore, awareness of chemical safety is an important part of responsible laboratory work. Safety awareness includes knowledge of chemical hazards, proper handling procedures, labeling, storage, use of protective equipment, waste disposal, and emergency measures (Papadopoli et al., 2020a; Ribeiro et al., 2025). However, having knowledge of safety procedures does not necessarily ensure that individuals follow them consistently during laboratory activities. Actual laboratory practices may also be influenced by training, experience, availability of safety equipment, workplace conditions, and individual behaviour (Ramos & Santos, 2026).

Understanding the connection between safety awareness and laboratory practices is therefore important for improving laboratory safety. Examining this relationship can help identify areas where safety knowledge is adequately reflected in practice and where additional training or preventive measures may be required.

Importance of Chemical Safety in Laboratory Work

Chemical safety is an essential part of laboratory work because chemistry involves the handling of substances that can undergo hazardous reactions or cause harmful effects through exposure. Acids, bases, oxidising agents, reducing agents, solvents, toxic compounds, and reactive chemicals require appropriate handling according to their chemical properties. Inadequate safety practices may result in chemical burns, poisoning, fire, explosions, incompatible chemical reactions, or environmental contamination (Bharadwaj, 2022).

From a chemistry perspective, safety depends on understanding the properties, reactivity, concentration, and compatibility of chemicals before their use. Proper laboratory practices also help maintain the accuracy and reliability of experimental work by preventing contamination, uncontrolled reactions, and improper storage conditions.

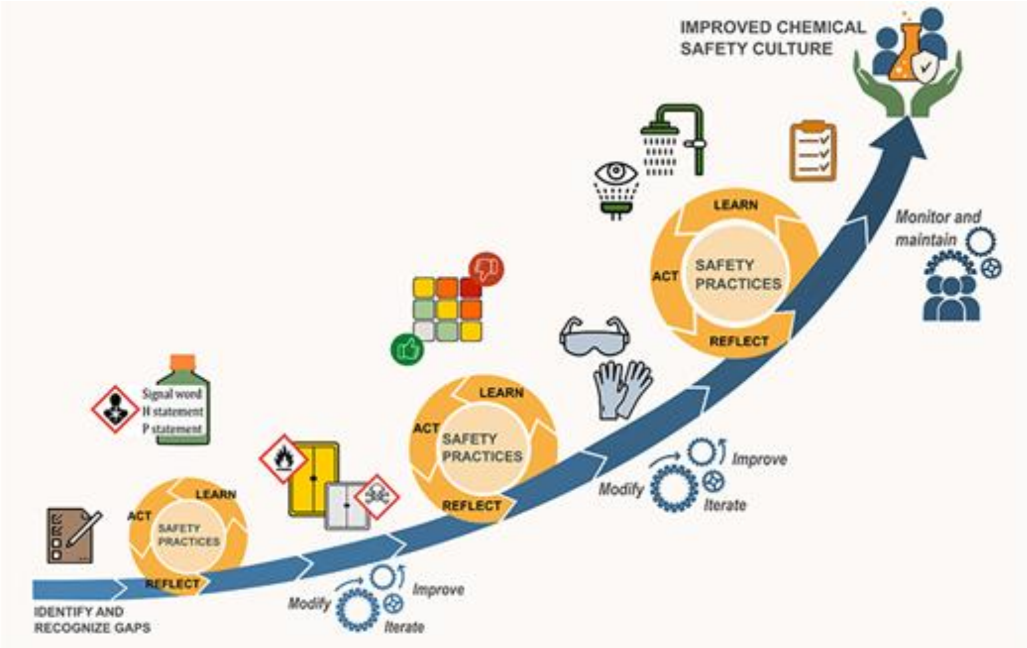

Figure:1 Laboratory Chemical Safety Practices

Source: https://pubs.acs.org/achsc5/article-abstract/33/1/73/5081546/Improving-Laboratory-Chemical-Safety-Practices?redirectedFrom=fulltext

The importance of chemical safety in laboratory work can be understood through the following points (Dini et al., 2021):

i. **Prevention of chemical exposure:** Proper handling reduces the risk of inhalation, ingestion, skin contact, and accidental exposure to hazardous substances.

ii. **Control of chemical reactions:** Knowledge of chemical compatibility helps prevent unwanted reactions between incompatible substances, particularly during mixing, heating, dilution, and storage.

iii. **Prevention of fire and explosions:** Appropriate handling of flammable solvents, oxidising substances, and reactive chemicals reduces the possibility of fire and explosive incidents.

iv. **Protection from corrosive substances:** Correct procedures for handling strong acids and bases help prevent chemical burns and damage to laboratory equipment.

v. **Proper chemical storage:** Chemicals should be stored according to their properties and compatibility to prevent leakage, decomposition, reaction, or accidental mixing.

vi. **Safe use of laboratory equipment:** Proper procedures during heating, distillation, extraction, and other chemical operations reduce the risk of accidents.

vii. **Effective chemical waste management:** Appropriate segregation and disposal of chemical waste help prevent hazardous reactions, exposure, and environmental pollution.

viii. **Protection of experimental integrity:** Safe and controlled laboratory conditions reduce contamination and unintended chemical changes that may affect experimental results.

ix. **Emergency preparedness:** Knowledge of spill response, eyewash facilities, safety showers, fire-control measures, and first-aid procedures enables timely action during chemical incidents.

x. **Responsible laboratory practice:** Chemical safety promotes careful observation, accurate handling, and disciplined working habits among students, researchers, technicians, and laboratory personnel.

Chemical Safety Awareness

Chemical safety awareness refers to the knowledge and understanding of the hazards associated with chemicals and the precautions required for their safe use (Ramos & Santos, 2026). In a chemistry laboratory, this awareness involves recognising chemical properties such as toxicity, corrosiveness, flammability, reactivity, volatility, and incompatibility (Papadopoli et al., 2020b). It also includes understanding hazard labels, safety information, appropriate personal protective equipment, safe handling methods, storage requirements, and emergency procedures.

A person with adequate chemical safety awareness is better prepared to identify potential risks before beginning an experiment and to select appropriate precautions according to the substances and procedures involved.

Chemical safety awareness extends beyond knowing individual laboratory rules. It involves applying chemical knowledge to practical situations where the behaviour of substances can change according to concentration, temperature, pressure, reaction conditions, and interaction with other materials (Alkhayri et al., 2023). For example, knowledge of acid–base reactions is important when diluting concentrated acids, while awareness of oxidation and reduction processes is relevant when handling oxidising or reducing agents. Similarly, understanding the volatility and flammability of organic solvents is necessary when using them near ignition sources. Awareness of chemical compatibility is particularly important during storage and waste disposal because incompatible substances may react even when they are not being used experimentally (Walters & Nigel, 2017).

Table:1 Major Components of Chemical Safety Awareness

Component	Chemistry-Based Safety Understanding
Chemical hazard identification	Recognition of toxic, corrosive, flammable, reactive, oxidising, and other hazardous properties
Chemical properties	Understanding toxicity, volatility, reactivity, concentration, stability, and physical state
Chemical compatibility	Knowledge of substances that may react dangerously when mixed or stored together
Hazard labelling	Ability to interpret chemical labels, hazard symbols, warnings, and precautionary information
Personal protective equipment	Knowledge of appropriate gloves, laboratory coats, goggles, face protection, and respiratory protection where required
Safe chemical handling	Understanding correct methods for transferring, mixing, heating, diluting, and using chemicals
Chemical storage	Awareness of storage requirements based on chemical properties and compatibility
Emergency response	Awareness of appropriate action during chemical spills, exposure, fire, or accidental reactions

Thus, chemical safety awareness provides the scientific basis for making appropriate decisions during laboratory work and contributes to safer handling, controlled experimentation, and prevention of avoidable chemical incidents.

LITERATURE REVIEWS

(Wang et al., 2025) Chemical labs, which are essential for scientific advancement, are inherently dangerous places to work. Significant safety concerns arise from the presence of combustible, explosive, and corrosive compounds in conjunction with high-pressure and high-temperature environments. Mishaps pose a threat to the well-being of workers, but they may also ruin machinery, pollute the environment, and have far-reaching consequences for society as a whole. A comprehensive strategy including all parties is required to guarantee a risk-free laboratory setting. Managers at all levels of an organization are responsible for creating and enforcing safety management systems that address all aspects of chemical storage, equipment handling, and garbage disposal. It is crucial for laboratory directors to supervise the application of these procedures and make sure that all members are properly educated and follow the rules. As direct operators, laboratory staff have a special responsibility to follow all safety protocols, wear protective gear, and properly dispose of experimental waste. Laboratories can protect themselves, their research sites, and the public from harm while making advances in science if they promote a culture of safety and teamwork.

(Mugivhisa et al., 2020) The purpose of the study was to assess the level of understanding among graduate students in the fields of biology, chemistry, and biochemistry on the precautions to take and dangers posed by harmful substances used in laboratory work. A total of eighty-three questionnaires were distributed as part of the exploratory research. Laboratory safety instruction was provided to the majority of students (78%), yet only 34% were able to recognise all the warning signals connected with dangerous compounds. Wearing buttoned lab coats (74%), closed shoes (78%), latex gloves (43%), properly disposing of waste in trash cans (10%), and checking warning labels on chemical containers before use (54%), while fume cupboards were used by only 25% of students. Of those who were asked, 72% were prepared for an emergency, while 28% had no idea what to do. Even while students still struggled to follow safety procedures, they understood the hazards of working with chemicals and were familiar with the warning signals that should have been there all along. Constant instruction on proper laboratory safety procedures, as well as frequent reminders in the form of safety charts, were considered necessary by the vast majority of participants.

(Al-zyoud et al., 2019) The research aimed to examine how undergraduates in the Biomedical Engineering and Pharmaceutical and Chemical Engineering programs at the German Jordanian University in Jordan felt about the safety of chemicals in the lab. A total of 174 students were randomly selected to participate in the anonymous cross-sectional survey. Demographic information, knowledge of chemical danger indicators, attitude toward chemical laboratory safety, safety procedures, and emergency equipment and procedure were the five areas that comprised the 32-question questionnaire. According to the descriptive statistics, the pupils' knowledge and comprehension of chemical danger warning signs were fair to excellent. The majority of students expressed neutral or negative views on the importance of chemical lab safety, but when asked to rate their own safety procedures, most said they were competent. The university's students had a passable level of safety knowledge and practice, but they lacked a professional safety education program and an organised approach to managing risks and creating a safe environment.

(Esmaeili et al., 2025) The analytical modelling research was carried out in 2024 with 360 participants representing four sizes of chemical enterprises: micro, small, medium, and big. We used standardised questionnaires to gather data. Analysis of the data was carried out using SPSS version 26. A mediating role analysis was conducted in AMOS v.24 using structural equation modelling (SEM), and model fit was evaluated using indices including CFI, RMSEA, and χ^2/df. Findings showed that small businesses rely heavily on informal training (84.62%), and that most people aren't acquainted with less prevalent pictograms such dangerous products (80.56% unfamiliarity). Enterprise size was shown to have a substantial impact on safety knowledge and awareness levels, according to data analysis ($P < 0.001$). Micro and small businesses had the lowest levels of knowledge (27.08 ± 3.05) and safety behaviour (3.65 ± 0.53) compared to large organisations. Large firms had a substantially greater risk perception (3.94 ± 0.26) than small (3.65 ± 0.33) and micro-enterprises (3.33 ± 0.36; $P < 0.001$). Through path analysis, it was shown that risk perception is a key mediator that enhances the connection between safety knowledge, GHS awareness, and safety behaviours (β = 0.203, $P < 0.001$). There is an immediate need for focused interventions to improve chemical safety at all organisational levels, and this study fills a knowledge gap by examining the processes through which important chemical safety variables interact. These interventions could include standardised bilingual labels, digital technology integration, and realistic hazard simulations.

(Sonawane et al., 2023) In order to assess the extent to which chemistry students at Jai Hind Educational Trust (JET), Z. B. Patil College (Dhule, India), and Concord University (Athens, West Virginia, USA) were knowledgeable about chemical safety and to raise awareness among their peers, an online survey was administered during the 2020–2021 academic year. The poll, which included 20 questions addressing three criteria: basic danger warning sign recognition, safety knowledge and attitudes, and chemical laboratory safety procedures, included 221 students as participants. Nearly all kids (97 percent) were aware of and had received instruction on safety protocols at their particular schools, according to the poll. Nevertheless, a considerable portion of the student body needs more instruction on the proper treatment of general chemical waste since they did not adhere to the safety protocols, which include donning a lab coat, goggles, and closed-toe shoes. The institutions were found to have a statistically significant link with some of the survey items after comparing them. Thorough examination of these findings demonstrated that instructors and institutional regulations significantly impact student perspectives on chemical safety and practices. The study's findings inform the proposal of potential solutions to these shortcomings.

RESEARCH GAP

The reviewed studies establish that chemical safety knowledge, hazard awareness, training, and institutional safety systems are important aspects of laboratory safety. However, the existing literature also reveals a gap between awareness and the consistent adoption of safe laboratory practices. Mugivhisa et al. (2020) found that although postgraduate students were generally aware of chemical hazards and many had received safety training, adherence to several safety practices remained inadequate. Similarly, Sonawane et al. (2023) reported that students had received safety training but continued to show deficiencies in the use of protective equipment, identification of hazard symbols, and chemical waste handling. Al-zyoud et al. (2019) also identified differences between students' awareness, attitudes, and actual safety practices, indicating that knowledge alone may not fully explain laboratory safety behaviour. More recent work by Esmaeili et al. (2025) examined the relationships among safety knowledge, risk perception, GHS awareness, and safety behaviour, particularly across different sizes of chemical enterprises, while Wang et al. (2025) emphasized the importance of coordinated safety management, training, compliance, and responsible laboratory practices. Nevertheless, much of the existing research has focused on particular student groups, specific institutions, or industrial settings, with comparatively less emphasis on examining the direct relationship between chemical safety awareness and laboratory practices among laboratory users as a broader respondent group. There is also limited empirical attention to how awareness is reflected in routine practices such as chemical handling, storage, waste disposal, emergency response, and the consistent adoption of safety procedures. Therefore, a focused empirical examination of these dimensions can provide further evidence on the extent to which chemical safety awareness is associated with laboratory practices and the adoption of safe laboratory behaviour.

OBJECTIVES OF THE STUDY

1. To assess the level of chemical safety awareness among laboratory users.
2. To examine the laboratory safety practices followed by laboratory users.
3. To identify the major areas of chemical safety awareness related to laboratory practices.
4. To examine the relationship between chemical safety awareness and laboratory practices.
5. To identify whether chemical safety awareness significantly influences the adoption of safe laboratory practices.

HYPOTHESES OF THE STUDY

H_{01}: There is no significant relationship between chemical safety awareness and laboratory practices among laboratory users.

H_{02}: Chemical safety awareness does not significantly influence the adoption of safe laboratory practices among laboratory users.

RESEARCH METHODOLOGY

The study adopted a quantitative research design to examine the relationship between chemical safety awareness and laboratory practices among laboratory users. The study was conducted among 270 respondents comprising students, research scholars, teachers or faculty members, laboratory technicians, and researchers engaged in different areas of laboratory work. Data were collected through a structured questionnaire consisting of demographic information and five-point Likert-scale statements covering chemical safety awareness, laboratory practices, and adoption of safe laboratory practices. The responses were measured using a scale ranging from Strongly Agree (1) to Strongly Disagree (5). The collected data were analysed using descriptive and inferential statistical techniques. Frequencies and percentages were used to describe the profile of the respondents, while mean and standard deviation were used to assess responses to the study variables. Pearson correlation was applied to examine the relationship between chemical safety awareness and laboratory practices, and ANOVA was used to examine the statistical significance associated with the adoption of safe laboratory practices. The hypotheses were tested at the 0.01 level of significance.

Methodological Component	Description
Research Design	Quantitative research design
Sample Size	270 laboratory users
Data Collection Instrument	Structured questionnaire
Measurement Scale	Five-point Likert scale: Strongly Agree = 1 to Strongly Disagree = 5
Major Variables	Chemical Safety Awareness, Laboratory Practices, Adoption of Safe Laboratory Practices
Data Analysis	Frequency, Percentage, Mean, Standard Deviation, Pearson Correlation and ANOVA
Level of Significance	0.01
Hypothesis Testing	Pearson correlation and ANOVA

DATA ANALYSIS AND INTERPRETATION

The data collected from 270 respondents were systematically analysed to examine chemical safety awareness and laboratory practices. Descriptive and inferential statistical techniques were used to present the responses and examine the relationships among the major study variables. The findings are presented and interpreted in accordance with the nature of the data and the statistical tests applied.

Table:2 Age

Age					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18-25 years	67	24.8	24.8	24.8
	25-35 years	125	46.3	46.3	71.1
	36-45 years	51	18.9	18.9	90.0
	Above 45 years	27	10.0	10.0	100.0
	Total	270	100.0	100.0	

Among the 270 respondents, the largest proportion belonged to the 25–35 years age group, comprising 125 respondents (46.3%). This was followed by respondents aged 18–25 years, with 67 respondents (24.8%). The 36–45 years age group accounted for 51 respondents (18.9%), while 27 respondents (10.0%) were above 45 years of age. Thus, the frequency and percentage distribution shows that respondents aged 25–35 years constituted the largest group, whereas those above 45 years represented the smallest proportion of the respondents.

Table:3 Gender

Gender					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	163	60.4	60.4	60.4
	Female	107	39.6	39.6	100.0
	Total	270	100.0	100.0	

Among the 270 respondents, 163 respondents (60.4%) were male, while 107 respondents (39.6%) were female. Thus, the frequency and percentage distribution indicates that male respondents constituted the larger proportion of the study participants, whereas female respondents accounted for a comparatively smaller proportion.

Table:4 Laboratory Role

Laboratory Role					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Student	66	24.4	24.4	24.4
	Research Scholar	48	17.8	17.8	42.2
	Teacher/Faculty	45	16.7	16.7	58.9
	Laboratory Technician	60	22.2	22.2	81.1
	Researcher	48	17.8	17.8	98.9
	Other	3	1.1	1.1	100.0
	Total	270	100.0	100.0	

Among the 270 respondents, 66 respondents (24.4%) were students, representing the largest proportion of the sample. This was followed by 60 laboratory technicians (22.2%). Research scholars and researchers each accounted for 48 respondents (17.8%), while 45 respondents (16.7%) were teachers or faculty members. Only 3 respondents (1.1%) belonged to other laboratory roles. Thus, the frequency and percentage distribution shows representation from different laboratory roles, with students forming the largest group and respondents belonging to other roles constituting the smallest proportion.

Among the 270 respondents, 115 respondents (42.6%) had less than 3 years of laboratory experience, representing the largest proportion. This was followed by 93 respondents (34.4%) with 3–5 years of experience. 53 respondents (19.6%) had 5–10 years of laboratory experience, while only 9 respondents (3.3%) had more than 10 years of experience. Thus, the frequency and percentage distribution shows that respondents with less than 3 years of laboratory experience constituted the largest group, whereas those with more than 10 years of experience represented the smallest proportion.

Table:5 Laboratory Experience

Laboratory Experience					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 3 years	115	42.6	42.6	42.6
	3–5 years	93	34.4	34.4	77.0
	5-10 years	53	19.6	19.6	96.7
	Above 10 years	9	3.3	3.3	100.0
	Total	270	100.0	100.0	

Table:6 Descriptive Statistics

Descriptive Statistics					
	N	Min	Max	Mean	SD
I am aware of the potential hazards associated with chemicals used in my laboratory.	270	1	5	3.19	1.488

I can identify chemical hazards from labels and hazard symbols.	270	1	5	2.07	1.172
I understand the risks associated with toxic, corrosive, flammable, and reactive chemicals.	270	1	5	1.88	1.118
I am aware of the safety precautions required before handling hazardous chemicals.	270	1	5	1.87	1.191
I understand the importance of using appropriate personal protective equipment when handling chemicals.	270	1	5	2.52	1.573
I am aware of the chemical compatibility requirements for safe storage.	270	1	5	2.99	1.366
I understand the importance of proper procedures for diluting and mixing chemicals.	270	1	5	2.20	1.264
I am aware of appropriate procedures for handling and disposing of chemical waste.	270	1	5	1.83	1.122
I know the appropriate actions to take in the event of a chemical spill or accidental exposure.	270	1	5	2.18	1.294
I am aware of the safety information provided in Safety Data Sheets for laboratory chemicals.	270	1	5	2.53	1.522
I wear appropriate personal protective equipment while working with chemicals.	270	1	5	3.02	1.367
I read chemical labels before using laboratory chemicals.	270	1	5	2.22	1.274
I keep chemical containers properly closed when they are not in use.	270	1	5	1.82	1.123
I use appropriate equipment when transferring or handling hazardous chemicals.	270	1	5	2.20	1.297
I maintain proper ventilation when working with volatile chemicals or harmful vapours.	270	1	5	2.48	1.490
I keep chemicals away from incompatible substances during laboratory work.	270	1	5	2.92	1.657
I dispose of chemical waste according to the prescribed laboratory procedures.	270	1	5	2.29	1.502
I maintain a clean and organised workspace during chemical experiments.	270	1	5	2.00	1.245
I follow prescribed procedures when heating, mixing, or diluting chemicals.	270	1	5	2.29	1.295
I report chemical spills, unsafe conditions, or laboratory incidents to the responsible person.	270	1	5	2.31	1.432
I consistently follow established chemical safety procedures during laboratory work.	270	1	5	2.40	1.441
I make safety precautions a routine part of every chemical experiment.	270	1	5	2.03	1.112
I check the potential hazards of chemicals before beginning laboratory work.	270	1	5	1.86	1.045
I consistently use the required personal protective equipment even during routine procedures.	270	1	5	1.90	1.127
I follow chemical storage requirements even when the laboratory is busy.	270	1	5	2.57	1.576
I avoid shortcuts that could compromise chemical safety during laboratory activities.	270	1	5	2.73	1.445
I consistently follow proper procedures for segregation and disposal of chemical waste.	270	1	5	2.11	1.258
I follow appropriate emergency procedures when a chemical incident occurs.	270	1	5	2.10	1.448
I maintain safe laboratory practices even when working without direct supervision.	270	1	5	2.24	1.332

I incorporate chemical safety considerations into my regular laboratory decision-making.	270	1	5	2.33	1.406
Valid N (listwise)	270				

The above-mentioned table presents the descriptive statistics of chemical safety awareness, laboratory practices, and adoption of safe laboratory practices among 270 respondents. The statements were measured on a five-point Likert scale ranging from Strongly Agree (1) to Strongly Disagree (5); therefore, lower mean scores indicate a higher level of agreement with the respective statements. For chemical safety awareness, the lowest mean was recorded for awareness of appropriate procedures for handling and disposing of chemical waste (M = 1.83, SD = 1.122), followed by awareness of safety precautions required before handling hazardous chemicals (M = 1.87, SD = 1.191) and understanding the risks associated with toxic, corrosive, flammable, and reactive chemicals (M = 1.88, SD = 1.118). The highest mean was observed for awareness of potential hazards associated with chemicals used in the laboratory (M = 3.19, SD = 1.488). Regarding laboratory practices, the lowest mean was found for keeping chemical containers properly closed when not in use (M = 1.82, SD = 1.123), while the highest mean was recorded for wearing appropriate personal protective equipment while working with chemicals (M = 3.02, SD = 1.367). For adoption of safe laboratory practices, the lowest mean was reported for checking potential chemical hazards before beginning laboratory work (M = 1.86, SD = 1.045), followed by consistently using required personal protective equipment during routine procedures (M = 1.90, SD = 1.127). The highest mean was observed for avoiding shortcuts that could compromise chemical safety during laboratory activities (M = 2.73, SD = 1.445). The findings therefore show variation in the level of agreement across the different dimensions of chemical safety awareness, laboratory practices, and adoption of safe laboratory practices.

Hypotheses testing

H_{01}: There is no significant relationship between chemical safety awareness and laboratory practices among laboratory users.

The Pearson correlation analysis shows a very strong positive relationship between chemical safety awareness and laboratory practices among laboratory users. The correlation coefficient was r = 0.974, indicating a very strong positive association between the two variables. The significance value was p = 0.000, which is less than the 0.01 level of significance. This indicates that the relationship is statistically significant at the 1% level. Therefore, the null hypothesis (H_{01}), which states that there is no significant relationship between chemical safety awareness and laboratory practices among laboratory users, is rejected. The findings indicate that higher levels of chemical safety awareness are associated with higher levels of laboratory practices among the 270 respondents.

Correlations			
		Chemical Safety Awareness	**Laboratory Practices Among Laboratory Users**
Chemical Safety Awareness	Pearson Correlation	1	.974**
	Sig. (2-tailed)		.000
	N	270	270
Laboratory Practices Among Laboratory Users	Pearson Correlation	.974**	1
	Sig. (2-tailed)	.000	
	N	270	270
**. Correlation is significant at the 0.01 level (2-tailed).			

H_{02}: Chemical safety awareness does not significantly influence the adoption of safe laboratory practices among laboratory users.

ANOVA					
Adoption of Safe Laboratory Practices Among Laboratory Users					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	6492.805	15	432.854	231.953	.000
Within Groups	473.995	254	1.866		
Total	6966.800	269			

The ANOVA results indicate a statistically significant difference in the adoption of safe laboratory practices among laboratory users, with an F-value of 231.953 and a significance value of p = 0.000. Since the significance value is less than the 0.01 level of significance, the result is statistically significant at the 1% level. The between-groups sum of squares was 6492.805, with a mean square of 432.854, whereas the within-groups sum of squares was 473.995, with a mean square of 1.866. The substantially higher between-groups variation indicates that the groups differ significantly in their adoption of safe laboratory practices. Therefore, the null hypothesis (H_{02}), which states that chemical safety awareness does not significantly influence the adoption of safe laboratory practices among laboratory users, is rejected. The findings indicate a statistically significant association between chemical safety awareness and the adoption of safe laboratory practices among the respondents.

CONCLUSION

The study examined the relationship between chemical safety awareness and laboratory practices among laboratory users. The findings indicate that chemical safety awareness is closely associated with the way safety practices are followed during laboratory work. Respondents showed greater agreement with several aspects of chemical safety awareness, particularly regarding chemical waste handling, safety precautions, and the risks associated with hazardous chemicals. Laboratory practices also showed variation across different safety-related activities, including chemical handling, storage, waste disposal, ventilation, and reporting of unsafe conditions. The adoption of safe laboratory practices further reflected differences in the extent to which safety procedures were incorporated into regular laboratory activities. The statistical findings provided strong evidence of a significant relationship between chemical safety awareness and laboratory practices. Pearson correlation analysis produced a very strong positive correlation of 0.974, with a significance value of 0.000. The ANOVA results also showed a statistically significant difference associated with the adoption of safe laboratory practices, with an F-value of 231.953 and a significance value of 0.000. These findings indicate that chemical safety awareness has an important association with the adoption of appropriate laboratory practices.

The study therefore highlights the need for continuous safety training, proper communication of chemical hazards, effective use of safety equipment, and regular reinforcement of safe handling and disposal procedures. Strengthening these areas can support safer laboratory environments and encourage responsible chemical practices among laboratory users.

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