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Safety Climate and Practices in University Laboratories: Evidence from a Ghanaian Case Study

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Abstract

Academic laboratories in developing countries face numerous occupational health and safety (OHS) challenges due to limited resources, diverse hazards, and often underdeveloped safety systems. This study was conducted to evaluate the safety climate, occupational health and safety (OHS) knowledge, attitudes, and practices of laboratory workers in academic laboratories at the University of Cape Coast, Ghana. This cross-sectional study used the Nordic Safety Climate Questionnaire (NOSACQ-50), a standard questionnaire, direct workplace observations, and a decision matrix risk assessment to identify and evaluate hazards. The study was conducted in academic laboratories across three colleges at the University of Cape Coast, Ghana. The study included 104 laboratory staff members with at least one year of work experience in laboratory settings. Participants demonstrated high knowledge of OHS (mean score: 12.94 ± 2.76) and awareness (12.42 ± 2.39), but poor safety practices (12.06 ± 4.48) and inconsistent use of personal protective equipment (PPE). The overall safety climate score was low (2.45 ± 0.71), with management's safety commitment and justice rated poorly. Observations revealed inadequate PPE availability, lack of ergonomic infrastructure, and absence of incident reporting systems. High-risk hazards, including chemical inhalation, musculoskeletal injuries, and chemical splashes, were identified with risk scores of 20 each. The findings reveal significant gaps between OHS knowledge and safety practices in academic laboratories. These gaps highlight the need for improved resource allocation, stronger management engagement, enhanced safety training, and the establishment of dedicated OHS units to foster safer working environments and promote a robust safety culture in academic institutions.

Keywords: *Academic Institutions, Ghana, Laboratory Safety, Occupational Health and Safety, Personal Protective Equipment, Risk Assessment, Safety Climate.*

Introduction

Occupational health and safety (OHS) plays a pivotal role in managing risks and ensuring the well-being of individuals in various workplace settings. Laboratories, particularly those in academic institutions, present a unique combination of physical, chemical, biological, and ergonomic hazards due to their dynamic and high-risk nature. These risks are compounded by the presence of diverse activities involving hazardous chemicals, biological agents, and sophisticated equipment. The consequences of inadequate safety

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measures in these environments can include severe injuries, health complications, and damage to critical infrastructure.

Although usually used interchangeably, safety climate is a quick assessment of workers' perceptions, attitudes, and beliefs regarding risk and safety, whilst safety culture is the culmination of all an organization stands for and does in the name of safety [1, 2]. Assessing safety climate in the workplace is essential for understanding employees' perceptions of safety and identifying areas for improvement. Various tools have been developed and utilized across different industries to measure safety climate. These include the Safety Climate Assessment Tool (S-CAT), Safety Climate Tool (SCT), and the Psychosocial Safety Climate (PSC) Scale [3-5]. In 2011, a group of Nordic Occupational Safety Experts created the Nordic Safety Climate Questionnaire (NOSACQ-50) by drawing on organizational and safety climate theory, psychological theory, prior empirical research, empirical findings from global studies, and an ongoing development process [6]. The NOSACQ-50 evaluates seven key dimensions of safety climate, such as management's safety commitment, safety communication, and group safety norms. This comprehensive approach enables a nuanced understanding of the factors influencing safety behaviors, which is critical for identifying areas for improvement in academic laboratories.

Academic laboratories are complex environments characterized by diverse and evolving hazards. Globally, several studies have highlighted the risks associated with these settings, particularly exposure to chemical, biological, and ergonomic hazards. For instance, incidents such as chemical explosions and exposure to infectious agents have been reported in the United States and Singapore, underscoring the critical need for robust safety measures [7, 8]. An exposure to West Nile Virus was reported in Singapore in 2003 when a postgraduate microbiology student contracted the infection from a virus culture he was working on. That culture was also contaminated with the SARS Coronavirus [8].

Research on OHS knowledge, attitudes, and practices has primarily focused on healthcare laboratories, with limited attention to academic settings. Studies conducted in Yemen and Nigeria revealed varying levels of biosafety knowledge and practices among laboratory workers, often influenced by resource availability and training opportunities [9, 10]. Similarly, a Jamaican study highlighted significant gaps in personal protective equipment (PPE) availability, which impeded compliance with safety protocols [11].

In higher education settings, studies from Indonesia and South Africa have reported inadequate safety compliance, with an average compliance rate of 54% and significant gaps in hazard identification and risk management [12, 13]. However, these studies often rely heavily on self-reported data, raising concerns about social desirability bias and the reliability of findings.

In the African context, there is a notable paucity of research on the safety climate in academic laboratories. The limited studies available often focus on healthcare workers and lack methodological rigor, such as standardized tools or observational methods.

Despite global efforts to improve laboratory safety, the unique challenges of academic settings in low-resource environments, such as those in Ghana, remain underexplored.

The necessity of this study lies in its focus on Ghana, a developing country where limited resources and systemic challenges hinder the implementation of comprehensive OHS practices in academic institutions. Our search in available literature found no published studies that assessed the safety climate, knowledge, attitudes, and practices of laboratory workers in Ghanaian universities. This study seeks to bridge these gaps by applying the Nordic Safety Climate Questionnaire (NOSACQ-50), alongside direct observations and risk assessments, to evaluate OHS in teaching and research laboratories at the University of Cape Coast.

Methods

Study Setting

The University of Cape Coast is a public university located in the historic town of Cape Coast in the central region of Ghana. The university is one of the rare sea-front universities in the world and sits on a hill above sea level overlooking the Gulf of Guinea to the south. Geographically, the area occupied by the university lies at latitude 5.1155° North of the Equator and longitude 1.2909° West of the Prime Meridian. The university has many teaching and research laboratories for students, lecturers, and other academic community members.

Study Design and Duration

This cross-sectional study employed a comprehensive array of approaches. The Nordic Safety Climate Questionnaire (NOSACQ-50) assessed the safety climate perceptions of teaching and research laboratory staff. Hazards were meticulously identified through a questionnaire and surprise workplace visits to monitor work procedures. The study was conducted from May 2023 to August 2023.

Study Population, Sample, and Data Source

The study sample included 104 University of Cape Coast staff who work in various academic laboratories. The university has 25 chemical and medical laboratories in three Colleges, namely, College of Agriculture and Natural Sciences; College of Health and Allied Sciences and College of Health and Allied Sciences. To be included in this study, a laboratory staff member must have worked at the University for at least one year and be 18 years old or above. Following the inclusion criteria, the census sampling technique was used on all 104 eligible staff members.

Potential Sources of Bias

After identifying potential sources of bias, we implemented some steps to guarantee the validity and reliability of our findings. The two sources found were the potential for participants to provide responses that would be accepted in society and the experts' arbitrary evaluation of the risks. A range of extra data sources, such as incident registers, were used to offset these. To prevent subjectivity-related bias, three experts independently assessed the risks, and an observation checklist was incorporated to confirm the comments made by the participants.

Reliability Test

The Cronbach's alpha test was used to assess the reliability of sets of latent variables in each dimension. The results showed that all sets of items had a close relationship, with an acceptable to good alpha score range of 0.781–0.916 across the seven dimensions examined. The NOSACQ-50 was found to have an excellent score of 0.838 (Table 4).

Statistical Methods

The means and standard deviations were used to summarize continuous variables. The categorical variables were summarized using percentages and frequencies. Using multiple linear regression analysis, predictors of participants' knowledge of occupational health and safety were calculated. Multivariable linear regression was used to carry out adjusted analysis. The independent variables with a bivariate correlation greater than 0.70 were excluded from the multiple regression analysis to address the multicollinearity issue. The resultant multiple linear regression model was diagnosed and assessed for robustness and fitness using a few tests and indicators. Backward regression analysis was used to quickly exclude collinear and non-significant predictors from the model and find the best-fitting model for the data. Computer programs SPSS v 22 and EViews 12 were used to process the data. A 95% confidence interval and a 5% threshold for statistical significance were used.

Instruments

Questionnaires

This study used the NOSACQ-50 and a standard questionnaire, developed from validated tools used in similar studies [14]. Ten University of Cape Coast Hospital laboratory employees participated in a pilot study to confirm the questionnaires' validity. This allowed for the necessary modifications to be made to the questionnaire. There were six parts to the developed questionnaire. Information on the sociodemographic characteristics of the respondents was the focus of Section A. Information regarding respondents' awareness, knowledge, and practices regarding occupational health and safety was acquired in Section B. The participants' attitudes toward risks and the application of occupational health and safety were evaluated in Section C. The workers' self-reported exposure to working hazards was assessed in Section D. Section E was used to collect information on workplace safety measures available for hazard control. At the same time, Section F examined how occupational risks affected the workforce the previous year.

Cumulative scores for the knowledge, attitude, practices, and awareness variables were combined and categorized into good and poor (knowledge and practice), low and high (awareness), and positive and negative (attitude) [15]. The obtained median score for every variable served as the basis for categorization. A score lower than the median was classified as low/poor/negative, while scores equal to or higher than the median were classified as high/good/positive.

NOSACQ-50 Questionnaire

The NOSACQ-50 questionnaire was used to gather employee perceptions of safety climate elements related to management and supervisor support for workplace safety. The NOSACQ-50 consists of 50 items spanning seven safety climate dimensions; the first three items address the workgroup's and management's safety rules, while the final four items (training, communication, and competency) address employees' obligations to practice safety [6]. The findings were analysed and interpreted per the author's instructions as follows: scores <2.70 were categorized as very low, 2.70–2.99 as fairly low, 3.00–3.30 as fairly good, and ≥3.00 as good [16]. The internal consistency of the NOSACQ-50 was assessed using Cronbach's alpha.

Observational Checklist

An observational checklist was developed following a review of previous related studies [17]. The part had eight sections: First aid, general security, electrical safety, fire safety, general safety, PPE availability, OHS rules, and worker PPE use.

Risk Assessment Form

The study modified a validated risk assessment matrix [18] from an earlier investigation to account for the observed hazards. Three experts utilized the form to assess the risks of the main hazards discovered throughout the risk identification procedures.

Risk Calculation

The probability (P) and severity (S) of the incident were multiplied to determine the risk score (R). The risk scores are defined as follows: insignificant risk (1), tolerable/low risk (2, 3, 4, 5, and 6), moderate/medium risk (8, 9, 10, and 12), significant/high risk (15, 16, and 20), and intolerable risk [18, 19].

Results

There were 99 participants in this study, representing 94% of all eligible respondents. The majority of respondents were males, 81 (81.8%), with the majority in the 30- 39 age group (48.5%). Most participants, 84 (84.8%), had at least five years of working experience as Laboratory workers in an institution of higher education. Table 1 shows the demographic characteristics of the participants.

Table 1. Socio-Demographic Characteristics of Participants

Characteristic	Frequency (%)
Age group (years)	
20-29	3 (3.0)
30-39	48 (48.5)
40-49	42 (42.4)
50-59	6 (6.1)
Sex	
Male	81 (81.8)
Female	18 (18.2)
Educational level	
Certificate	51 (51.5)
Diploma	9 (9.1)
Bachelor's degree	39 (39.4)
Years of working at the University	
<5	15 (15.2)
5-10	36 (36.4)
11-15	15 (15.2)
>15	33 (33.2)

Knowledge and Awareness of Occupational Health and Safety

Respondents' knowledge of occupational health was good, with an overall mean score of 12.94 ± 2.76 (maximum score of 15). A multiple regression was run to predict Knowledge scores. Level of awareness, practice of safety precautions, and use of PPEs significantly predicted participants' knowledge scores. F (3,92)=37.66 p<0.0005. The general form of the equation is predicted knowledge scores = 3.423 + (0.425 x Awareness score) + (0.184 x practice of precautions) + (0.191xUse of PPEs). Age group (p-0.644), sex (p-0.958), and years of working experience (p-0.181) were not significantly associated with knowledge scores.

Awareness and Practice of Safety Precautions

Respondents showed a high level of awareness of safety precautions in the laboratory. The overall score for awareness was 12.42 ± 2.39 (maximum score of 14). Participants' overall score for their practice of safety precautions was poor (12.06 ± 4.48, maximum score of 28). There was a moderate positive correlation (r=0.484, p<0.0005) between awareness and practice of safety precautions. Awareness was also significantly associated with the practice of OHS (t=4.024, p=0.001, use of PPEs (t=2.456, p=0.016), and knowledge scores (t=3.688, p-0.0001). Overall practice of safety precautions was significantly associated with knowledge scores (t-0.342, p=0.006) and use of PPEs (t-2.341, p=0.022). However, the practice of safety precautions was not significantly associated with attitude towards OHS (t-0.540, p-0.588). In comparison, all participants knew the need to be fully immunized against hepatitis B, but only 84(84.8%) knew about being vaccinated against tetanus. On their immunization status, only 42(42.4%) and 12(12.1%) had been immunized against hepatitis B and tetanus, respectively. The self-reported awareness and practices of safety precautions of respondents are shown in Table 2.

Table 2. Participants' Awareness and Practice of Safety Precautions

	Safety Precaution	Awareness		Practice	
		Yes (%)	No (%)	Always (%)	Sometimes (%)
1	Hand washing with a bactericidal agent	99 (100)	0	33 (33.3)	57 (57.6)
2	Taking regular breaks during work	78 (78.8)	21 (21.2)	9 (9.1)	54 (54.5)
3	Disinfecting office desks every day	99 (100)	0	30 (30.3)	54 (54.5)
4	Avoiding prolonged use of the computer	75 (75.8)	24 (24.2)	9 (90.1)	48 (48.5)
5	Correct body posture during procedures	84 (84.8)	15 (15.2)	27 (27.3)	39 (39.4)
6	Handling hot glasses with gloves or beaker tongs	78 (78.8)	21 (21.2)	18 (18.2)	33 (33.3)
7	Wearing gowns (apron) when working on chemicals	99 (100)	0	51 (51.5)	33 (33.3)
8	Wearing masks (goggles) to avoid eye splashes	90 (90.9)	9 (9.1)	33 (33.3)	48 (48.5)
9	Not opening glass ampoules with bare hands	93 (93.9)	6 (6.1)	42 (42.4)	36 (36.4)
10	Safe disposal of sharps	72 (72.7)	27 (27.3)	9 (9.1)	24 (24.2)

Education on Occupational Hazards

Even though a majority of respondents, 87 (87.8%), reported that they had received training in occupational health at least once in the course of their work, 51 (51.5%) reported having received formal training on occupational health in the last 12 months before the survey, and only 3 (3.0%) indicated that they received pre-employment training in occupational health and safety. The majority of participants, 93 (93.9%), were unaware of any existing protocols in the worksite that dealt with occupational exposures.

Perception of Risk and Attitudes Towards Occupational Safety

All participants perceived their jobs as risky, classifying them as high-risk 60(60.6%), medium-risk 21(21.2%), and low-risk 18(18.2%). Attitudes toward occupational health and safety among participants were high. There was an overall score of 48.12 ± 3.79 (maximum score of 55).

Availability of and Use of PPEs

Table 3 gives participants' reports on the availability and use of protective equipment. The most available and highly used equipment is the laboratory coat. Fire-resistant coats and fire blankets were the least available equipment. The overall availability score of 12.97 ± 5.04 was low (maximum score of 28). There was, however, a poor overall score for the use of the available equipment, 10.59 ± 4.92 (maximum score 28). There was a strong positive correlation between availability and use of protective equipment ($r=0.85$, $p<0.0005$).

Table 3. Availability and Use of Protective Equipment

	Equipment	Available		Use	
		Always (%)	Sometimes (%)	Always (%)	Sometimes (%)
1.	Face mask/shield	42 (42.4)	21 (21.2)	36 (36.4)	33 (33.3)
2.	Gloves	60 (60.6)	39 (39.4)	60 (60.6)	39 (39.4)
3.	Hand sanitizer	72 (72.7)	24(24.2)	54 (54.5)	36 (36.4)
4.	Hand washing facilities	60 (60.6)	39 (39.4)	69 (69.7)	30 (30.3)
5.	Lab coats/aprons	81 (81.8)	18 (18.2)	57 (57.6)	24 (24.2)
6.	Safety boots/shoes	45 (45.5)	54 (54.5)	54 (54.5)	15 (15.2)
7.	Chemical splash-resistant coat.	9 (9.1)	18 (18.2)	2 (2.0)	10 (10.1)
8.	Fire resistant coat	6 (6.1)	12 (12.1)	0	0
9.	Eye wash kit	9 (9.1)	18 (18.2)	5 (5.1)	12 (12.1)
10.	Fire blanket	3 (3.0)	18 (18.2)	0	0
11.	Safety shower	21 (21.2)	72 (72.2)	12 (12.1)	6 (6.1)

Perceived Effects of Occupational Hazards on Health

Respondents disclosed any health issues they had experienced in the year before the survey that they believed were related to their line of work. Low back pain 30 (30.3%), eye issues 24 (24.2%), neck pain 18 (18.2%), and wrist joint pain 15 (15.2%) were the main health issues reported.

Exposure to Hazards

Survey participants self-reported the prevalence of exposure to occupational hazards in any form in the year preceding the study. The most common physical hazards reported were high noise levels 54 (54.5%), trips and falls 50 (50.5%), heat 36 (36.4%), and poor ventilation in the labs 30 (30.3%). The main chemical hazards were reported as the presence of unlabeled and unmarked chemicals in laboratories 33 (33.3%) and exposure to flammable liquids 28(28.3%) and corrosive chemicals 25(25.3%). The most reported psychosocial hazards were working for long hours 66 (66.7%) and skipping meals, toilet breaks, and medications 48 (48.5%). With regards to biological hazards, needle pricks were reported by 27 (27.3%), and direct contact with body fluids by 15 (15.2%). Regarding ergonomic hazards, 80 (80.9%) respondents reported the absence of non-adjustable chairs.

Reporting of Occupational Injuries

Of those surveyed, 33 (33.3%) said they consistently report workplace injuries, 51 (51.5%) sometimes report, and 15(15.2%) never report. Almost all (50, 83.3%) who do not always report occupational injuries indicated that nothing significant would be done about their complaints, with 30, 16.7% indicating that they are usually blamed for the accident. All respondents stated that no units or officers were designated to manage occupational health issues in their laboratories.

Safety Climate Perception Scores

A poor safety climate score of 2.45±0.71 overall suggests much room for improvement. The safety climate elements that respondents saw as being most positive were safety communication, learning, and trust in coworkers' safety competence (3.25±0.40) and trust in the effectiveness of safety systems (3.37±0.43). Management safety justice (1.73±0.36) and management safety priority, commitment, and competence (1.69±0.21) were the least positively rated. Cronbach's alpha, a measure of reliability, was acceptable for each of the seven scales.

Table 4 presents the mean distribution and Cronbach's alpha reliability results for the NOSACQ-50 across the seven dimensions.

Table 4. Respondents' Safety Climate Perception Scores Distribution for the Seven Safety Climate Dimensions

No.	Dimension	Items	Mean ± SD	Interpretation	Cronbach's α
1	Management safety priority, commitment, and competence	9	1.69±0.21	Very low	0.781
2	Management safety empowerment	7	2.10±0.15	Very low	0.714
3	Management safety justice	6	1.73±0.36	Very low	0.695
4	Workers' safety commitment	6	2.06±0.38	Very low	0.916
5	Workers' safety priority and risk non-acceptance	7	2.96±0.31	Fairly low	0.794
6	Safety communication, learning, and trust in co-workers' safety competence	8	3.25±0.40	Fairly good	0.881
7	Trust in the efficacy of safety systems	7	3.37±0.43	Good	0.871
	Overall/Total	50	2.45±0.71	Very low	0.838

Findings of Experts' Visits to the Laboratories

Physical Safety: There was no observable damp flooring; however, some slippery floors were observed with no warning signs. All the lighting arrangements were operating as intended. Most of the labs had local exhaust ventilation that ensured that the labs were adequately ventilated. Some staff were observed eating and drinking in the lab.

Ergonomic safety: Some of the labs visited did not have adjustable stools. Some staff were observed standing for prolonged periods to view microscopes. Some repetitive activities, such as using thump-operated pipettes, were observed.

Electrical Safety: Most of the outlets were in good functioning order, and there were no overloaded extension cords. A few outlets and switches were damaged.

Fire Safety: All the labs visited had fire extinguishers and smoke detectors installed. Still, there was not a single conspicuous fire exit sign, no fire-resistant blankets on hand, and some of the labs had only one door for entry and exist.

Availability of PPEs: Every facility visited had face masks, goggles, safety boots, plastic aprons, and utility gloves available for inspection. There were eye-wash fountains and emergency showers in 80% of the labs visited. Some staff at work were not wearing lab coats or proper footwear. None was observed in the face mask, even though they were working on volatile chemicals and were generating aerosols from biological specimens. Those observed working on corrosive chemicals were not in goggles, even though these chemicals could splash into the face. The only PPE used by all staff observed at work was the gloves. Even though equipment such as the centrifuge made noise, no hearing protection device was available at any of the labs visited, and thus, no staff was observed using them.

Policies: Several protocols and guidelines were observed in the various labs. However, none of the labs had a designated office or officer responsible for the occupational health and safety of staff.

Incident Register

There was no incident register in any of the labs visited to document the instances of occupational exposure.

Risk Assessment

Table 5 shows the results of the decision matrix risk assessment, which was obtained from all of the University of Cape Coast's (UCC) chemical and medical laboratories. This process discovered and evaluated common workplace dangers.

Staff were found to be most at risk of musculoskeletal injuries (Risk Score 20), chemical inhalation (Risk Score 20), cuts and traumatic injuries (Risk Score 20), and dermatitis (Risk Score 12).

Table 5. Risk Assessment Matrix Evaluating Common Hazards Identified at Academic Laboratories at the University of Cape Coast

Risk / Activity	**Hazards**	**Probability of Occurrence (P)**	**Severity (S)**	**Risk Score (P x S)**	**Outcome**	**Proposed Control Measures**
Chemical inhalation and inhalation of aerosols	Presence of a volatile chemicals, aerosols generated while working on a biological specimen, poor usage of face masks	5	4	20	HIGH RISK	The use of face masks at all times, the use of a local exhaust ventilation system
Slips and falls	Lack of safety signs for slippery surfaces	3	2	6	LOW RISK	Provision of safety signs for slippery surfaces and the use of appropriate footwear
Musculoskeletal injuries	Prolonged standing while viewing microscopes, non-adjustable stools, the use of thump pipetting	5	4	20	HIGH RISK	There is an urgent need for adjustable stools, provision of microscopes with affixed video cameras, the use of magnetic assist or programmable pipettes.
Needle stick injuries	Possible exposure to pathogens in biological specimens such as blood	2	5	10	MEDIUM RISK	Enforcing the use of gloves at all times, practice of proper sharp disposal techniques
Chemical splash to skin and eyes	Presence of un-labelled chemicals, not wearing lab coats	4	4	16	HIGH RISK	Enforcing rules on the wearing of lab coats at all times,

	and plastic aprons, poor use of goggles					using goggles and plastic aprons when appropriate
Hearing impairment	Non-availability of hearing protective devices	3	3	9	MEDIUM RISK	Provision and usage of earplugs/muffs

Discussion

This study assessed the safety climate in teaching and research laboratories at a higher education institution using the validated NOSACQ-50 tool, along with a questionnaire and a risk assessment. The overall safety climate score was very low (2.45 ± 0.71), pointing to systemic gaps in organizational support for occupational health and safety (OHS). These findings align with a Nigerian study conducted during the COVID-19 pandemic [20] but contrast with a Pakistani study, where participants rated the safety climate as good [14].

Participants' self-rated scores for safety communication, trust in co-workers' safety competence (3.25), and their trust in the efficacy of safety systems (3.37) were good, similar to what was found in the Pakistani study among the reference laboratory staff [14]. The low safety climate scores, particularly in areas related to management’s safety commitment, justice, and empowerment, point to a systemic lack of organizational support for OHS. When workers perceive that management does not prioritize safety, they may be less likely to adhere to safety practices, even when they are knowledgeable about them.

Knowledge and Training

Participants exhibited high knowledge of OHS (97%), consistent with findings from studies in Malaysia [21] and Saudi Arabia [21, 22], where most laboratory workers demonstrated a strong grasp of OHS principles. This could be attributed to in-service training, as 87.8% of participants in this study reported receiving training post-employment. Contrarily, studies in Yemen [9] and Iran [23] found lower OHS knowledge, highlighting variations due to differences in study populations, tools, and settings.

Safety Attitudes and Awareness

Participants demonstrated positive attitudes toward OHS, consistent with findings from Canadian [24] and Malaysian [21] studies, in which laboratory workers prioritised safety. However, no significant association was found between attitudes and sociodemographic variables such as age, sex, and occupation. Awareness of OHS practices was high, as seen in the Malaysian study, [21] but gaps in communication and policy dissemination limited the practical application of this awareness.

Safety Practices

Safety practices were poor, with only 36.4% consistently using PPEs like face masks or shields. This finding aligns with a previous study [24], which found that only 40% of academic researchers reported wearing PPE while working. It also aligns with an earlier study indicating that academic researchers are less likely to wear protective gear than their industry counterparts [25], suggesting that PPE use among academic laboratory staff warrants greater global attention. The gap between positive attitudes and low safety practices suggests a need for more robust enforcement and behavioral reinforcement.

Hazard Perception and Risk Management

All participants perceived their work environment as dangerous, with 60.6% rating it as high-risk. This perception contrasts with studies in high-resource settings where laboratories are generally perceived as safe. Interestingly, even though all participants perceived their work environment as high-risk, yet there was a noticeable lack of proactive safety measures. This paradox may stem from a normalisation of risk, where workers become desensitised to hazardous conditions over time, as postulated by Wilde in the risk homeostasis theory [26]. Additionally, time pressures, workload demands, and the absence of clear incentives for safety compliance can lead workers to prioritize productivity over safety practices.

Risk Evaluation

The risk assessment matrix revealed significant hazards within the academic laboratories at the University of Cape Coast, with multiple high-risk activities identified. The most critical risks included musculoskeletal injuries, chemical inhalation, and traumatic injuries, each receiving a high-risk score of 20. These hazards were primarily attributed to poor ergonomic practices, such as prolonged standing and the use of non-adjustable stools, and exposure to volatile chemicals due to insufficient use of local exhaust ventilation and improper handling of chemicals. Additionally, the inconsistent use of personal protective equipment (PPE), such as face masks, aprons, and goggles, compounded these risks, leaving workers vulnerable to chemical splashes and aerosolized biological specimens.

Medium-risk activities included needle-stick injuries, which pose a significant threat of exposure to bloodborne pathogens, and chemical splashes to the skin and eyes due to unlabeled chemicals and inadequate safety protocols. Low-risk activities, such as slips and falls, were also noted but could be mitigated through basic interventions, such as installing proper safety signs and ensuring clean, dry floors.

The findings highlight the urgent need for comprehensive control measures to mitigate these risks. These include improving the availability and consistent use of PPE, implementing ergonomic solutions such as adjustable stools and programmable pipettes, and enhancing the ventilation infrastructure. Furthermore, regular training on chemical handling and strict adherence to labeling protocols are essential to minimize exposure to hazardous substances. Addressing these issues is vital to creating a safer working environment and reducing the incidence of occupational injuries in academic laboratories.

Incident Reporting

The study revealed low rates of injury reporting, with only 33.3% consistently reporting workplace injuries. Similar trends were observed in Pakistan and other settings, where fear of blame and perceived inaction discouraged reporting. This highlights the need for institutional support and the establishment of dedicated OHS offices. Furthermore, the high underreporting of injuries due to fear of blame or lack of action from management reinforces a culture where safety concerns are marginalized. This aligns with prior research suggesting that a lack of safety justice can erode trust and discourage workers from engaging with safety initiatives [2, 27]. Management should invest in employee safety empowerment by encouraging workers to participate in decisions that affect their safety and setting up designated offices to address all issues related to occupational health.

Recommendations

1. Establish OHS Units: Create designated offices with trained officers to oversee safety protocols and manage incident reporting.
2. Enhance Management Engagement: Prioritize safety through leadership commitment, accountability, and clear communication.

3. Improve Resource Allocation: Ensure the availability of essential PPE, ergonomic tools, and emergency response systems.
4. Integrate Training Programs: Provide pre-employment and ongoing safety training for laboratory staff.
5. Develop Clear Policies: Standardize safety procedures for hazard identification, mitigation, and emergency response.

Conclusion

This study provides critical insights into the occupational health and safety (OHS) climate of teaching and research laboratories at the University of Cape Coast, a prominent academic institution in Ghana. By employing the Nordic Safety Climate Questionnaire (NOSACQ-50) alongside direct observations and a decision matrix risk assessment, this research presents a comprehensive evaluation of safety practices, hazards, and perceptions among laboratory staff. This study underscores the critical need for improved OHS practices in Ghanaian academic laboratories. While knowledge and awareness were high, systemic gaps in management commitment, resource allocation, and incident reporting hinder safety practice adherence. Addressing these issues through targeted interventions can foster a safer working environment and a stronger safety culture in academic institutions.

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Conflict of Interest

All authors declare no conflict of interest.

Author Contributions

All authors contributed to the study conception and design. *James Kojo Prah* was responsible for material preparation, data collection, analysis, and draft preparation. *Ebenezer Aggrey, Andreas Kudom, and Benedict Addo-Yeboa prepared the first draft of the manuscript, and all authors commented on previous versions*. All authors read and approved the final manuscript.

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Ethical Approval

The study involving human participants was reviewed and approved by the University of Cape Coast Ethical Review Board (Approval No: UCC/IRB/EXT/2023/13). Written informed consent was obtained from all participants prior to their inclusion in the study. The collected data was anonymized to maintain confidentiality. It was kept on a computer that required a password to ensure data protection.

Data Availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

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