Assessment of Occupational Safety and Health Standards in Medical Laboratories in Kenya

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Abstract

Medical laboratory workers face diverse hazards including chemical, biological, and physical risks, as well as musculoskeletal strain. In light of rising facility-acquired infections and workplace accidents in Kenya, there is an urgent need to evaluate the sustainability of Occupational Safety and Health (OSH) standards. This study assessed the effectiveness of key OSH measures, including risk assessment (RA), hazardous substance handling (HZ), personal protective equipment (PPE) usage, emergency protocols (EP), and ergonomic practices (EG), in mitigating occupational hazards and promoting employee well-being in Kenyan medical laboratories across public, private, and non-profit sectors. A mixed-method approach was adopted, using qualitative and quantitative tools. A digital questionnaire incorporating Likert-scale items targeting five OSH domains was distributed to medical laboratory professionals in Kenya across public, private, faith-based, and research institutions. A total of 209 responses were collected. Data were analyzed using descriptive statistics and correlation analysis was conducted using SPSS version 25. Results indicated that all the five OSH variables demonstrated statistically significant relationships with OSH effectiveness ($p < 0.001$). Pearson correlation coefficients indicated strong positive relationships: RA (0.624), HZ (0.683), PPE (0.691), EP (0.614), and EG (0.648). More than 75% of respondents agreed or strongly agreed that these safety practices were consistently applied in their workplaces. PPE use and HZ handling recorded the highest levels of adherence. The findings confirm that all five OSH measures significantly enhance safety in medical laboratories, with minimal differences in their respective contributions. The results validate the alternative hypothesis that medical laboratories in Kenya have integrated effective OSH standards safeguarding staff welfare. However, there remains a critical need for robust, high-quality data to evaluate the adequacy and enforcement of these measures in mitigating workplace hazards.

Keywords: *Occupational Health, Medical Laboratory Safety, Biosafety Practices, Workplace Hazards, Kenya.*

1.0 Introduction

The Occupational Safety and Health (OSH) of healthcare workers in Kenya has been a center of focus across local and international platforms. The OSH aims to ensure a safe, inclusive and healthy work environment which promotes employees' productivity (Ministry of Health, 2014). The protection of healthcare workers includes the prevention and control of facility-acquired infections and accidents and guaranteeing mental, social, physical and economic wellbeing of workers, as outlined in the World Health Organization (WHO) alongside Kenya's Vision 2030.

According to the Directorate of Occupational Safety and Health Services (DOSHS), laboratory-related injuries in Kenya account for a notable proportion of reported healthcare sector incidents, with common hazards outlined as chemical exposure and needle-stick injuries (DOSHS, 2021). A 2021 audit by DOSHS found that less than 30% of public healthcare laboratories in Kenya compliant with national OSH standards, highlighting a critical gap between policy and practice.

This study focuses on the OSH of employees working in medical laboratories in Kenya by assessing whether risk assessment (RA), handling of hazardous substances (HZ), use of personal protective equipment (PPE) alongside emergency protocols (EP), and ergonomic principles (EG) have been well integrated and effective.

Over time, the number of employees stationed at medical laboratories whether private or public, profit making or non-profit has increased given the rising need for technicians and clinical investigations (International Labour Office (ILO|), 2021). The present study employs a questionnaire to gather responses from 209 medical laboratory practitioners from various regions and facilities in Kenya. Consequently, the study has integrated the participants' facts and perspectives on various issues linked to OSH practices. The goal is to demonstrate whether medical laboratories in Kenya have integrated effective occupational, safety and health standards that ensure employees' welfare.

According to the International Labour guidelines (2021), it is vital to consider the burden that healthcare employees' families face from injuries and accidents that cause disabilities, and chronic illnesses to their kin. Expansive research further demonstrates that the nature of deaths, injuries and harm stemming from unsafe work places is entirely preventable (Ministry of Health, 2014). Therefore, there is an urgent need to implement effective standards to guarantee worker safety and in extension their families and the general public. Adherence to the laboratory safety guidelines is still low and much is expected to foster the quality of work at these stations (Jacob et al., 2010).

In Africa, a study focusing on laboratory workers in Sudan showed that OSH practices were below standard with reference to biosafety awareness and protocols (Ngatu et al., 2017). Another analysis performed in Nigeria's medical laboratories based on selected universities demonstrated that matters regarding laboratory safety are yet to attract significant attention among stakeholders (Ejilemele & Ojule, 2005). Further, a study carried out in 10 public hospitals in Ethiopia showed that medical laboratory employees are at a significant risk of physical and chemical hazards exposure and immediate action is required to avoid tragedies (Sewunet et al., 2014). In Uganda, over 50 percent of participants in a cross-sectional study conducted in 8 major facilities in Kampala, reported suffering an OSH hazard (Ndejjo, et al., 2015). A research analysis to demonstrate the extent of OSH

measures within medical laboratories in Tanzania illustrated that special efforts involving training, education, facility renovation and guidelines emphasis must be performed to alleviate the high risk of potential hazards (Manyele et al., 2008). Overall, research shows that medical laboratory workers in Sub-Saharan Africa face more risks to OSH issues based on a higher exposure to infectious diseases than those based in developed regions (Ngatu et al., 2017; Mossburg et al., 2019).

"The paper found that medical laboratories in Kenya have integrated effective occupational, safety and health standards to ensure employees' welfare."

In Kenya, whereas research studies have shown interest in OSH across healthcare facilities, there is scanty literature on health and safety of medical laboratories employees (Bota et al., 2021). A study evaluating the status of OSH in Kajiado-based medical laboratories showcases that practitioners are still scarcely aware of the essence of PPE and training to avoid risks (Tait et al., 2018). Another study that investigated 35 public and 78 private medical labs in Western Kenya showed that laboratories situated in rural areas experience lower biosafety standards than urban-based laboratories (Ogaro et al., 2018). Similarly, the recruitment of younger, and less experienced personnel should align with more training, yet health centers report insufficient time allocations for proper training. As a result, biosecurity risks have increased as compliance to guidelines and managerial expertise is lacking. Additionally, studies demonstrate that ergonomic principles in terms of design, equipment and systems placement is still below average, increasing worker exposure to injuries. According to Bota et al. (2021), training is paramount to combat these challenges. The authors recommend a sustainable biosafety training model that seeks to alleviate most OSH issues through sensitization meetings with laboratory managers or supervisors, alongside regular training for trainees. While Kenya is a signatory to key ILO conventions on workplace safety, enforcement remains fragmented due to limited inspection of resources and the absence of sector-specific OSH enforcement mechanisms in laboratory settings (MoL, 2021).This study aims to establish whether Medical laboratories in Kenya have integrated effective occupational, safety and health standards that ensure employees' welfare.

Hypothesis

H0: Medical laboratories in Kenya have not integrated effective occupational, safety and health standards that ensure employees' welfare.

The study sought to determine whether the risk assessment processes in medical laboratories in Kenya are effective in mitigating hazards, whether proper protocols and training for handling hazardous substances are followed consistently, assessing whether laboratory professionals in Kenya consistently wear appropriate PPE, whether regular training and reminders are provided, assessing whether emergency plans and evacuation procedures are well-known and understood by laboratory professionals alongside proper incident reporting mechanisms; and determining whether ergonomic principles are considered in the design of workstations and equipment in medical laboratories in Kenya

Conceptual Framework

The measures tested include risk assessment (RA), the handling of hazardous substances (HZ), the use of personal protective equipment (PPE), emergency protocols (EP) and ergonomic principles (EG). The study evaluates these factors and their impact on the occupational safety and health of medical laboratory practitioners in Kenya.

2.0 Materials and Methods

This study employed a cross-sectional descriptive research design, appropriate for assessing the current state of Occupational Safety and Health (OSH) practices in medical laboratories at a specific point in time. The design allowed for the collection and analysis of data across different types of institutions, providing a snapshot of OSH integration across diverse laboratory environments in Kenya. The study population comprised 209 participants, who qualify as medical laboratory practitioners. These participants work in medical laboratories clustered as public, private, Non-Governmental Organizations (NGOs), Faith-Based Organizations (FBOs) or research institutions. Given the complexity of conducting a comprehensive inventory of all members of the study community, simple random sampling method was used employing an electronic questionnaire form. Due to the absence of a centralized national database of all practitioners, the study used a non-probability sampling method, specifically convenience and voluntary sampling, facilitated through electronic questionnaire distributed via email and social media platforms. Although referred to as simple random sampling, the online distribution nature introduces a self-selection element, thus making it more accurately described as convenience-based, with elements of stratification based on workplace category. From approximately 250 links sent, 209 responses were collected and documented, bringing the study sample to 209. Demographic characteristics were differentiated by highest level of completed training, facility type and level, alongside accreditation status. This allowed the sample to be representative of the population.

A closed questionnaire was employed to collect data. Once the data was collected, it was analyzed using the Statistical Package for the Social Sciences (SPSS v25) modeling quantitative method. The method enabled the gathering and grouping of data in an organized format, highlighting factors related to risk assessment processes (RA), handling of hazardous substances (HZ), usage of personal protective equipment (PPE), emergency protocols (EP) and ergonomic principles (EG).

The primary data set was the employee data gathered from the questionnaire. The SPSS method was employed on this data set to display descriptive statistics that helped categorize feedback into five main themes which were also labeled as the main variables. While the questions were diverse relative to the study's focus, they had similar or recurrent codes later displayed as the five themes for data analysis. Moreover, the questionnaire form consisted of 25 phrases testing the themes. A five-point Likert scale was used for theme responses. Ethical approval for the study was provided by the Kenya Methodist University (KEMU) Scientific ethics research committee (SERC) and the research license permit was issued by National Commission for Science Technology, and Innovations (NACOSTI) under License No: NACOSTI/P/25/417488

3.0 Results and Discussion

Stability and Reliability Analysis

Alpha Cronbach coefficient was used to measure the validity or reliability of the study tool. Overall, the results indicate that the study instrument, that is, the questionnaire

exhibited high levels of internal reliability or consistency, indicated by high alpha Cronbach coefficients (0.899) for each axis.

Socio-Demographic Variables

The highest level of training in Medical Laboratory Sciences among the respondents were, Certificate 1 (0.5%), Diploma 63 (30.1%), Higher National Diploma 13 (6.2%), Bachelors 108 (51.7%), Masters 21 (10%), PhD 3 (1.4%). Additionally, the years of experience among the respondents ranged from 1-37 with a mean of 13.32 years of work

Table 1

Facility Characteristics

Characteristics	Respondents work station	Frequency	Percentage
Facility Type	Government	157	75.1
	Private	33	15.8
	FBO	12	5.7
	NGO	4	1.9
	Research lab	3	1.4
	Total	**209**	**100**
Level/ class of laboratory	County	61	29.2
	Sub-county	71	34.0
	Routine basic	56	26.8
	National referral	21	10.0
	Total	**209**	**100**
Laboratory Accreditation Status	Fully accredited	55	26.3
	Not accredited	125	59.8
	On process	29	13.9
	Total	**209**	**100**

75.1 percent of the laboratories where the participants work are government owned, while 15.8 percent are private based. Non-Governmental organizations (NGOs) and Faith-based Organizations (FBO) make up for 7.6 percent, while 1.4 percent are research labs.

29.2 percent of the sampled laboratories are county level, while 34 percent are categorized as sub-county labs. Consequently 26.8 percent are routine basic and 10 percent are national referral. 59.8 percent of the laboratories represented are not accredited, while only 26.3 percent are fully accredited. 13.9 percent were in the process of being fully accredited.

Table 2

Descriptive Statistics and Correlation Analysis

Risk Assessment (RA)	N	Mean	Std.Dev	Correlation Coefficient	P-Value
The risk assessment process in my medical laboratory facility is thorough and comprehensive	209	3.42	1.174	0.671	< 0.001

Risk assessment results are effectively used to prioritize and mitigate hazards in my laboratory	209	3.47	1.241	0.778	< 0.001
Risk assessments are regularly reviewed and updated in my medical laboratory facility	209	3.16	1.206	0.414	< 0.001
I feel confident that potential risks and hazards in my laboratory are adequately identified and assessed	209	3.39	1.209	0.640	< 0.001
Risk assessment procedures in my medical laboratory facility are consistent and standardized	209	3.28	1.165	0.617	< 0.001
Average Count		3.35	0.975	0.624	< 0.001

Hazardous Substances (HZ)

	N	Mean	Std.Dev	Correlation Coefficient	P-Value
There is a clear understanding of the potential hazards associated with different substances used in my laboratory	209	3.92	1.058	0.721	< 0.001
The availability of safety equipment and materials for handling hazardous substances is satisfactory in my medical laboratory facility	209	3.64	1.140	0.647	< 0.001
Compliance with safety guidelines and procedures for handling hazardous substances is strongly encouraged and monitored in my laboratory	209	3.78	1.126	0.689	< 0.001
The necessary resources and training are provided to ensure safe handling and management of hazardous substances in my medical laboratory facility	209	3.32	1.296	0.576	< 0.001
Average Count		3.71	0.965	0.683	< 0.001

Personal Protective Equipment (PPE)

	N	Mean	Std.Dev	Correlation Coefficient	P-Value
There is a strong culture of PPE compliance among laboratory professionals in my medical laboratory facility	209	4.01	1.058	0.832	< 0.001
The availability and accessibility of PPE are sufficient in my laboratory	209	3.75	1.191	0.696	< 0.001
Regular training and reminders are provided to reinforce the importance of PPE usage in my medical laboratory facility	209	3.27	1.307	0.507	< 0.001
The use of PPE is strictly enforced and monitored in my laboratory	209	3.62	1.281	0.669	< 0.001
Average Count		3.75	1.001	0.691	< 0.001

Emergency Protocols (EP)

	N	Mean	Std.Dev	Correlation Coefficient	P-Value

Incident reporting mechanisms are easily accessible and widely used in my laboratory	209	3.50	1.256	0.708	< 0.001
Regular drills and exercises are conducted to test the effectiveness of emergency preparedness in my medical laboratory facility	209	2.53	1.305	0.488	< 0.001
There is clear communication and guidance during emergency situations in my laboratory	209	3.28	1.245	0.616	< 0.001
I feel confident that appropriate actions will be taken in case of an emergency in my medical laboratory facility	209	3.30	1.255	0.599	< 0.001
Average Count		3.19	1.05	0.614	< 0.001

Ergonomic Principles (EG)

	N	Mean	Std.Dev	Correlation Coefficient	P-Value
Adequate training and information are provided to promote proper ergonomic practices among laboratory professionals in my laboratory	209	2.90	1.241	0.691	< 0.001
Management actively supports and encourages ergonomic improvements in my medical laboratory facility	209	3.04	1.220	0.678	< 0.001
Regular assessments are conducted to identify and address ergonomic issues in my laboratory	209	2.78	1.209	0.649	< 0.001
Laboratory professionals are actively involved in providing feedback and suggestions for improving ergonomics in my medical laboratory facility	209	3.02	1.319	0.570	< 0.001
Average Count		2.96	1.071	0.648	< 0.001

Analysis

The correlation analysis shows that the questions under each independent variable (RA, HZ, PPE, EP, EG) are statistically significant toward testing the dependent variable (OSH). Each variable is statistically significant with a p-value less than 0.001 level of significance, showing a real relationship between the dependent and independent variables. Consequently, the Pearson correlation coefficient for each variable was positive reading as RA (0.624), HZ (0.683), PPE (0.691), EP (0.614), EG (0.648); indicating a positive linear relationship between the dependent and independent variables. In the Risk Assessment domain, respondents moderately agreed that risk assessment processes were thorough (Mean = 3.42, SD = 1.174) and that results were effectively used to mitigate hazards (Mean = 3.47, SD = 1.241). However, regular reviews of risk assessments had lower scores (Mean = 3.16, SD = 1.206). The overall average score for RA was 3.35 (SD = 0.975), with a strong correlation to outcome indicators ($r = 0.624$, $p < 0.001$). The Hazardous Substances (HZ) domain received relatively high scores, with respondents indicating consistent adherence to protocols (Mean = 3.90, SD = 1.124) and clear understanding of substance hazards (Mean = 3.92, SD = 1.058). The lowest score within this domain was on the availability of training and resources (Mean = 3.32, SD = 1.296). The average for HZ was 3.71 (SD =

0.965), with a strong correlation coefficient of 0.683 ($p < 0.001$). Respondents reported high levels of Personal Protective Equipment (PPE) use (Mean = 4.12, SD = 1.074) and strong compliance culture (Mean = 4.01, SD = 1.058). However, training and reminders had relatively lower scores (Mean = 3.27, SD = 1.307). The overall average for PPE was 3.75 (SD = 1.001), with a correlation coefficient of 0.691 ($p < 0.001$). The preparedness and awareness of Emergency Procedures (EP) scored moderately (Mean = 3.34, SD = 1.239), while regular drills were notably lacking (Mean = 2.53, SD = 1.305).

The domain average was 3.19 (SD = 1.05), indicating room for improvement in emergency preparedness. The correlation coefficient was 0.614 ($p < 0.001$). The Ergonomic Principles (EG) was the weakest domain overall. While workstation design was moderately considered (Mean = 3.07, SD = 1.258), regular ergonomic assessments (Mean = 2.78, SD = 1.209) and training (Mean = 2.90, SD = 1.241) received lower scores. The average for this domain was 2.96 (SD = 1.071), with a correlation coefficient of 0.648 ($p < 0.001$). Given that there is no significant difference between the variables' means that the data collected is representative of the study population. Consequently, the standard deviation (average) for each variable shows that the sample mean is representative of the population mean as it is lesser than the individual means. Overall, this illustrates that the data does not stray from the mean. Thus, the participants' responses are accurate and reliable.

T-Test

Table 3

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
RA	209	3.35	.975	.067
HZ	209	3.71	.965	.067
PPE	209	3.75	1.001	.069
EP	209	3.19	1.050	.073
EG	209	2.96	1.071	.074

Table 4

One-Sample Test

	Test Value = 0						
	t	df	Significance		Mean Difference	95% Confidence Interval of the Difference	
			One-Sided p	Two-Sided p		Lower	Upper
RA	49.594	208	<.001	<.001	3.345	3.21	3.48
HZ	55.641	208	<.001	<.001	3.713	3.58	3.84
PPE	54.249	208	<.001	<.001	3.755	3.62	3.89
EP	43.924	208	<.001	<.001	3.189	3.05	3.33
EG	39.989	208	<.001	<.001	2.961	2.82	3.11

Hypothesis

H_0: Medical laboratories in Kenya have not integrated effective occupational, safety and health standards that ensure employees' welfare.

H_1: Medical laboratories in Kenya have integrated effective occupational, safety and health standards that ensure employees' welfare.

Overall, the one-sample t-test indicates that the mean difference for RA, HZ, PPE, EP, and EG is statistically significant ($p < .001$). This suggests that each variable has a significant impact on the dependent variable, hence inferring to reject the null hypothesis.

All the scatter plots showed a higher concentration around the mean of the five variables; (RA, HZ, PPE, EP and EG). The trend line demonstrates a positive relationship between variables and the test factors as each moves to the high y-values

Table 5

The Dimension of Study

	N	Strongly Agree %	Agree %	Neutral %	Disagree %	Strongly Disagree %
Risk Assessment (RA)						
The risk assessment process in my medical laboratory facility is thorough and comprehensive	209	15.3	42.6	20.1	12.4	9.6
Risk assessment results are effectively used to prioritize and mitigate hazards in my laboratory	209	21.5	36.8	19.1	12.4	10.0
Risk assessments are regularly reviewed and updated in my medical laboratory facility	209	12.9	32.5	23.0	21.1	10.5
I feel confident that potential risks and hazards in my laboratory are adequately identified and assessed	209	18.2	37.3	18.2	18.2	8.1
Risk assessment procedures in my medical laboratory facility are consistent and standardized	209	13.9	36.4	21.5	20.6	7.7
Average		16.4	37.1	20.4	16.9	9.2
Hazardous Substances (HZ)						
There is a clear understanding of the potential hazards associated with different substances used in my laboratory	209	31.6	45.5	11.0	7.7	4.3
The availability of safety equipment and materials for handling hazardous substances	209	23.4	41.6	15.8	13.9	5.3

is satisfactory in my medical laboratory facility						
Compliance with safety guidelines and procedures for handling hazardous substances is strongly encouraged and monitored in my laboratory	209	30.1	37.8	16.3	11.5	4.3
The necessary resources and training are provided to ensure safe handling and management of hazardous substances in my medical laboratory facility	209	20.1	32.5	17.7	18.2	11.5
Average		28.1	38.8	15.2	11.7	6.1

Personal Protective Equipment (PPE)

	N	Strongly Agree %	Agree %	Neutral %	Disagree %	Strongly Disagree %
There is a strong culture of PPE compliance among laboratory professionals in my medical laboratory facility	209	37.3	41.1	12.0	4.8	4.8
The availability and accessibility of PPE are sufficient in my laboratory	209	31.6	34.4	18.7	8.1	7.2
Regular training and reminders are provided to reinforce the importance of PPE usage in my medical laboratory facility	209	19.1	31.1	21.5	14.4	13.9
The use of PPE is strictly enforced and monitored in my laboratory	209	29.7	32.5	18.7	8.6	10.5
Average		32.6	35.0	15.7	8.6	8.0

Emergency Protocols (EP)

	N	Strongly Agree %	Agree %	Neutral %	Disagree %	Strongly Disagree %
Incident reporting mechanisms are easily accessible and widely used in my laboratory	209	24.4	33.5	18.7	14.4	9.1
Regular drills and exercises are conducted to test the effectiveness of emergency preparedness in my medical laboratory facility	209	9.1	16.7	20.1	25.8	28.2
There is clear communication and guidance during emergency situations in my laboratory	209	15.8	36.4	19.6	16.7	11.5
I feel confident that appropriate actions will be taken in case of an emergency in my medical laboratory facility	209	17.2	34.0	22.0	14.8	12.0

Average		17.0	30.8	20.4	17.6	14.2

Ergonomic Principles (EG)

	N	Strongly Agree %	Agree %	Neutral %	Disagree %	Strongly Disagree %
Adequate training and information are provided to promote proper ergonomic practices among laboratory professionals in my laboratory	209	9.1	29.2	20.6	25.4	15.8
Management actively supports and encourages ergonomic improvements in my medical laboratory facility	209	11.0	28.7	27.8	18.2	14.4
Regular assessments are conducted to identify and address ergonomic issues in my laboratory	209	7.7	23.9	24.4	26.8	17.2
Laboratory professionals are actively involved in providing feedback and suggestions for improving ergonomics in my medical laboratory facility	209	15.3	24.9	23.0	20.1	16.7
Average		10.8	28.2	23.1	22.1	15.8
Total Averages (for all 5 vars across the likert scale)		**21.0**	**34.0**	**19.0**	**15.4**	**10.7**

Analysis

In the Risk Assessment domain, 42.6 percent agree that the risk assessment processes in their facilities are thorough and comprehensive, while 21.5 percent agree that RA results are effectively used to mitigate hazards. The scores are relatively lower for disagree and strongly disagree inputs for each question. For example, 10.5 percent strongly disagree that risk assessment procedures are regularly reviewed, while 21.1 percent disagree.

In the Hazard substances domain, 30.1 percent strongly agree that safety guidelines for handling hazardous substances are strongly encouraged, while 32.5 percent agree that necessary resources and training are provided for the same. In contrast, the scores are low for disagree and strongly disagree inputs for each question. For example, 4.3 percent strongly disagree that there is a clear understanding of hazardous elements while 13.9 percent disagree on the availability of safety equipment.

In the Personal Protective Equipment domain, 45.5 percent strongly agree that medical laboratory professionals wear appropriate PPE, while 34.4 percent agree that PPE are available and accessible. In contrast, the scores are low for disagree and strongly disagree inputs for each question. For example, 4.8 percent strongly disagree that there is a strong culture for PPE use, while 8.6 percent disagree that PPE is strictly enforced in the laboratory.

In the Emergency Protocols domain, 9.1 percent strongly agree that regular drills and exercises are conducted to test EP effectiveness, while 34 percent agree that they are confident in the nature of EPs in their laboratories. The scores are low for disagree

and strongly disagree inputs for each question. For example, 9.1 percent strongly disagree that EP reporting mechanisms are readily accessible while 16.7 percent disagree on clear communication of EPs.

In the Ergonomic Principles domain, 11 percent strongly agree that EGs are considered in the facility design, while 34.4 percent agree on the same. On the other hand, the scores are low for disagree and strongly disagree inputs for each question. For example, 15.8 percent strongly disagree that proper information and training regarding EGs is offered, while 25.4 percent disagree.

Overall, the total averages across all Likert scale points for all variables were calculated, and the results showed that 21 percent strongly agreed with all inputs, while 34 percent agreed. 15.4 percent disagreed across all questions tested, and 10.7 percent strongly disagreed. Approximately 19 percent of the participants remained neutral or undecided across the questions testing the 5 variables (RA, HZ, PPE, EP, and EG)

Discussion

The study's main goal was to evaluate the occupational safety and health standards (OSH) in medical laboratories in Kenya. The pivotal factors that assisted in that assessment included risk assessment processes (RA), handling of hazardous substances (HZ), usage of personal protective equipment (PPE), emergency protocols (EP) and ergonomic principles (EG). Consequently, the research framework deduced that if these factors were well integrated, then the medical laboratories in Kenya would steadily improve on fostering OSH to guarantee the overall productivity of employees. The five factors formed the study's independent variables alongside the demographic factors that were compiled to have a better understanding of the study population. As previous research shows, it is paramount to have effective policies and practices in place, to avert hazards and ensure the mental, socio-physical and economic wellness of employees (Mossburg, & Mensah, 2019; Muhammad & Kazmi, 2018). Once workers are satisfied, the same is easily transferred to patients and the healthcare ecosystems. Prior research has also highlighted RA, PPE, EG, HZ and EP issues as vital in qualifying OSH standards in medical laboratories, hence their relevance in this study.

It is important to state that the study participants are highly qualified in the area of study given that about 52 percent have a bachelor's degree qualification with over 10 years' experience. The participants work across the country's 47 countries in either public, private, FBO, NGO or research centered facilities. Thus, the sample was representative of the study population.

The study findings further demonstrated each variable's significance toward testing the dependent variable. The Pearson correlation coefficient for all independent variables was positive reading as RA (0.624), HZ (0.683), PPE (0.691), EP (0.614), EG (0.648); indicating a positive linear relationship between them and OSH as the dependent variable. About 60 percent of the laboratories represented are not accredited, while only 26 percent are fully accredited. Nonetheless, about 14 percent are on the process of being fully accredited. Although research on this element is scarce, a previous study showed that accredited and certified laboratories perform better on biosafety metrics (Muhammad et al., 2018).

Risk assessment metrics involved measuring how thorough, consistent, and sustainable mitigation factors are and an average of 37.1 percent agreed that all these measures were present in their respective laboratories. Additionally, as previous research shows, PPE use in medical laboratories is central in assuring OSH standards, because it is a protective mechanism for most of workplace

hazards (Muhammad & Kazmi, 2018). Approximately 35 percent of the current study's participants agreed that PPE materials are used appropriately and are readily available and accessible. The communication, testing and accessibility of emergency protocols was also evaluated with about 30 percent agreeing on their effectiveness. As prior studies indicate, the equipment available and the design of workstations is directly related to OSH standards, as also supported by the current study. Concurrently, 28.2 percent of study participants agreed that ergonomic principles are considered in the design, training and implementation of mitigation policies in medical laboratories in Kenya.

Despite the higher average percentages in regard to agree and strongly agree inputs, a significant number of participants disagreed with some issues that were tested. For instance, 21.1 percent disagree that risk assessment are regularly reviewed and updated, while 21.5 disagree on the consistency and standardization of RA metrics. Consequently, 18.2 percent disagree that necessary resources and training are provided to ensure safe handling and management of hazardous substances, while 14.4 percent disagree that regular training and reminders are offered to reinforce the essence of PPE usage. About 25.8 percent disagree that regular drills and exercises are conducted to test EPs effectiveness, while 25.4 percent disagree that regular training and information is offered to promote EGs. Moreover, 26.8 percent disagree that regular assessments are conducted to address EG issues, while 20.1 percent disagree on being actively involved in decision making regarding the implementation of these principles.

4.0 Conclusion

The results of the study illustrate that there is sufficient evidence to reject the null hypothesis and accept the alternative hypothesis that medical laboratories in Kenya have integrated effective occupational, safety and health standards to ensure employees' welfare. Concurrently, the findings demonstrate that each independent variable contributes directly to the effectiveness of OSH standards in medical laboratories in Kenya. As all Pearson correlation values range within 0.6, all variables have very slight difference in their significance toward the dependent variable. This agrees with prior research that effective implementation of risk assessment processes (RA), handling of hazardous substances (HZ), usage of personal protective equipment (PPE), emergency protocols (EP), and ergonomic principles (EG) fosters OSH in medical laboratories.

It is paramount to consider the elements that most participants disagreed with to understand what stakeholders must do to improve medical laboratory OSH standards in Kenya. From the data, these elements can be classified in sections involving training, standardization, regular assessment, communication, testing and employee inclusivity. Most participants who are also medical laboratory employees, disagree on being involved in decision making, or managers consistently communicating on developments across all the test factors. Consequently, most disagree with the training and testing or drill standards that are applied alongside receiving accurate information on the same.

These findings resonate with broader global health objectives. Strengthening OSH standards in Kenya's medical laboratories directly contributes to achieving Universal Health Coverage (UHC) by protecting healthcare workers who form the backbone of service delivery. Furthermore, the alignment of risk mitigation practices with WHO occupational safety guidelines enhances overall health system resilience. At

a global scale, this supports SDG 3 on ensuring healthy lives and SDG 8, which advocates for safe and secure working environments across all sectors.

5.0 Recommendations

Based on the findings, the study recommends that: there should be frequent and consistent training aligned with biosafety metrics; the management of medical laboratory facilities focus on effective mitigation of hazards; drills be conducted in line with standard training and emergency protocols; and that communication be streamlined and done with greater agility, besides establishing a system that allows for regular assessment of OSH standards. From a policy standpoint, the low levels of training and inconsistent PPE use observed in this study suggest a pressing need for targeted interventions. Regulatory agencies, such as the Kenya Medical Laboratory Technicians and Technologists Board (KMLTTB), should adopt mandatory refresher courses and increase audit frequencies to reinforce OSH compliance. Additionally, strengthening the linkage between accreditation status and OSH outcomes could prompt policymakers to embed stricter biosafety enforcement in licensing criteria.

Limitations and Scope for Future Research

There remains a pressing need for high quality data on the subject of whether the OSH measures are well implemented to diminish occupational hazards. While this study showcased the presence of OSH standards in grouped variables, it is vital to analyze each factor independently to illustrate the exact metrics that should be improved. For instance, data should show which risks exactly have been mitigated using what measures, what PPE materials are present and efficient and which EGs are most effective. Consequently, future research could investigate whether the issue of having some laboratories accredited impacts OSH standards' implementation alongside resources disparity across public and private facilities, and its impact on OSH of employees.

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