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Occupational Health Hazards and Safety Protocol Compliance among Clinical Staff across Tertiary and Secondary Healthcare Facilities in Gombe State, Nigeria: A Multi-Center Cross-Sectional Analysis

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Abstract

Background

Healthcare practitioners routinely confront diverse biological, physical, ergonomic, chemical, and psychological hazards. Sustained adherence to Occupational Safety and Health (OSH) guidelines and personal protective equipment (PPE) protocols remains central to preventing occupational injuries, controlling nosocomial infections, and safeguarding workforce capacity. However, baseline empirical data regarding safety compliance and hazard distribution across different health facility tiers in North-Eastern Nigeria are limited.

Objective

This study evaluated occupational safety practices, institutional safety policy awareness, and hazard exposure patterns among clinical personnel across five major public healthcare facilities in Gombe State.

Methods

We conducted a multi-center cross-sectional quantitative survey across seven clinical professions (Nursing/Midwifery, Medicine, Medical Laboratory Science, Pharmacy, Physiotherapy, Radiography, and Dentistry). A multi-stage stratified proportionate random sampling framework was applied to a regional clinical workforce of N_{pop} = 1,450 across five hospitals (Federal Teaching Hospital Gombe, State Specialist Hospital Gombe, Federal Medical Centre Kumo, General Hospital Bajoga, and General Hospital Kaltungo). To achieve adequate statistical power and preserve an Events Per Variable ratio > 25 for multivariable modeling, 575 questionnaires were distributed. We retrieved n = 502 valid questionnaires (87.3% response rate; covering 34.6% of the regional clinical workforce). Data were gathered using a validated tool adapted from the Weymouth Portland Health and Safety Self-Assessment Questionnaire (α = 0.83, Content Validity Index = 0.88). Chi-square tests (χ^2), Cramér's V effect sizes, and multivariable binary logistic regression models (reporting Adjusted Odds Ratios [aOR] and 95% Confidence Intervals [95% CI]) were performed ($p < 0.05$).

Results

Ergonomic strain emerged as the dominant hazard, with 76.5% (n = 384) of participants experiencing work-related musculoskeletal disorders primarily low back pain (51.2%) and neck/shoulder discomfort (25.3%) followed by high workload-related psychological stress (69.7%). Biological exposures were frequent: 56.4% reported mucosal or skin contact with blood and body fluids, while 43.2% sustained percutaneous needle-stick or sharps injuries within the preceding 12 months. PPE adherence varied

widely: standard glove utilization was high (93.2%), whereas use of facial protection (68.1%), protective gowns (47.4%), specialized safety footwear (31.5%), and protective eyewear or face shields (23.1%) was limited. Supply chain deficits and institutional stock-outs were identified by 80.5% of respondents as the primary obstacle to compliance, with secondary state hospitals reporting significantly higher stock-out frequencies than the federal tertiary center ($p < 0.001$). Hazard patterns differed significantly across professions ($\chi^2 = 82.45$, df = 6, $p < 0.001$, Cramér's V = 0.30). Multivariable logistic regression revealed that ≥ 5 years of clinical experience (aOR = 2.68, 95% CI: 1.82–3.95, $p < 0.001$) and completion of formal institutional OSH orientation (aOR = 3.42, 95% CI: 2.28–5.13, $p < 0.001$) independently predicted high PPE compliance. Conversely, nurses and physicians faced greater odds of percutaneous injury compared to allied health controls (aOR = 3.38, 95% CI: 2.21–5.17, $p < 0.001$).

Conclusion

Healthcare workers across public tertiary and secondary facilities in Gombe State experience notable ergonomic strain, psychological stress, and biological exposures. Although basic barrier practices are common, widespread compliance with comprehensive PPE protocols is hampered by supply deficits especially within secondary general hospitals and incomplete safety onboarding for early-career staff. Institutional safety management, mandatory orientation programs, ergonomic workspace adjustments, and stable supply procurement are needed to protect clinical personnel.

Clinical Trial Registration

Not applicable.

1. Introduction

Occupational Safety and Health (OSH) frameworks encompass institutional policies, administrative controls, engineering measures, and personal safety practices designed to protect employees from workplace hazards while maintaining operational efficiency (World Health Organization [WHO] & International Labour Organization [ILO], 2022). In clinical environments, maintaining effective safety structures is essential for mitigating occupational illness, reducing workforce turnover, and safeguarding quality of care (National Institute for Occupational Safety and Health [NIOSH], 2021).

Healthcare facilities present complex operational risks, including potential exposure to bloodborne pathogens, respiratory microorganisms, hazardous chemical reagents, diagnostic ionizing radiation, physical strains, and persistent psychological stress (Auta et al., 2018; WHO, 2021). Globally, occupational injuries and work-related illnesses account for significant morbidity among healthcare personnel, particularly in low- and middle-income countries where health infrastructure and resource allocation are often constrained (Centers for Disease Control and Prevention [CDC], 2023; ILO, 2023).

In sub-Saharan Africa, clinical safety management faces ongoing operational challenges, including erratic supplies of personal protective equipment (PPE), high patient-to-clinician ratios, inadequate ergonomic infrastructure, and variable enforcement of workplace safety standards (Ndejjo et al., 2018; Occupational Safety and Health Administration [OSHA], 2022). While tertiary health centers often possess dedicated infection control units, secondary regional hospitals frequently operate under restricted budgets and inconsistent supply chain channels (Federal Ministry of Health [FMOH], 2024).

Gombe State serves as a major clinical hub for North-Eastern Nigeria. However, multi-center empirical evaluations examining occupational hazard distributions, institutional policy implementation, and safety compliance across different facility tiers in this region remain scarce. This study evaluated OSH practices, identified hazard prevalence, and analyzed independent predictors of safety protocol compliance among clinical staff across five public tertiary and secondary health facilities in Gombe State.

2. Materials and Methods

2.1 Study Design and Setting

This multi-center cross-sectional quantitative survey was conducted across five major public hospitals in Gombe State, North-Eastern Nigeria, between October 2025 and February 2026:

1. **Federal Teaching Hospital (FTH), Gombe**: A 500-bed federal tertiary academic referral institution providing multi-specialty clinical services (Gombe Central Senatorial District).
2. **State Specialist Hospital (SSH), Gombe**: A 380-bed state-managed secondary referral hospital serving urban populations (Gombe Central Senatorial District).
3. **Federal Medical Centre (FMC), Kumo**: A federal secondary referral facility serving central and southern regional zones (Gombe Central/South Senatorial District).
4. **General Hospital (GH), Bajoga**: A state-managed secondary healthcare facility serving northern semi-urban and rural communities (Gombe North Senatorial District).
5. **General Hospital (GH), Kaltungo**: A state-managed secondary hospital serving southern agricultural communities (Gombe South Senatorial District).

2.2 Population and Eligibility Criteria

The target population comprised all actively practicing, licensed clinical personnel (N_{pop} = 1,450) across seven disciplines: Nursing/Midwifery, Medicine (Physicians), Medical Laboratory Science, Pharmacy, Physiotherapy, Radiography, and Dentistry.

- **Inclusion Criteria**: Registered clinical professionals employed at one of the five participating facilities for at least six consecutive months, actively engaged in direct patient care or diagnostic services, and providing written informed consent.

- **Exclusion Criteria**: Administrative non-clinical staff, health technologists, ward orderlies, environmental support personnel, and staff on extended study, annual, or medical leave during the survey period.

2.3 Sample Size Estimation and Sampling Strategy

The minimum required sample size was calculated using Cochran's formula with Finite Population Correction (FPC):

$n_0 = Z^2 \bullet p \bullet (1 - p)/e^2$

Where Z = 1.96 (95% Confidence Interval), p = 0.50 (maximum variance assumption), and e = 0.04 (4% precision margin). Applying these parameters yielded an uncorrected baseline sample of $n_0 = 600.25$. Adjusting for the finite regional workforce population (N_{pop} = 1,450):

$n_{adj} = 600.25/1 + (599.25/1450) \approx 425$

To accommodate potential design effects from multi-site sampling (Deff = 1.15) and compensate for unreturned or incomplete questionnaires (15%), the target distribution sample was expanded to **N = 575 questionnaires**.

A multi-stage stratified proportionate random sampling technique was implemented:

1. **Institutional Stratification**: Questionnaires were allocated across the five health facilities in direct proportion to their clinical workforce size (N_{pop}).
2. **Departmental Stratification**: Within each facility, allocation was proportionally distributed across the seven clinical professions based on duty rosters.
3. **Participant Selection**: Simple random selection via computer-generated random numbers applied to anonymized staff lists was used to identify individual respondents within each stratum.

2.4 Research Instrument and Reliability Validation

Data collection was conducted using a structured, English-language, self-administered questionnaire. The instrument was specifically adapted for this study by modifying the validated *Weymouth and Portland Health and Safety Self-Assessment Questionnaire* (Weymouth & Portland Borough Council, 2012) and refining items to align with national clinical safety guidelines (*Federal Ministry of Health [FMOH], 2024*). The complete English version of the finalized survey instrument is available in **Supplementary File S1**.

The questionnaire comprises four structured sections:

- **Section A**: Demographic and professional characteristics (age, gender, professional discipline, cadre, facility tier, and years of clinical experience).

- **Section B**: Safety practices and personal protective equipment (PPE) utilization. This section evaluates the routine use of five core PPE items (gloves, fluid-resistant masks, protective gowns, safety footwear, and face shields), institutional supply barriers, and waste management practices. Overall PPE compliance was calculated as a composite score across these five items; respondents achieving ≥ 80% compliance were classified as having "High Compliance" (n = 321), while those scoring < 80% were categorized as having "Sub-optimal Compliance" (n = 181).
- **Section C**: Safety policy awareness, institutional safety culture, and history of occupational safety and health (OSH) orientation.
- **Section D**: Occupational hazard exposure history, including musculoskeletal symptoms across anatomical regions, 12-month incidence of needle-stick/sharps injuries (NSIs), bio-fluid splashes, chemical exposures, and physical hazards.

Validation and Reliability

Content validity was evaluated by an expert panel of six public health and occupational medicine specialists, yielding an Item-Level Content Validity Index (I-CVI) of 0.88. Pre-testing among 30 clinical staff at Town Maternity Hospital, Gombe (a facility excluded from the primary sample frame) demonstrated strong internal consistency, yielding a Cronbach's alpha of $\alpha = 0.83$ for continuous scale domains and a Kuder–Richardson 20 (KR-20) coefficient of 0.81 for binary safety items. To minimize social desirability bias, survey completion was anonymous, and completed questionnaires were returned via locked collection boxes placed in staff breakrooms.

A total of **n = 502 validly completed questionnaires** were retrieved (87.3% net response rate), representing 34.6% of the regional clinical workforce.

Table 1 presents the sampling frame and response rates for a study across a multi-center healthcare network comprising five facilities in Gombe State. Out of a total staff population (Npop) of 1,450 across tertiary and secondary tiers, 575 questionnaires (N) were proportionately allocated and issued based on each facility's population weight. A total of 502 valid questionnaires (n) were retrieved, yielding an overall study response rate of 87.3%.

Key highlights of the sample distribution include:

- **Federal Teaching Hospital, Gombe (Tertiary/Federal)**: Represents the largest portion of the sampling frame (Npop = 650, 44.8% weight). It received 258 issued questionnaires, yielding 227 valid responses (88.0% response rate).
- **State Specialist Hospital, Gombe (Secondary/State)**: Comprises 22.1% of the population weight (Npop = 320), with 111 valid responses retrieved out of 127 issued (87.4% response rate).
- **Federal Medical Centre, Kumo (Secondary/Federal)**: Accounted for 14.5% of the total staff (Npop = 210), resulting in 72 valid responses from 83 issued questionnaires (86.7% response rate).

- **General Hospital, Bajoga (Secondary/State)**: Representing Gombe North (Npop = 140, 9.7% weight), 48 valid responses were returned out of 56 issued (85.7% response rate).
- **General Hospital, Kaltungo (Secondary/State)**: Representing Gombe South (Npop = 130, 9.0% weight), 44 valid responses were returned out of 51 issued (86.3% response rate).

Overall, response rates remained highly consistent across all five centers, ranging from 85.7% to 88.0%, ensuring balanced representation across geographical zones and healthcare delivery tiers. As shown in Table 1 below.

Table 1
Multi-Center Stratified Sample Allocation Matrix (N = 575, n = 502)

Facility Center	Tier & Region	Staff Population (Npop)	Weight (%)	Issued Questionnaires (N)	Valid Retrieved (n)	Response Rate (%)
Federal Teaching Hospital, Gombe	Tertiary / Federal (Gombe Central)	650	44.8%	258	227	88.0%
State Specialist Hospital, Gombe	Secondary / State (Gombe Central)	320	22.1%	127	111	87.4%
Federal Medical Centre, Kumo	Secondary / Federal (Gombe Central/South)	210	14.5%	83	72	86.7%
General Hospital, Bajoga	Secondary / State (Gombe North)	140	9.7%	56	48	85.7%
General Hospital, Kaltungo	Secondary / State (Gombe South)	130	9.0%	51	44	86.3%
TOTAL	**Multi-Center Network**	**1,450**	**100.0%**	**575**	**502**	**87.3%**

2.4 Research Instrument and Reliability Validation

Data collection used a structured self-administered questionnaire modified from the Weymouth Portland Health and Safety Self-Assessment Questionnaire and refined according to national clinical safety guidelines (FMOH, 2024). The instrument contained four domains:

- **Section A**: Demographic and professional profile (Age, Gender, Profession, Cadre, Facility, Practice Experience).
- **Section B**: Safety practices and PPE utilization (Routine use of gloves, fluid-resistant masks, protective gowns, safety footwear, and face shields; institutional supply barriers; waste disposal

practices). Overall PPE compliance was calculated as a composite score across 5 core equipment items; respondents achieving ≥ 80% compliance were classified as "High Compliance" (n = 321), while those scoring < 80% were categorized as "Sub-optimal Compliance" (n = 181).

- **Section C**: Safety policy awareness and institutional orientation history.
- **Section D**: Occupational hazard exposure history (Musculoskeletal symptoms by anatomical region; 12-month incidence of needle-stick/sharps injuries [NSIs]; bio-fluid splashes; chemical exposure; physical hazards).

Validation and Reliability

Content validity was reviewed by an expert panel of six public health and occupational medicine specialists, establishing an Item-Level Content Validity Index ({I-CVI) of 0.88. Pilot testing among 30 clinical staff at an unselected facility (Town Maternity Hospital, Gombe) demonstrated internal consistency, yielding a Cronbach's alpha of α = 0.83 for continuous scale domains and a Kuder-Richardson 20 (KR-20) coefficient of 0.81 for binary safety items. To reduce social desirability bias, survey completion was anonymous, and questionnaires were returned via locked collection boxes in staff breakrooms.

2.5 Statistical Analysis

Statistical processing was executed using IBM SPSS Version 28.0 and Stata Version 17:

1. **Descriptive Analyses**: Frequencies, percentages, means, and standard deviations summarized demographic characteristics, hazard exposure rates, and PPE compliance metrics.
2. **Bivariate Comparisons**: Pearson's Chi-square (χ^2) tests of independence, Fisher's Exact Tests, and Cramér's V effect sizes were computed to examine associations between safety compliance, professional discipline, experience levels, and facility tiers. Cramér's V values were interpreted as small (0.10), moderate (0.30), or large (≥ 0.50).
3. **Multivariable Modeling**: Binary multivariable logistic regression isolated independent determinants of high PPE compliance and 12-month percutaneous injury risk, controlling for potential confounders (age, gender, facility tier, cadre, experience, and OSH orientation). Adjusted Odds Ratios (aOR) with 95% Confidence Intervals (95% CI) were reported. Goodness-of-fit was confirmed using the Hosmer-Lemeshow test ($p > 0.05$), and variance inflation factors verified the absence of harmful multicollinearity (VIF < 2.5). Statistical significance was set at $\alpha = 0.05$.

3. Results

Data from n = 502 valid respondents were included in the final analysis.

3.1 Demographic and Professional Characteristics

The sample comprised 281 males (56.0%) and 221 females (44.0%). The Federal Teaching Hospital Gombe accounted for 45.2% (n = 227) of respondents, while secondary institutions collectively accounted for 54.8% (n = 275). Nursing/Midwifery represented the largest professional group (39.8%), followed by Medicine (22.3%), Medical Laboratory Science (14.1%), Pharmacy (9.8%), Physiotherapy (5.2%), Radiography (4.4%), and Dentistry (4.4%). Overall, 42.6% of participants possessed 1 to 5 years of post-qualification clinical experience. **As shown in 2 below.**

Table 2
Demographic Profile of Analytical Sample (n = 502)

Parameter	Sub-category	Frequency (n)	Percentage (%)
Facility Center	Federal Teaching Hospital, Gombe	227	45.2
	State Specialist Hospital, Gombe	111	22.1
	Federal Medical Centre, Kumo	72	14.3
	General Hospital, Bajoga	48	9.6
	General Hospital, Kaltungo	44	8.8
Facility Tier	Tertiary Facility (Federal)	227	45.2
	Secondary Facilities (State/Federal)	275	54.8
Gender	Male	281	56.0
	Female	221	44.0
Age Category (Years)	20–29	129	25.7
	30–39	228	45.4
	40–49	95	18.9
	≥ 50	50	10.0
Professional Cadre	Nursing / Midwifery	200	39.8
	Medicine (Physician)	112	22.3
	Medical Laboratory Science	71	14.1
	Pharmacy	49	9.8
	Physiotherapy	26	5.2
	Radiography	22	4.4
	Dentistry	22	4.4
Practice Duration	< 1 year	58	11.6
	1–5 years	214	42.6
	6–10 years	132	26.3
	> 10 years	98	19.5

3.2 Occupational Hazard Distribution

Hazard exposure rates are detailed in Table 3. Work-Related Musculoskeletal Disorders (WRMSDs) represented the most frequent occupational health issue, reported by 76.5% (n = 384) of participants.

Low back pain was the most common localized complaint (51.2%), followed by cervical/shoulder discomfort (25.3%). High workload-related psychological stress was reported by 69.7% of clinicians. Biological risks were prevalent across facilities: 56.4% reported mucosal or non-intact skin contact with blood or body fluids, and 43.2% sustained at least one needle-stick or sharps injury within the previous 12 months. As shown in 3 below.

Table 3
Occupational Hazard Exposures Reported by Clinical Personnel (n = 502)

Hazard Type	Specific Category / Anatomical Region	Frequency (n)	Percentage (%)
Ergonomic Strain	Work-Related Musculoskeletal Disorders (WRMSDs)	384	76.5
	— Low Back Pain	257	51.2
	— Cervical / Shoulder Strain	127	25.3
	— Wrist / Peripheral Joint Discomfort	51	10.2
Psychological Stress	High Workload / Operational Stress	350	69.7
Biological Exposure	Blood / Body Fluid Mucosal Splashes	283	56.4
	Needle-Stick / Sharps Injuries (NSIs)	217	43.2
Chemical Exposure	Disinfectant / Reagent Chemical Contact	168	33.5
Physical Factors	Excessive Noise / Ambient Workstation Heat	136	27.1

3.3 Equipment Utilization Patterns and Supply Barriers

Safety equipment usage varied considerably by product type (Table 4). Standard medical glove utilization was consistently high (93.2%). Conversely, routine use was lower for fluid-resistant face masks (68.1%), protective gowns/aprons (47.4%), specialized safety footwear (31.5%), and protective eyewear or face shields (23.1%). Equipment stock-outs and procurement shortfalls were cited by 80.5% (n = 404) of respondents as the primary reason for inconsistent PPE use. Institutional comparisons indicated that secondary state general hospitals reported significantly higher supply deficit rates (87.6%) than the tertiary teaching hospital (72.2%, $p < 0.001$). As shown in Table 4 below.

Table 4
Utilization Frequencies of Personal Protective Equipment (n = 502)

Equipment Item	Always (n,%)	Sometimes (n,%)	Never (n,%)	Primary Reported Constraint
Medical Gloves	468 (93.2%)	34 (6.8%)	0 (0.0%)	Regular Availability
Fluid-Resistant Masks	342 (68.1%)	128 (25.5%)	32 (6.4%)	Intermittent Stock-Outs
Protective Gowns / Aprons	238 (47.4%)	208 (41.4%)	56 (11.2%)	Frequent Stock-Outs
Safety Footwear / Boots	158 (31.5%)	176 (35.1%)	168 (33.5%)	Non-Provision by Facility
Eye Goggles / Face Shields	116 (23.1%)	192 (38.2%)	194 (38.6%)	Severe Stock-Outs

3.4 Cross-Tabulation and Bivariate Hypotheses Testing

Bivariate analyses demonstrated that clinicians with ≥ 5 years of practice experience maintained significantly higher safety compliance (χ^2 = 42.18, df = 3, $p < 0.001$, Cramér's V = 0.29) and safety policy awareness (χ^2 = 48.65, df = 3, $p < 0.001$, Cramér's V = 0.31). Hazard exposure patterns differed significantly across clinical professions (χ^2 = 82.45, df = 6, $p < 0.001$, Cramér's V = 0.30), with nursing and medical personnel reporting the highest biological exposure rates, whereas physiotherapists recorded the highest ergonomic strain burden (88.5%). Tertiary facility staff reported higher overall PPE availability compared to secondary hospital personnel (χ^2 = 24.82, df = 1, $p < 0.001$, Cramér's V = 0.22). Gender was not significantly associated with compliance levels (χ^2 = 0.28, df = 1, $p = 0.597$). As shown in Table 4 below.

Table 5

Bivariate Chi-Square (χ^2) Analyses and Effect Size Metrics (n = 502)

Sub-Hypothesis	Variable Comparison	Chi-Square (χ^2)	df	Cramér's V	p-value	Decision
Sub-Hypothesis 1	Compliance vs. Practice Experience	42.18	3	V = 0.29	p < 0.001	Rejected (p < 0.05)
Sub-Hypothesis 2	Compliance vs. Practitioner Gender	0.28	1	V = 0.02	p = 0.597	Retained (p > 0.05)
Sub-Hypothesis 3	Hazard Exposure vs. Profession	82.45	6	V = 0.30	p < 0.001	Rejected (p < 0.05)
Sub-Hypothesis 4	Policy Awareness vs. Experience	48.65	3	V = 0.31	p < 0.001	Rejected (p < 0.05)
Sub-Hypothesis 5	PPE Compliance vs. Facility Tier	24.82	1	V = 0.22	p < 0.001	Rejected (p < 0.05)

3.5 Multivariable Logistic Regression Analysis

Multivariable logistic regression models were developed to identify independent factors associated with high PPE compliance (n = 321) and 12-month percutaneous injury history (n = 217), adjusting for facility tier, age, gender, cadre, and experience (Table 6). Hosmer-Lemeshow testing confirmed acceptable model fit for PPE compliance (χ^2 = 7.42, p = 0.492) and sharps injuries (χ^2 = 5.81, p = 0.668).

Clinical practice duration ≥ 5 years independently predicted high PPE compliance (aOR = 2.68, 95% CI: 1.82–3.95, p < 0.001) and was associated with a lower likelihood of sharps injuries (aOR = 0.48, 95% CI: 0.32–0.72, p = 0.001). Formal institutional OSH orientation was associated with increased odds of compliance (aOR = 3.42, 95% CI: 2.28–5.13, p < 0.001) and lower odds of percutaneous injury (aOR = 0.38, 95% CI: 0.25–0.58, p < 0.001). Practice within the tertiary teaching hospital independently predicted higher PPE compliance relative to secondary facilities (aOR = 1.85, 95% CI: 1.26–2.72, p = 0.002). Nursing and medical personnel exhibited higher odds of sustaining percutaneous injuries compared to allied health professionals ({aOR} = 3.38, 95% CI: 2.21–5.17, p < 0.001). As shown in Table 5 below.

Table 6
Multivariable Logistic Regression Models for Safety Compliance and Sharps Injuries (n = 502)

Risk Factor	Category	High PPE Compliance (n = 321) aOR (95% CI)	p-value	Sharps Injury History (n = 217) aOR (95% CI)	p-value
Experience	< 5 years (Ref)	1.00	—	1.00	—
	≥ 5 years	2.68 (1.82–3.95)	**< 0.001***	0.48 (0.32–0.72)	**0.001***
Facility Tier	Secondary Hospitals (Ref)	1.00	—	1.00	—
	Tertiary Hospital (FTH)	1.85 (1.26–2.72)	**0.002***	0.76 (0.51–1.12)	0.165
Gender	Male (Ref)	1.00	—	1.00	—
	Female	0.94 (0.64–1.38)	0.758	0.88 (0.59–1.31)	0.528
Cadre	Allied Health Controls (Ref)	1.00	—	1.00	—
	Nursing / Medicine	1.36 (0.91–2.03)	0.132	3.38 (2.21–5.17)	**< 0.001***
OSH Onboarding	No Formal Training (Ref)	1.00	—	1.00	—
	Received Orientation	3.42 (2.28–5.13)	**< 0.001***	0.38 (0.25–0.58)	**< 0.001***

*Statistically significant at $p < 0.05$. **aOR**: Adjusted Odds Ratio; **CI**: Confidence Interval; **Ref**: Reference Category.

Note

The "Allied Health Controls" reference category (n = 190) aggregates Medical Laboratory Science (n = 71), Pharmacy (n = 49), Physiotherapy (n = 26), Radiography (n = 22), and Dentistry (n = 22) to maintain model stability.

4 Discussion

This multi-center investigation evaluated occupational health hazards, safety compliance patterns, and institutional predictors across five public healthcare facilities in Gombe State. By surveying n = 502 clinical professionals across tertiary and secondary healthcare levels, the study captured diverse operational contexts within the regional health system.

4.1 Ergonomic and Psychological Stress Burden

Ergonomic hazards constituted the primary source of reported morbidity, with 76.5% of clinicians experiencing work-related musculoskeletal symptoms. Low back pain (51.2%) and cervical/shoulder strain (25.3%) were particularly prominent. These findings align with reports from healthcare settings across sub-Saharan Africa, where manual patient handling, non-adjustable ward furniture, and prolonged standing during procedures are common (Ndejjo et al., 2018; WHO & ILO, 2022).

Physiotherapists reported the highest professional rate of ergonomic strain (88.5%), reflecting the physical demands of therapeutic patient transfers and manual mobilizations. Alongside physical strain, 69.7% of respondents reported high workload-related psychological stress, underscoring the compounding effects of staffing constraints and high patient volumes in public facilities.

4.2 Biological Exposures and Percutaneous Injury Risks

Biological risks remain an ongoing operational issue, evidenced by high rates of bio-fluid contact (56.4%) and percutaneous sharps injuries (43.2% over 12 months). Multivariable modeling indicated that nursing and medical staff faced more than three times the odds of percutaneous injury compared to allied health personnel (aOR = 3.38, $p < 0.001$). This increased risk relates directly to frequent involvement in high-volume invasive procedures, phlebotomy, surgical interventions, and emergency resuscitations, where rapid tasks and unexpected patient movements increase exposure opportunities (Auta et al., 2018; CDC, 2023).

4.3 PPE Compliance Disparities and Resource Constraints

Although routine glove utilization was widespread (93.2%), adherence to specialized protective gear such as fluid-resistant masks (68.1%), protective gowns (47.4%), specialized footwear (31.5%), and eye shields (23.1%) was lower. Crucially, 80.5% of surveyed staff identified institutional stock-outs and procurement supply gaps as the main barrier to complete compliance.

The multi-center analysis highlighted resource disparities between health facility tiers: staff at the federal tertiary teaching hospital were significantly more likely to maintain high PPE compliance (aOR = 1.85, $p = 0.002$) and experienced fewer stock-outs than staff in state secondary general hospitals. When specialized items are unavailable, clinicians routinely prioritize basic hand barrier protection while foregoing facial and eye protection, leaving mucous membranes exposed during higher-risk clinical procedures.

4.4 Institutional Predictors of Safety Compliance

Multivariable regression demonstrated that clinical experience ≥ 5 years (aOR = 2.68) and participation in formal institutional OSH orientation (aOR = 3.42) independently predicted higher safety compliance and lower percutaneous injury rates. Newly recruited personnel are often deployed directly into high-volume clinical settings without structured training on local infection control protocols, waste management procedures, or post-exposure prophylaxis reporting workflows (NIOSH, 2021). Providing systematic safety orientation for early-career clinicians represents a clear opportunity to improve compliance and lower injury risks. Practitioner gender was not associated with compliance levels (aOR = 0.94, $p = 0.758$),

indicating that safety practices are primarily shaped by institutional and environmental factors rather than demographic variations.

4.5 Limitations

Several methodological limitations should be considered:

1. **Self-Reported Data**: Outcome measures such as 12-month injury histories and PPE compliance relied on self-reported survey responses, which may be subject to recall or social desirability biases. However, given that official administrative incident registers in resource-constrained environments often suffer from under-reporting due to fear of disciplinary consequences, anonymous self-surveys provide valuable baseline data.
2. **Cross-Sectional Structure**: The observational design precludes establishing direct cause-and-effect relationships between specific institutional policies and long-term health outcomes, although multivariable adjustment provided control for key confounding factors.

5. Conclusion and Recommendations

Clinical staff across public tertiary and secondary healthcare facilities in Gombe State face notable ergonomic, psychological, and biological workplace hazards. While basic hand protection is widely used, overall safety compliance remains constrained by institutional supply shortages for specialized protective equipment particularly within secondary state general hospitals—and inconsistent safety onboarding for early-career staff.

To address these challenges effectively within regional resource limits, interventions are prioritized by feasibility and operational impact:

Immediate Administrative Interventions:

1. **Mandatory Safety Orientation**: Establish compulsory OSH onboarding modules covering biological risk management, sharp waste handling, ergonomic principles, and post-exposure prophylaxis workflows for all newly hired clinical personnel prior to ward placement.
2. **Institutional Safety Committees**: Activate functional OSH oversight committees in secondary hospitals to maintain anonymous hazard reporting registers, conduct routine risk audits, and oversee local safety protocol enforcement.

Medium-Term Capital and Logistics Interventions:

1. **Regional Supply Chain Logistics**: Develop centralized buffer inventory systems through the State Ministry of Health to prevent supply interruptions of essential protective items, particularly in secondary general hospitals.
2. **Ergonomic Workstation Upgrades**: Introduce adjustable patient beds, mechanical transfer aids, and clinical posture training programs to reduce work-related musculoskeletal strain.

Declarations

Ethics Approval and Consent to Participate: Ethical clearance was granted by the Health Research Ethics Committee of the Ministry of Health, Gombe State (Protocol Reference: MOH/ADM/621/V.I/184), with administrative concurrence from all participating hospital management boards. Written informed consent was obtained from all participants prior to data collection. Study procedures adhered to the principles of the Declaration of Helsinki.

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