Original Article

Nurses Knowledge Regarding Occupational Health Hazards at Dongola Specialized Teaching Hospital Northern-State (2025)

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Abstract

Background: Nurses working in critical care units face substantial occupational hazards that may affect their safety, performance, and well-being. **Objectives:** This study was to assess nurses' knowledge regarding health occupational hazards and their exposure to biological and psychological risks in Dongola Specialized Teaching Hospital, Sudan. **Methods:** A descriptive cross-sectional study was conducted in March 2025 among 140 ICU and Emergency Department nurses selected through convenience sampling. Data was collected using a validated, self-administered questionnaire based on WHO and International Labour Organization occupational health and safety guidelines. Knowledge scores were categorized using Modified Bloom's criteria, and data analysis was performed using SPSS version 26. **Results:** Participants were predominantly young, female, bachelor-educated, and early in their careers. High levels of exposure to biological hazards were reported (85.5%), particularly contact with contaminated specimens (90.7%) and

sharp injuries (87.9%). Psychological hazards, including stress (94%) and verbal abuse (92%). Although most nurses acknowledged the availability of safety guidelines (65%), notable gaps remained.

83% of the participants demonstrated good knowledge of occupational hazards, with no significant associations between knowledge and demographic variables (p > 0.05).

Conclusion: Despite strong knowledge of occupational hazards, nurses in critical care units continue to face high levels of biological and psychological risks. Strengthening safety protocols, improving institutional support systems, and ensuring consistent training are essential to enhance workplace safety and protect nursing staff.

Key words: Nurses, Occupational health hazards, Hospital, Northern State, Sudan;

Introduction

Background: Occupational health hazards remain a significant global public health concern, particularly within the healthcare sector. According to international occupational safety reports, millions of healthcare workers are exposed to biological hazards, toxic chemicals, physical and ergonomic risks, and psychosocial stressors each year [1]. The World Health Organization (WHO) estimates that healthcare personnel, including nurses, experience a disproportionately high burden of work-related illnesses and injuries, including infectious diseases, needle-stick injuries, musculoskeletal disorders, and workplace violence [2]. These hazards contribute not only to physical harm but also to substantial economic losses through increased absenteeism, reduced productivity, and long-term disability [3].

Nursing is considered one of the most hazardous professions due to frequent direct contact with patients and continuous exposure to clinical procedures. They are frequently exposed to blood and body fluids,

with recent studies revealing more than half of registered nurses reporting such exposures and significant under-reporting of incidents [4]. Nurses also experience musculoskeletal strain, especially from lifting and transferring patients, which correlates with high exposure to ergonomic hazards and is associated with back, upper-limb, and lower-limb pain [5]. In addition, psychosocial stress, including high job demands, poor social support, and work–life imbalance, has been linked to musculoskeletal disorders across various body areas [6]. Research shows that more than half of nurses report high vulnerability to occupational hazards, largely due to the nature and intensity of their clinical duties [7]. Furthermore, many incidents go underreported, especially when perceived as minor or routine, with needle-stick injuries being among the few consistently documented events [8].

Studies conducted in low- and middle-income countries reveal that occupational hazards among nurses are often exacerbated by inadequate staffing, insufficient training,

lack of protective equipment, and weak reporting and surveillance systems [9]. High rates of musculoskeletal pain (up to 89% in some settings), increased exposure to infectious diseases, and a prevalence of needle-stick injuries exceeding 70% have been reported in countries such as Iran, Nepal, and parts of Sub-Saharan Africa [10,11]. In many facilities, occupational health services are poorly organized or entirely absent, leaving nurses without proper preventive strategies or post-exposure management systems [12].

In Sudan, nurses constitute the backbone of hospital-based care, especially in governmental and specialized teaching hospitals. However, occupational health systems remain limited, with challenges including scarce personal protective equipment (PPE), inadequate training programs, and the absence of structured occupational safety policies [13]. Hospitals in the Northern State, including Dongola Specialized Teaching Hospital, follow similar patterns, where nurses face risks of biological exposure, back injuries due to patient handling, psychological stress, and procedural hazards such as needle-stick injuries [14]. Despite the presence of basic infection prevention guidelines, adherence

and enforcement remain inconsistent due to resource constraints and heavy workloads [15].

Although nurses in Sudan routinely encounter occupational hazards, there is limited evidence assessing their knowledge regarding the causes, prevention, and management of such hazards. The lack of systematic reporting mechanisms further complicates understanding the true burden of occupational risks. Existing studies indicate that nurses' knowledge and preventive practices are critical determinants of workplace safety [16], yet no comprehensive assessment has been conducted in Dongola Specialized Teaching Hospital. This gap highlights the need for research to evaluate nurses' knowledge, identify deficiencies, and strategies to improve occupational health and safety standards within the facility.

Materials and Methods

A descriptive cross-sectional hospital-based study was conducted at Dongola Specialized Teaching Hospital in Northern State, Sudan, during the year 2025. Data collection took place from the 1st to the 31st of March 2025. The study population consisted of nursing staff who were directly involved in patient care in critical areas, specifically the

Intensive Care Unit (ICU) and the emergency Departments. A non-probability convenience sampling technique was used, yielding a final sample size of 140 nurses. Inclusion criteria for nurses involved in the study were, a higher nursing qualification level such as Diploma, bachelor's degree, master's degree and/or PhD; should be registered with the Sudan Council for Medical and Health Professions and had at least one year of clinical experience in the ICU or Emergency Department. Those who did not meet these requirements, as well as nurses who participated in the pilot study, were excluded.

Data was collected using a structured, self-administered questionnaire developed by the researchers in accordance with international occupational health and safety guidelines, WHO, International Labour Organization, *caring for those who care: Guide for the development and implementation of occupational health and safety [16].* The questionnaire contained five sections: socio demographic data, nurses' knowledge about biological hazards, nurses' knowledge about psychological hazards, nurses' Knowledge about strategies/guidelines on occupational safety and Nurses' Knowledge about occupational Hazards. Content validity was assessed by a panel of five experts in nursing and occupational health. To establish reliability, a pilot study involving 14 nurses was conducted, and these participants were excluded from the main study. Reliability testing using Pearson's correlation coefficient yielded a value of $r = 0.80$, indicating good internal consistency of the instrument.

The dependent variable in the study was nurses' knowledge of occupational health hazards, while the independent variables included age, gender, educational qualification, years of experience, and participation in occupational health training courses. Given the ongoing conflict and safety challenges in Sudan, data were collected online using a Google Form to ensure accessibility and confidentiality. Each correct response in the knowledge assessment was awarded one point, and incorrect responses scored zero.

the study uses Modified Bloom's Cutoff point (as example commonly used in African and Asian nursing studies for the knowledge measurement [17] as follows:

75% = good Knowledge, 50–74% = moderate Knowledge, <50% = poor Knowledge.

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS, version 26). Descriptive statistics, including frequencies and percentages, were used to summarize demographic characteristics and knowledge levels. Pearson correlation analysis was used to examine relationships between knowledge scores and selected demographic variables, while Chi-square tests assessed associations between categorical variables. Statistical significance was set at a p-value of 0.05 or less, and findings were presented in tables and figures for clarity.

Ethical Consideration

Ethical approval for this study was obtained from the Research Committee of the Graduate College of Medical and Health Studies, University of Alneelain, Faculty of Nursing Science. Additional permission was granted by the Khartoum State Ministry of Health Research Department and Dongola Specialized Teaching Hospital. The objectives and procedures of the study were clearly explained to the hospital administration and all eligible participants before data collection.

Due to the observational and minimal-risk nature of the study, written consent was waived, and **verbal informed consent** was obtained from each participant. Participation was entirely voluntary, and individuals were informed of their right to withdraw from the study at any time without any consequences. Confidentiality and anonymity were strictly maintained; no personal identifiers were collected, and all data were used solely for research purposes. Data were stored securely on a password-protected device accessible only to the research team.

Results

There were 140 participants in this study, the majority were females (83.6%). Most of the participants (87.1%) were aged 25 – 29 years. See figure 1
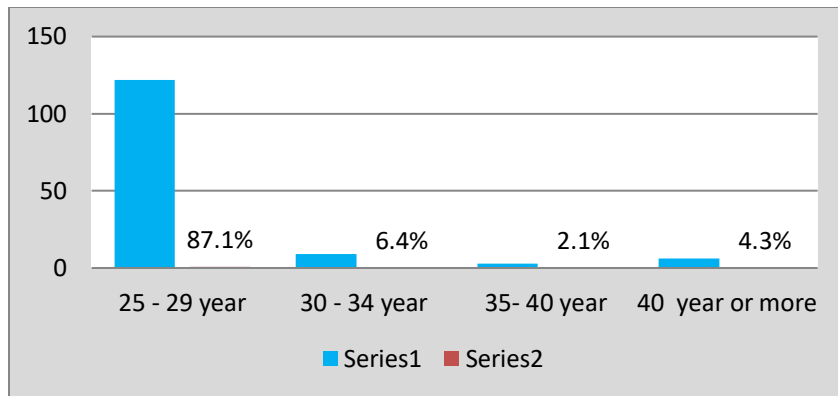
Figure (1): Distribution of participants age group n=140

The vast majority of the participants (88.6%) held bachelor's degree. See figure 2
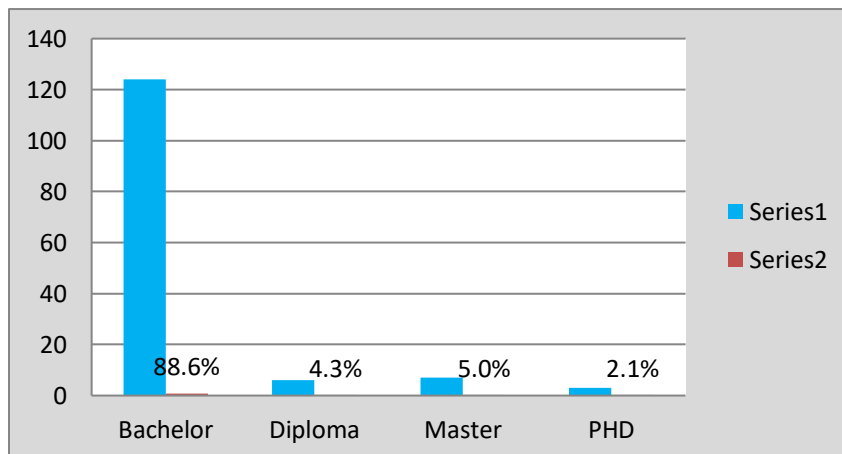

Figure (2): Distribution of participant's level of qualifications n=140

Figure 3 shows the participants years of experience. There was a Strong Concentration in Early Careers: over 90% having less than 10 years of experience. This shows that the dataset represents a predominantly junior workforce.
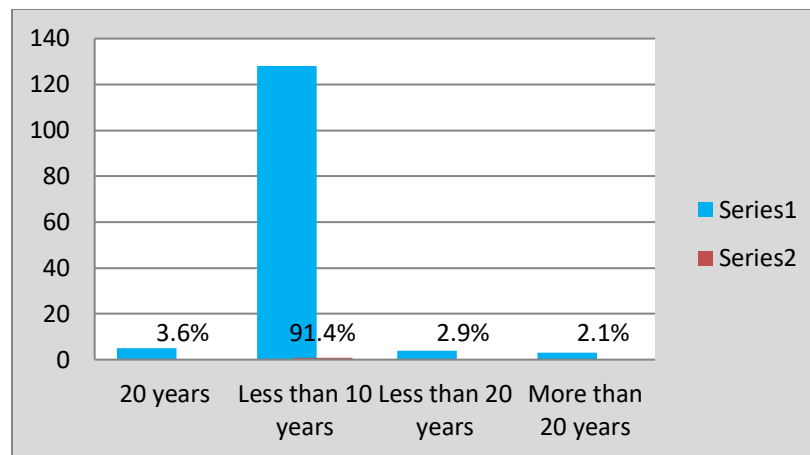
Figure (3): Distribution of participant's years of experience n=140

Figure 4 shows the distribution of study participants qualifications. Registered nurses represent two-thirds (63.6%) of the workforce, showing that the dataset is mainly composed of frontline staff providing direct patient care. Although Head Nurses has significant minority (one-quarter) (25.0%) but hold supervisory or leadership positions which indicate a moderate level of managerial roles.
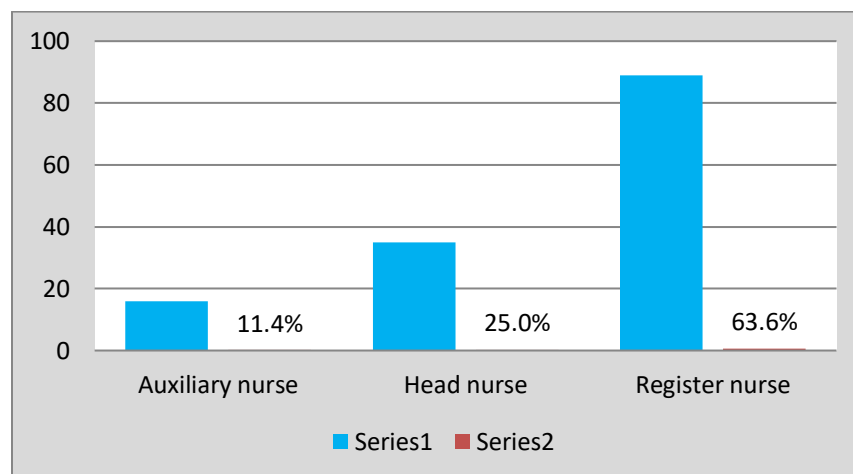

Figure (4): Distribution of study participants Job description + level: n=140

Figure (5) illustrates the distribution of nurses across hospital departments. Ward Nurses Form the Largest Group where more than two-fifths of the staff work in general wards, showing that the majority of nursing resources are allocated to inpatient care. Critical Care Staff (ICU +

Emergency): Together the ICU (26.4%) and Emergency Department (27.1%) account for just over half of the workforce, reflecting significant staffing needs in high-acuity areas.

Cardiac Care Unit Only 4.3% are assigned to the CCU, suggesting either a smaller unit size or limited demand compared to other departments.

If this reflects a hospital workforce, the distribution shows an emphasis on general patient care (wards) but also a strong allocation to critical care and emergency services, which are resource intensive.

The low CCU proportion may indicate that specialized cardiac care is either centralized in a different facility or requires fewer nurses relative to general and emergency services.
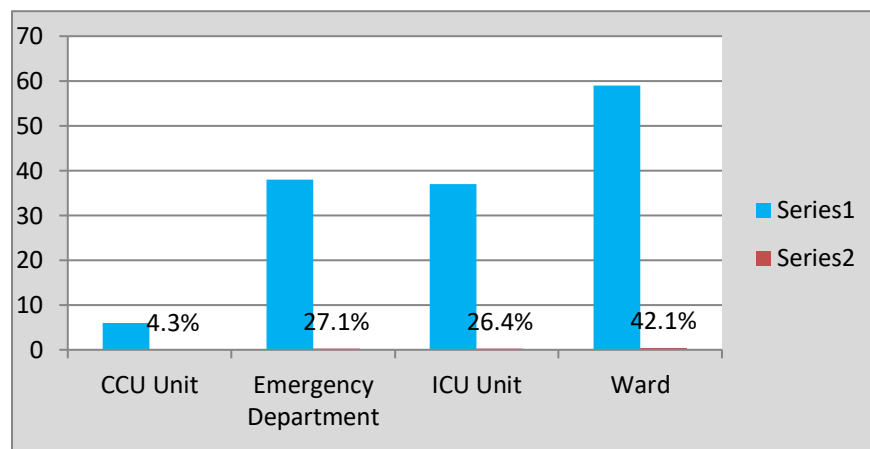

Figure (5). Distribution of participants work place n= 140

Figure (6) illustrates nurses' responses regarding the availability and consistency of training programs. Majority of nurses (67.9%) confirmed that they do receive training programs, suggesting that institutions are making efforts to provide educational and skill-updating opportunities. Those who answered by sometimes are (20.0%). As well about one-fifth of nurses reported that training programs are offered only occasionally or irregularly, indicating inconsistency in implementation. A minority who answered by No (12.1%) still stated they do not receive training programs at all, highlighting a gap in staff development.

Training plays a crucial role in ensuring knowledge of safety protocols, updated clinical skills, and compliance with infection control practices.
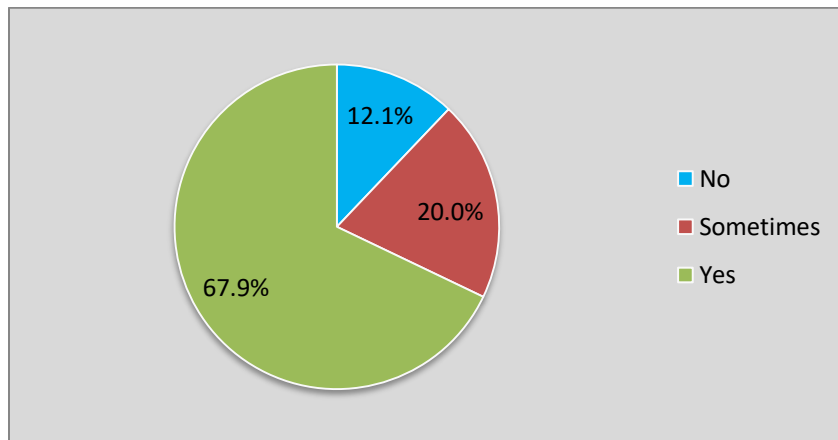

Figure (6): Distribution of participants according to their exposure to training program: n=140

Figure (7) shows the distribution of working hours among individuals in a dataset. It shows nearly half of respondents (49.3%) reported sleeping less than 8 hours per day, suggesting reduced or flexible work schedules. Standard work hours reflect one-third (34.3%) work the conventional 8-hour shift, which is common in many workplaces. Extended hours represent (16.4%) reported working more than 8 hours, reflecting a smaller but significant portion facing heavier workloads or overtime. It is interpreted that if this data is from a healthcare setting (nurses, as earlier charts suggested), it indicates that while most staff have standard or even shorter shifts, a notable minority face extended hour, which could contribute to workload stress, fatigue, and job dissatisfaction. The large share of more-than-8-hour shifts could reflect part-time roles, rotation policies, or administrative adjustments to manage staffing needs.
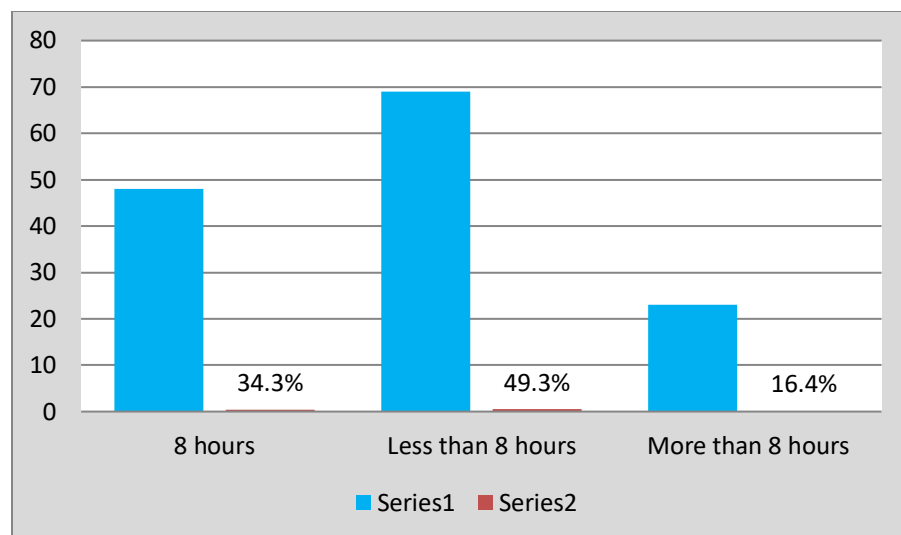
Figure (7): The distribution of daily hours of sleep among participants' =140

Table (1) Distribution of items related to participants awareness of biological hazards n=140

Items Description	Yes / Freq %	NO / Freq %	Total
Cuts	110 (78.6%)	30 (21.4%)	100%
Wounds	124 (88.6%)	16 (11.4%)	100%
Laceration	107 (76.4%)	33 (23.6%)	100%
Sharp related injuries	123 (87.9%)	17 (12.1%)	100%
Direct contact with contaminated specimens	127 (90.7%)	13 (9.3%)	100%
Air borne diseases	122 (87.1%)	18 (12.9%)	100%
Cross contamination from solid materials	122 (87.1%)	18 (12.9%)	100%
Infectious diseases	123 (87.9%)	17 (12.1%)	100%
Average	85.5%	14.5%	100%

Table (1) shows the distribution of biological hazards encountered by the study population. There was high prevalence of occupational hazards shown among the majority of nurses (85.5%) reported exposure to at least one form of occupational hazard, indicating a significant safety concern in the hospital environment.

Most common hazards in present contact with contaminated specimens (90.7%) and exposure to wounds (88.6%) were the most frequently reported, followed closely by sharp-related injuries and infectious diseases.

Least reported hazards present cuts (78.6%) and lacerations (76.4%) were slightly less frequent but still affect more than three-quarters of nurses.

These findings underscore the urgent need for improved occupational safety measures, especially infection control, proper disposal of sharps, and consistent use of personal protective equipment (PPE)

Table (2) Distribution of items related to participants awareness of psychological hazards among study population n =140

Item Description	Yes /Freq & %	No/ Freq & Perc	Total
Stress	131 (94%)	9 (6.4%)	100%
Verbal abuse	129 (92%)	11 (7%)	100%
Rewards	85 (61%)	55 (39%)	100%
Support	86 (61%)	54 (39%)	100%
Average	77%	45%	

Table (2) shows distribution of psychological hazards among the study population. High prevalence of negative factors like Stress (94%) and verbal abuse (92%) are extremely common, indicating a challenging and possibly unsafe work environment.

Moderate positive factors like rewards (61%) and support (61%) were present but not universal, showing room for improvement in motivation and organizational backing.

The findings highlight the need for workplace interventions to reduce stress and abuse while enhancing reward systems and staff support mechanisms.

Table (3). Distribution of study participants of strategies or guideline of practices on occupational safety n=140

Items Description	Yes / Freq & Percent.	No / Freq & Percent	Total
Information provided on how to prevent occupational hazards	113 (81%)	27 (19%)	100%
Is the information provided adequately?	92 (66%)	48 (34%)	100%
If there is any suffering of occupational injuries, is there any support provided ?.	86 (61%)	54 (39%)	100%
Do you get satisfied support?	79 (56%)	61 (44%)	100%
Do you think that the strategies in place which deal with occupational injuries are adequate?	82 (59%)	58 (41%)	100%
Average	65%	35%	100%

Table (3) shows the distribution of the study participants responses regarding strategies or guidelines on occupational safety. It focuses on availability of information, adequacy of information, and support in case of occupational injuries. On average, nearly two-thirds of the

nurses (64.6%) reported the presence of adequate information, support, and preventive strategies related to occupational hazards.

However, the remaining 35.4% indicated deficiencies, suggesting room for improvement in communication, training, and institutional response mechanisms

Table (4). Distribution of Participants Level of Knowledge about Occupational Hazard: n=140

Level of Knowledge about Occupational Hazard		Poor	Moderate	Good	Total
Biological Hazards	N	5	23	112	140
	%	4%	16%	80%	100%
Psychosocial hazards	N	9	41	90	140
	%	6%	29%	64%	100%
Total	N	2	22	116	140
	%	1%	16%	83%	100%

Table (4) presents the level of knowledge about occupational hazards among participants, categorized into Biological Hazards and Psychosocial Hazards.

Overall, Knowledge:

- Poor Knowledge: Only 1% of participants exhibit poor knowledge overall.

- Moderate Knowledge: Approximately 16% of participants have a moderate level of knowledge.

- Good Knowledge: The majority, which accounts for 83% of participants, possess a good level of knowledge across all occupational hazards.

The data suggests a strong understanding of both biological and psychosocial   hazards among participants, with a significant majority demonstrating good knowledge in these areas.

Table (5). Association of Participants Knowledge & Demographic Data (n=140)

Variables				Knowledge about Occupational hazard			Chi-Square Tests P-value	Correlation Coefficient
				Poor	Moderate	Good		
Years of experience	0-4	N		0	0		0.607	0.14
		%		0%	0%	0%		
	5-9	N		2	22	104		
		%		2%	17%	81%		
	10-19	N		0	0	4		
		%		0%	0%	100%		
	20+	N		0	0	8		
		%		0%	0%	100%		
Having training program	No	N		0	4	13	0.727	0.05
		%		0%	24%	76%		
	Sometimes	N		0	5	23 between the Demographic Data		
		%		0%	18%	82%		
	Yes	N		2	13	80		
		%		2%	14%	84%		
Practices on Occupational Hazards	Bad	N		0	4	14	0.203	0.16
		%		0%	22%	78%		
	Moderate	N		1	6	15		
		%		5%	27%	68%		
	Good	N		1	12	87		
		%		1%	12%	87%		

Table (5) presents the Participants Knowledge association with the demographic data

All p-values are greater than 0.05, indicating no statistically significant relationships between nurses' knowledge of occupational hazards and their years of experience, training attendance, or practices.

All correlation coefficients are positive but weak (0.05–0.16), suggesting that while better experience, training, or practice may be associated with improved knowledge, these associations are not strong or significant statistically

Discussion

This study examined nurses' demographic characteristics, knowledge levels, and exposure to occupational hazards at Dongola Specialized Teaching Hospital. The demographic profile revealed that the majority of participants were female (83.6%), young (25–29 years), bachelor-educated, and early in their careers. This demographic pattern shows strong similarity to studies in low- and middle-income settings, for example in the United Arab Emirates, where a large-scale survey found that most nurses were female, aged ≤ 30, and held a bachelor's degree. But in a study done in a tertiary health facility in Nigeria [18] The similarity is justified by the persistent global trend of nursing being a female-dominated profession, especially in socio-cultural contexts where gender norms influence workforce composition. However, the younger age distribution in this study contrasts with data from high-income countries, such as the UK, where the nursing labour force is notably older: for instance, the UK Nursing Labour Market Review reported increasing proportions of registered nurses aged over 50 years [19-20]. Similarly, in Canada, a national survey found that more than 60% of nurses were aged 45 or older [21]. This contrast is justified by differences in workforce dynamics: while high-income countries may retain more experienced staff due to stronger retention systems and pension structures, settings like Sudan may experience migration or attrition of senior nurses, resulting in a predominantly younger nursing workforce. In addition, the higher proportion of bachelor-degree nurses in this study contradicts patterns seen in parts of Africa such as Nigeria, where diploma or certificate-level training remains common among nurses. For instance, in a Nigerian study of healthcare workers, many nurses still held non-degree credentials, despite awareness of occupational risk [22]. This

contrast is justified by recent educational reforms: Sudan may be pushing for higher academic qualifications (e.g., bachelor's degrees) for professional nursing roles, which would elevate the educational profile of its nursing workforce.

Workforce distribution in high-acuity departments (such as wards, ICUs, and emergency units) shows similarity to findings from other low-resource settings, such as Uganda and Ethiopia [23,24]. Hospitals in many countries allocate a disproportionate share of staffing to units that handle critical-care or high-acuity patients, because these units require more intensive nursing skills and higher nurse-to-patient ratios [23, 24]. Such staffing logic applies universally, supporting the justified similarity in allocation. In Sudan, the distribution of nurses in hospitals tend to concentrate their limited skilled workforce in the critical-care units because they require closer monitoring, higher technical competence, and lower nurse-to-patient ratios. This prioritization is a common staffing strategy in resource-constrained settings and explains the similarity in workforce allocation across countries facing comparable health-system challenges.

Training availability (67.9%) among nurses in this study appears relatively high and aligns with capacity-building trends in other public hospital systems. For example, in Ghana, nurse managers perceive high exposure to occupational hazards and emphasize the need for structured occupational health and safety (OHS)training [25]. Provision of mandatory, regular, and structured training for all nurses, including updated guidelines will improve the workplace safety.

Nurses in this study demonstrated strong overall knowledge of occupational hazards (83%), consistent with emphasis on occupational safety globally. For instance, in northern Saudi Arabia, a multicenter study found high prevalence of self-reported knowledge of biological and non-biological hazards among health-care workers. [26] Meanwhile, in contrast, much lower knowledge levels have been documented in other settings; for example, among health workers in Owerri, Nigeria, a study reported variable awareness of common occupational hazards [27]. This rejection is justified by varying institutional policy enforcement, frequency of training, and resources (e.g., PPE) in different hospitals.

Exposure to biological hazards was high (mean 85.5%) in this study. This resembles findings from other resource-limited settings where PPE shortage, high patient loads, and inadequate staffing lead to frequent risky exposures [28]. The similarity is justified by the shared challenges in health systems facing constrained resources: even with good knowledge, these systemic barriers impede full protection [29]. To reduce the biological hazards risk in Sudan hospitals, stakeholders need to ensure continuous availability of PPE, safety-engineered sharps devices, proper waste disposal systems and establish clear protocols for reporting and managing occupational injuries.

Despite high participants level of knowledge, exposure remained elevated, reinforcing the idea that awareness alone does not necessarily translate into safe practice without strong enforcement and institutional support [30]. This similar to a study review emphasizes the limitation of individual-level knowledge training alone and the need for organizational and systemic intervention approaches for effective workplace health and safety improvements. [31].

Psychological hazards in this study (stress at 94%, verbal abuse 92%) were highly prevalent. These rates are comparable to studies from other countries: for example, workplace violence against nurses is widespread. In Ethiopia, a systematic review found that verbal abuse was among the most common forms of violence against nurses [32 ,33]. In Egypt, qualitative research among emergency nurses indicated complex organizational and interpersonal pressures contributing to violence. The similarity is justified by common upstream drivers— overcrowded hospitals, limited resources, and weak workplace violence prevention infrastructure [33]. In contrast, much lower rates of such psychological hazards have been documented in some higher-income countries with more robust legal protections and stronger organizational policies. For example, in South Korea, [34] research has shown different dynamics of verbal violence and Post-Traumatic Stress Disorder (PTSD) among nurses in operating rooms, with institutional support moderating effects [34]. This contrast was justified by differences in governance, regulation, and resource capacity between contexts. To support and protect the nurses in the workplace, developing anti-violence policies, reporting systems, and staff protection mechanisms

should be enforced. Strengthening administrative support for nurses experiencing stress, abuse, or burnout, introduce employee wellness and mental health.

Perceptions of institutional safety strategies (59–66% reporting adequacy) in this study align with findings from low-/middle-income contexts where safety culture is often nascent and uneven [22]. Nevertheless, in comparison, studies in well-resourced systems (e.g., South Korea or Australia [35], often report higher satisfaction rates (e.g., > 80%) with institutional occupational health systems and safety policies.

Finally, the findings in this study reveal that no significant associations were found between knowledge and variables such as experience, training, or safety practices diverge from some contexts but resemble others. In low-resource settings, the translation from training to practice may be weak due to institutional constraints. For example, in Nigeria, although healthcare workers had high knowledge, compliance was inconsistent [22]. On the other hand, in some countries like India and Pakistan, structured, repeated training interventions have been shown to boost both knowledge and practice more reliably. While specific

studies in Pakistan/India mirroring the exact variables were not identified in this search, the contradiction can be justified by differences in training design: Sudanese programs may lack sufficient reinforcement, repetition, or evaluation to change behavior consistently.

 Conclusion

This study demonstrated that nurses at Dongola Specialized Teaching Hospital are predominantly young, female, and bachelor-educated, reflecting global and regional patterns in low- and middle-income settings. This contrasts with older nursing workforces seen in high-income countries. Despite the relatively high educational profile and good overall knowledge of occupational hazards, exposure to both biological and psychological hazards remained substantial. This gap highlights that knowledge alone is insufficient without institutional reinforcement, adequate resources, and strong safety systems. Workforce distribution patterns—especially the concentration of nurses in high-acuity units—mirror trends in other resource-constrained countries, reflecting universal demands for intensive care and higher skill levels in critical departments.

Training availability was comparatively high, yet it did not translate into significant improvements in safety practices, suggesting limitations in training design, frequency, or institutional support. High exposure to biological hazards and widespread psychological stress and verbal abuse underscore systemic challenges such as inadequate PPE supply, staffing shortages, overcrowded facilities, and weak workplace-violence prevention mechanisms. While perceptions of institutional safety strategies were moderate, they indicate a developing but insufficient safety culture.

Overall, the study emphasizes the need for stronger institutional policies, improved resource allocation, continuous and structured training programs, and comprehensive occupational health systems to protect nurses and enhance safe practice. Strengthening these areas is essential to translating knowledge into effective hazard prevention and sustaining a safer working environment for the nursing workforce in Sudan

Limitations of the Study

Single-center design: The study was conducted only at Dongola Specialized Teaching Hospital, which limits the generalizability of the findings. The results may not reflect the situation in other hospitals or healthcare settings in Northern Sudan or beyond. Self-reported data: Most of the information was collected through self-administered questionnaires, which might have introduced response bias. Participants could have overestimated their knowledge or compliance with safety measures.

Acknowledgement:

Conflict of interest

The authors declare no conflicts of interest to the authorship and/or publication of this manuscript.

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