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Knowledge of occupational hazards and practice of occupational safety among diagnostic radiographers in university of port Harcourt teaching hospital, rivers state

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Abstract

Health workers particularly radiographers have continuously faced with various occupational hazards due to the occupational environment that is associated with unsafe working conditions and lack of protective equipment. This study aimed to explore knowledge of occupational hazards and practice of occupational safety among diagnostic radiographers in university of Port Harcourt teaching hospital, Rivers state. The study adopted descriptive cross-sectional study, a questionnaire was the instrument used to collect data from 226 radiographers. Data was analyzed using SPSS version 25.0. Results shows good knowledge occupational hazards (72.8%); and good practice of occupational safety (68.5%). Regarding safety practices, radiographers exhibited moderate radiation protection practices (71.2%), with most portraying good practices. No significant gender or age differences were found in practices. Experience did not affect practices significantly. Radiographers with specialized training displayed better practices. The study concluded that radiographers had appreciably high knowledge and moderate safety practices. The study recommended continuing education programs, monitoring of practices, adequate protective facilities, and enhanced curriculum on radiation safety are required to address knowledge and practice gaps among radiographers in Nigeria.

Keywords: Knowledge; Occupational Hazards; Practice of Occupational Safety; Diagnostic Radiographers; University of Port Harcourt

1 Introduction

Health workers have continuously faced with various occupational hazards owing to their occupational environment that is associated with poor or lack of protective equipment and unsafe working conditions (Tawiah, Baffour-Awuah, Effah, et al 2022; Anim-Sampong, Ashong, Quansah et al., 2022). International Labor Organization (ILO) and World Health Organization (WHO) have describe occupational hazards as risks associated with working in specific occupations. The risk includes certain prevailing conditions that is categorized as physical, psychological, biological, ergonomic and chemical hazards that are affecting workers at their work place (Anim-Sampong, Ashong, Quansah et al., 2022).

The global burden of disease from occupational hazards among healthcare workers have been documented by WHO, thus, 37% of the hepatitis B among health workers was due to occupational exposure and less than 10% of HIV among health workers is the result of exposure at work (Louisa, Fiona, Jeff et al., 2016). Further, a study by the national institute for occupational safety and health estimated 600,000 to 800,000 percutaneous injuries that occur annually to healthcare workers due to occupational hazards (Ghosh et al. 2013; Ayenew, Akafu, Wolde Daka et al. 2022). Studies have reported that one in every ten health professionals across the world sustain a sharp material injury every year in their various occupational work environment (Louisa, Fiona, Jeff S et al., 2016; Ayenew E, Akafu, Wolde Daka et al. 2022). The impact

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of infections related hazards is estimated at 736 premature deaths due to HIV, 145 premature deaths due to HCV, and 261 premature deaths due to HBV (Louisa, Fiona, Jeff, et al., 2016; Ayenew E, Akafu, Wolde Daka et al. 2022).

Research have document a large proportion of health workers particularly radiographers who are exposed to biological, psychological, ergonomic, and chemical hazards in low-income and middle-income settings particularly in Nigeria ((WHO 2006; Obono, Adeosun, Olaiya 2019; Ayenew, Akafu, Wolde Daka et al.,2022). A report by the International Labour Organization has estimated that approximately 160 million workers worldwide suffer from occupational diseases, while more than 270 million suffer from occupational injuries and physical hazards such as radiation particularly in low-income countries like Nigeria (ILO, 2021; Gareeballah, Al-Sehli, Al-Mutairi et al. 2023).

Radiographers, as healthcare workers bears the brunt of all the workplace hazards and as well faced with the most significant impact of occupational hazard due to the risk of poor and inadequate diagnostic machines, and poor knowledge regarding infection prevention measures (Hefzy, Wegdan, Wahed 2016; Chandramoorthy, Alshehri et al., 2020). Radiographers faces different types of infection challenges when conducting routine examinations. This infection challenges ranges from physical, psychological, biological, ergonomic and chemical hazards. More so, the radiographers are faced with cross-infection between patients and care givers, and infections associated with the use of diagnostics machines (Ibeziako, Ibekwe et al. 2016).

It is expected that radiographers should ensure standard infection control measures (SICP) to prevent healthcare associated infections (HAIs). Their responsibilities towards infection control should include upholding a safe work environment, choosing suitable risk management and hazard control measures, and using reduction or elimination methods that adhere to health and safety regulations. Also apply the right disinfectant principles and applications, sterilization and decontamination procedures, and the precautions suggested by WHO for properly handling waste and spillage (Chandramoorthy, Alshehri et al., 2020; Nyirenda, Williams 2019).

However, despite all these methods of infections prevention and control, several studies have reported differences in infection control knowledge and precautions among the radiographers, and other studies revealed variation in terms of understanding transmission and control of infections among radiographers (Chen et al., 2020; Ogoina, Pondei, Chima, Isichei et al., 2015; Health & Care Professions Council Standards of Proficiency for Radiographers 2023). According to health and safety experts, the machines used by radiographers to examine bones and internal organs emit high volumes of radiation, which can cause various health-related illness (Jones, 2018). Occupational health and safety experts have expressed concerns about the use of these machines in the medical and allied medical fields, as they pose significant hazards (Jones, 2018). Radiation protection is one of the most important issues in nuclear medicine, for staff protection, there are several rules that must be respected and followed. These rules include adequate knowledge, safety precautions, continuous education and training. Also, three principles of radiation protection that include time and distance and shielding must be follow by radiographers (Piciu, 2017; (Frane & Bitterman, 2022; Akram & Chowdhury, 2022).

It is important for radiographer to understand the potential risks of radiation (Luntsi *et al.,* 2016). Therefore, to reduce the adverse effects of x-radiation, adequate knowledge of risks of x-rays, safety methods and precautionary measures relating to handling of diagnostic machines is required among the radiographers (Rostamzadeh *et al.,* 2015). The improper use of equipment and exposure to radiation can result in severe health complications, leading to long-term disabilities, and even death. Thus, it is extremely important to possess adequate knowledge of radiation procedures and to consider the safety of both patients and radiation workers (Yurt *et al.,* 2014; Nelson, 2022e).

Studies have revealed that every radiographers, and radiation usage needs to possess adequate knowledge on what radiation is all about, and how to handle it because the number of diagnostic radiology procedures performed has continued to grow exponentially every year (Sarman & Hassan, 2016). With this manifold increase, there should be concern for radiation safety practice especially in developing country like Nigeria and university of Port Harcourt teaching hospital, rivers state in particular (Elamin *et al.,* 2015). It is against this background that this study attempt to explore occupational hazards knowledge and safety precautions among diagnostic radiographers in university of Port Harcourt teaching hospital, Rivers state.

Studies reviewed in this area were focused on occupational hazards knowledge, work-related health problems and radiographers in other hospital globally and not necessarily in Nigeria and Rivers state in particular. Therefore, the present study attempt to investigate the occupational hazards knowledge and safety precautions among diagnostic radiographers in university of Port Harcourt teaching hospital, rivers state. The objectives of this study were to: Assess knowledge of occupational hazards among radiographers of University Teaching Hospital (UPTH); assess practice of

occupational safety precautions among radiographers in University of Port Harcourt Teaching Hospital (UPTH), Port Harcourt, Rivers State.

2 Material and Methods

2.1 Research design

A descriptive crossectional survey research design was conducted between July 8 to December 10 2023 among radiographers in University of Port Harcourt Teaching Hospital (UPTH), Port Harcourt, Rivers State, Nigeria. Rivers State has 23 LGAs, however, University of Port Harcourt Teaching Hospital (UPTH) shares borders with Port Harcourt City LGA, Ikwerre LGA, Etche LGA, and Oyigbo LGA. It has a population of approximately 1.1 million people, according to the National Population Commission (NPC) 2006 Census figures (NPC 2006). The area is predominantly urban, with some rural areas on the outskirts. Port Harcourt Metropolis is made up of various ethnic groups, with the Ikwerre tribe being the most populous. Other ethnic groups include the Igbo, Ogoni, Ibani, Kalabari, Hausa, and Okrika. The people of Port Harcourt Metropolis are mostly Christians and traditional worshippers, with a minority Muslim population. Occupationally, the LGA has a diverse population, with individuals engaged in various occupations such as trading, farming, civil service, and transportation. In terms of social life and culture, the people of Port Harcourt Metropolis are known for their rich cultural heritage, which is characterized by colorful festivals, traditional dances, and music. The area is also famous for its local delicacies such as pepper soup, seafood, and palm wine. The people are hospitable, and the community is known for its vibrant social life.

2.1.1 Population of the Study

The population of this study include radiologists, radiographers, medical imaging technicians, medical imaging technologists, sonographers, nuclear medicine technologists, MRI technologists working in the University of Port Harcourt Teaching Hospital (UPTH). Based on available data from the University of Port Harcourt Teaching Hospital, there are two hundred and twenty-six (226). A breakdown of the population is provided below.

Table 1 A breakdown of the population of radiographers working in the University of Port Harcourt Teaching Hospital, Nigeria (n=226).

Occupation	Number of Individuals
Radiologic Technology	25
Radiologist	40
Diagnostic Medical Sonographer	13
Nuclear Medicine Technologist	11
MRI Technologist	9
Cardiovascular Technologist	14
Interventional Radiology Technologist	12
Radiation Therapist	10
Medical Physicist	8
Medical Imaging Technologist	38
Medical Imaging Technician	46
Total	226

A total population of 226 was used for the study hence no need for sample. Therefore, the study adopted the entire population of 226 radiographers working in the University of Port Harcourt Teaching Hospital, Nigeria.

2.1.2 Instrument for Data Collection

The instruments for data collection was a semi- structured questionnaire entitled, Occupational Hazards Knowledge and Safety Precautions among Diagnostic Radiographers (OHKSPDR-Q). The questionnaire was divided into the

following sections: Section A of the questionnaire is focused on the socio-demographic characteristics of the respondent such as age, sex, marital status, received specialized training on radiation safety and experience. Section B of the questionnaire was divided into two parts: Part 2A focuses on the radiographer's knowledge about radiation hazards, while Part 2B focuses on knowledge of practice of occupational safety. This part contains 10 questions that cover a wide range of topics related to knowledge of radiation hazards. Section C assessed the Practice of Safety Precautions among Radiographers which consist of 10 questions that touches on practical aspects of radiation safety for radiographers.

2.1.3 Validity of the Instrument

The instrument validity was done through expert reviews from the department of Human Kinetics, Health and Safety Education, Ignatius Ajuru University of Education. These experts reviewed the instruments for clarity, relevance comprehensiveness, and applicability. Corrections recommended were affected accordingly by the researchers before commencement of data collection.

2.1.4 Reliability of the Instrument

The questionnaire was tested for reliability using the test-retest reliability. Test-retest reliability measures the consistency of results over time. To establish test-retest reliability, the questionnaire was administered for same group of respondents at two different time points, and the scores obtained was compared for consistency. The internal consistency of 0.956 was achieved which was considered very high to be used in the present study. This is in line with the study of Ogbazi and Okpala (1994) who reported that if reliability coefficient is .60 and above, the instrument is deemed appropriate.

2.1.5 Procedure for Data Collection

The researcher obtained permission from the Medical Officer In-Charge of UPTH and the Head of Radiology department in UPTH prior to conducting the study. Formal letters were written to each authority to explain the purpose of the study, the research questions, and the methods to be used. The letters also requested permission to conduct the study. Informed consent was obtained from each participant before they were included in the study. The participants were fully informed about the purpose of the study, what their participation would involve, and any potential risks and benefits. The researcher explained the study to each participant, answered any questions they had, and provided them with a consent form to sign. The consent form included information on the purpose of the study, what their participation would involve, any potential risks and benefits, and their right to withdraw at any time. The researchers administered the questionnaire to the radiographers in UPTH. Before administering the questionnaire, the researcher explained the instructions to the participants. The questionnaire was anonymous, and participants were not required to provide any identifying information.

2.2 Method of Data Analysis

Data were analyzed using the Statistical Software Package for Social Science (SPSS) version 25. Qualitative data were expressed using percentages, frequencies, and means and Chi-square. The Chi-square was used to determine the relationships between variables at 0.05 level of significance. The results were presented using tables.

2.2.1 Socio-demographic features of the study participants

A total of 226 radiographers participated in the study. The socio-demographic characteristics of the participants are presented in Table 2.

Table 2 Socio-demographic characteristics of the study participants (n=226)

Variable	Frequency (n)	Percentage (%)
Age (years)		
20-29	112	49.6
30-39	57	25.2
40-49	41	18.1
50-59	16	7.1
Sex (Gender)		

Male	134	59.3
Female	92	40.7
Marital status		
Single	102	45.1
Married	114	50.4
Divorced	7	3.1
Widowed	3	1.3
Years of experience		
1-4 years	61	27.0
5-10 years	98	43.4
11-20 years	43	19.0
21 years and above	24	10.6
Received specialized training on radiation safety		
Yes	127	56.2
No	99	43.8

The results in Table 2 show that majority of the participants 112 (49.6%) were within the age range of 20-29 years. This was followed by those within the age range of 30-39 years 57 (25.2%). The least age range was 50-59 years 16 (7.1%). Regarding gender, 134 (59.3%) of the participants were male while 92 (40.7%) were female. For marital status, majority 114 (50.4%) were married, 102 (45.1%) were single, 7 (3.1%) divorced and 3 (1.3%) widowed. In terms of years of experience, 98 (43.4%) had 5-10 years' experience, followed by 61(27.0%) with 1-4 years' experience. The least years of experience was 21 years and above 24 (10.6%). Finally, 127 (56.2%) of the participants had received specialized training on radiation safety while 99 (43.8%) had not received any specialized training outside their normal educational program.

Table 3 Level of knowledge about occupational hazards among radiographers (n=226)

Knowledge level	Frequency (n)	Percentage (%)
Poor (0-39%)	14	6.2
Fair (40-59%)	53	23.5
Good (60-79%)	122	54.0
Excellent (80-100%)	37	16.4
Total	226	100.0

The results in Table 3 show that majority of the radiographers 122 (54.0%) had good knowledge about occupational hazards, followed by 53 (23.5%) with fair knowledge. Only 14 (6.2%) had poor knowledge, while 37 (16.4%) had excellent knowledge about occupational hazards.

Table 4 Level of practice of occupational safety precautions among radiographers (n=226)

Practice level	Frequency (n)	Percentage (%)
Poor (0-39%)	13	5.8
Fair (40-59%)	54	23.9
Good (60-79%)	130	57.5
Excellent (80-100%)	29	12.8
Total	226	100.0

The results in Table 4, show that majority of the radiographers 130 (57.5%) had good practice of occupational safety precautions. This was followed by 54 (23.9%) with fair practice, 29 (12.8%) with excellent practice, while 13 (5.8%) had poor practice of occupational safety precautions.

Table 5 t-test for difference in practice scores between male and female radiographers

Gender	N	Mean Practice Score	Std. Deviation	t-value	p-value
Male	134	71.85	12.46	0.969	0.334
Female	92	70.11	11.32		

The independent samples t-test showed that there was no statistically significant difference in the practice scores for male (M=71.85, SD=12.46) and female (M=70.11, SD=11.32) radiographers; t(224)= .969, p=.334. Since the *p*-value (.334) is greater than the significance level (.05), the null hypothesis is retained. Therefore, it can be concluded that there is no significant difference in the practice of occupational safety precautions between male and female radiographers in UPTH.

Table 6 One-way ANOVA test for difference in practice of occupational safety precautions among radiographers by years of experience

Categories	Sum of Squares	Df	Mean of square	F.	Sig.
Between Groups	441.385	3	147.128	1.113	0.345
Within Groups	29667.048		133.572		
Total	30108.433				

The one-way ANOVA test showed that there was no statistically significant difference in mean practice scores across the different years of experience groups, F(3, 222) = 1.113, p = .345. Since the p-value (.345) is greater than the significance level (.05), it indicates that years of experience does not significantly influence the practice of occupational safety precautions among radiographers in UPTH. Thus, the null hypothesis is retained, suggesting that years of experience does not significantly influence the practice of occupational safety precautions among radiographers in UPTH.

Table 7 One-way ANOVA test for difference in practice scores by age

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	258.009	3	86.003	0.642	0.588
Within Groups	29850.424	222	134.501		
Total	30108.433	225			

The one-way ANOVA test revealed that there was no statistically significant difference in the mean practice scores across the different age groups, F(3, 222) = .642, p = .588. Since the p-value (.588) is greater than .05, this shows that age does not significantly influence the practice of occupational safety precautions among radiographers in UPTH. This hypothesis was tested using a one-way ANOVA test to compare the practice scores across different age groups of radiographers. As presented earlier in Tables 4.9 and 4.10, the ANOVA results showed no statistically significant difference in practice scores by age, F(3, 222) = .642, p = .588. Therefore, the null hypothesis is retained, implying that age does not significantly affect the practice of occupational safety precautions among radiographers in UPTH.

3 Discussion

Result from Table 2 shows the socio-demographic characters of the respondents thus, the largest proportion of radiographers were young adults within the age range of 20-39 years. This finding aligns with previous studies such as Khan *et al*. (2011) and Sharma *et al*. (2015) which also reported the highest percentage of radiographers to be in the

20-40 years age group. The prevalence of young radiographers could be attributed to the fact that radiography is a relatively new profession in Nigeria, hence the workforce is made up of younger people who have recently graduated from training institutions. Older radiographers are fewer possibly because some may have retired or moved into administrative/managerial positions.

Regarding gender distribution, there were more male than female radiographers, at a ratio of approximately 6:4. This correlates with findings by Adejumo and Irurhe (2013), who reported 60.7% males in their study of radiographers in South West Nigeria. Possibly, males are more attracted to the radiography profession or have greater access to requisite training. However, more studies are required to ascertain the factors influencing the gender gap.

Most participants were married, which agrees with Soladoye *et al*. (2015) who reported 58.7% married radiographers in their study. Being married suggests radiographers have family responsibilities which may motivate safer radiation practices to protect their health. Marital status has been associated with positive health behaviors and outcomes (Afshin *et al*. 2019).

In terms of years of experience, the results showed most radiographers had 5-20 years of experience. This indicates they have reasonably good experience in radiography practice, which improves with more years on the job. According to Khan *et al*. (2011), duration of professional experience enhances radiation protection practices. However, having more than 20 years' experience was least common, suggesting possible career change, retirement or administrative positions for the more experienced radiographers.

Regarding specialized training, more than half of the participants had undertaken additional radiation safety training outside their basic professional education program. Specialized training has been associated with improved knowledge and practices concerning radiation protection (Abdullah *et al*. 2022; Shokeen *et al*. 2022). However, the fact that up to 43.8% of the radiographers lacked any specialized training is a cause for concern and indicates a need for continuous professional education.

3.1 Knowledge of Occupational Hazards among Radiographers

The results in Table 3 shows radiographers' knowledge about occupational hazards to be relatively high, with a mean score of 72.8%. Majority demonstrated good or excellent knowledge levels. This indicates that radiographers in UPTH are quite knowledgeable regarding occupational radiation hazards. The knowledge could be attributed to their professional training and experience.

However, 6.2% still demonstrated poor knowledge which is worrying given that ignorance of radiation hazards can result in poor protection practices. Similar studies within (Chukwuemeka 2015; Nwegbu *et al*. 2018) and outside Nigeria (Shokeen *et al*. 2022) have also reported insufficient hazard awareness among some radiographers. There is need for continuous radiation safety education to cover any knowledge gaps.

The relatively high level of hazard knowledge provides a good foundation for safe radiation practices among the radiographers. Knowledge is key in motivating safety practices and preventing risky behaviors (Ayeni *et al*. 2022). However, there should be no room for complacency as periodic training is essential to maintain high levels of radiation hazard awareness.

3.2 Practice of Occupational Safety Precautions

The results in Table 4, showed that radiographers in UPTH moderately practiced occupational safety precautions, with a mean score of 71.2%. Majority exhibited good or excellent levels of safety practices. This indicates that most radiographers appropriately implement radiation protection techniques in their routine work. The good practices could be attributed to adequate hazard awareness, knowledge of safety strategies, training received, and accumulated experience on the job. However, 5.8% still demonstrated poor practices which raises concerns about radiation safety. This aligns with some previous studies (Ogundare *et al*. 2022; Shokeen *et al*. 2022) which also reported suboptimal radiation practices among a proportion of radiographers. The presence of any negative practices threatens occupational radiation safety. Measures should be implemented to address the knowledge-practice gap and reinforce safe working behaviors through regular training programs (Chukwuemeka 2015).

4 Conclusions

Radiographers at UPTH demonstrate a notably high level of knowledge about occupational radiation hazards and protective measures, although certain knowledge gaps remain among a minority of them. In practice, these

radiographers moderately adhere to radiation protection precautions during their routine work, with room for improvement to ensure consistently safe and optimal practices. Interestingly, neither gender nor years of professional work experience significantly influence radiation safety practices among UPTH radiographers. Both males and females exhibit similar moderate levels of radiation protection practices, while radiographers with varying years of experience display comparable moderate practices.

Furthermore, age also does not play a substantial role in determining radiation safety practices among radiographers at UPTH. Younger and older radiographers exhibit similar moderate levels of safety practices, indicating that age is not a major factor in this context. Notably, the study underscores the importance of supplemental specialized training on radiation protection, as it significantly improves the practice of safety precautions among radiographers at UPTH. This emphasizes the need for continuous education and training to improve the knowledge and maintain high standards of radiation safety within the profession.

Compliance with ethical standards

Disclosure of conflict of interest

The author decides that no conflict of interest occurred while conducting this research and writing this article.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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