

Assessment of Occupational Hazards Exposure among Medical Radiological Workers in Port Harcourt Metropolis of Rivers State

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Abstract

Background

In the field of medicine, radiation hazards become inescapable issue because at every point which ranges from meeting the patient, diagnosis to treatment, health personnel are expose them.

Aim: The aim of this study was to assess the extent of assessment of occupational hazards exposure among medical radiological workers in Port Harcourt metropolis of Rivers State. Six research questions were stated and answered in this study.

Methodology: A descriptive cross-sectional survey design was adopted for the study as the research design. The sample size of 314 was determined using Cochran formula method. A multi-stage sampling procedure was adopted for the study which was presented in three stages in order to select the sample for the study. The instrument for eliciting information for this study was structured questionnaire titled Questionnaire on Assessment of Occupational Hazards among Medical Radiological Workers (QAOHSPMRW). The Reliability coefficient value of 0.82 was obtained using Pearson Products Moment Correlation Coefficient. Collected data were coded and analyzed using SPSS (version 25.0).

Results: The result illustrated that 269(85.7%) of the respondents had high physical hazards and 45(14.3%) had low physical hazards. The result showed that 231(73.6%) of the respondents had high chemical hazards and 83(26.4%) had low chemical hazards. Also, the result indicated that 273(86.9%) of the respondents had high biological hazards and 41(13.1%) had low biological hazards. The result showed that 260(82.8%) of the respondents had high ergonomic hazards and 54(17.2%) had low ergonomic hazards. The result depicted that 76(24.2%) of the radiological workers had high psychosocial hazards and 238(75.2%) had low psychosocial hazards. The result showed that 220(70.0%) of the respondents had high mechanical hazards and 94(30.0%) had low mechanical hazards.

Conclusion and Recommendation: It was concluded that the extent of occupational hazards exposure among radiological workers was very high. The study recommended that Ministry of Health through hospital management board should form a monitoring and inspection team to check for compliance with safety precautionary measures in different health facilities including medical radiological centres.

Keywords: occupational hazards exposure, medical radiologists, Port Harcourt Metropolis

INTRODUCTION

The nature of radiological workers is hazardous due to their consistent exposure to radiations. Hence, safety measures remain the hallmark of accident and hazard preventions in any workplace. It is pertinent that workers in the hospital or clinical settings are educated on hazards such as biological, chemical, physical, psychosocial, ergonomic and mechanical hazards most especially

in the radiological laboratory. WHO (2024) explained that there are ionizing or x-ray and non-ionizing radiation that occur in healthcare setting which pose specific risk to the health and safety of the workers such as contributing to skin cancer, skin burn, cataract and lasers ones lead to tissue burn, eye damage, fire and explosion and system failures. The extent of hazards exposure is due to the presence of ionizing radiation from medical imaging procedures that can pose health risks if not managed. O'Sullivan, et al. (2010) reported that 87% of good number of radiation workers had not received safety protection instruction and measures as it might expose them to physical hazards. Medical radiological workers or radiographers working in the x-ray department may be exposed to radiation and might not have complied with safety measures at all time. Lee et al. (2014) indicated in their study that 77% of radiological workers had underestimated doses of radiation as they carry out x-ray diagnosis. Additionally, Biswas et al. (2021) put up that more average number of workers suffer health problems attributable to occupational hazards and excess dose of radiations.

The possibility of radiation adverse health effects is proportional to the dose received. Physical hazard has to do with things such as noise, vibration, objects, radiation among others that may create the chances of accident to occur. X-ray radiation is a form of physical hazard that has the potentials of triggering health problems and long-term health implications on the radiologists. Biswas et al. (2021) revealed that with $\geq 50\%$ representation of women was 33% of physical occupational hazard solely from medical radiation. Naithani et al. (2021) are of the view that improvement in knowledge of occupational hazards and safety measures, which was found to be statistically significant with p-value of 0.001 for all categories. Adejumo et al. (2012) asserted that compliance to safety measures among radio-diagnostic workers would reduce the chances of occupational hazards due to increase in knowledge. Radiations are more dangerous to the health of the workers that needs consistent compliance to safety measures resulting from exposure to physical hazards.

Chemical hazards are chemicals such as film developing solution in making radiograph from radiological examination. The chemicals used for preparation of x-ray films are hazardous to health of the workers as it may contain corrosive chemicals or substances. Naithani et al. (2021) revealed that radiation workers are over 11 times more likely to encounter chemical hazards than any other form of hazard. Biswas et al. (2021) indicated that less than average (35%) of radiation workers are exposed to chemical occupational hazard such as developer and activating solutions of x-ray. Additionally, Badawy et al. (2016) buttressed that the use of safety device such as hand gloves may reduce the effects of chemical substances thereby minimize occupational hazards. Erkan, et al. (2019) added that practicing radiation measures and safety devices are necessary for effective utilization to improve the standard of the occupation.

Biological hazards involve the pathogenic contamination on the workers either from the clients and objects that cause health problems. Evidently, Naithani, et al. (2021) illustrated that medical radiation workers are 2 times more likely to encounter biological hazards that result in short- and long-term effects. Similarly, Abuzaid et al. (2019) indicated that poor adherence to radiographic safety measures may contribute to significant occupational hazards hence safety measure remains the major prevention of hazards among workers. Psychosocial hazards involve the relationship between the man and his work environment that may deleteriously affect health. Verbal abuse, discrimination, burnout, and poor communication affects the relationship with the work. Kawthalkar et al. (2019) revealed that significant correlation was found between repetitive stress injuries and burnout while 46% reported either physical or verbal abuse from patients. Significant correlation was found between increasing number of USG examinations performed per

day and the prevalence of neck pain, low back pain, and shoulder pain ($P < 0.05$) (Kawthalkar et al. 2019). Salama, et al (2016) revealed that there is a significant association between the levels of radiation exposure in all selected hospitals concerning imaging and waiting X-ray, mammogram, MRS and CT-scan operating room ($P < 0.01$). For radiation safety, most hospitals have lead aprons and thyroid shields in place, but only about 50% have lead glasses and lead shields, showing that many hospitals still lack essential equipment. Lee et al. (2018) added that female workers had a higher risk of radiation-related excess cancer, although they were exposed to lower radiation doses than male workers. Cha et al. (2020) indicated that high exposure to occupational hazard in radiological laboratory contribute to cardiovascular disorders. It is pertinent to note that estimated lifetime cancer risk from occupational radiation exposure varied significantly by sex and occupational group is recorded yearly of which medical radiologists are the most victims. Non-implementation of institutional knowledge of radiation protection during laboratory procedure is major issue that constitutes occupational radiation hazards that medical radiographers are highly exposed. However, the radiation diagnosis is supposed to be well protected job as it is highly hazardous to health but negligence and non-availability of safety devices have affected the smooth process of the radiological procedure. Reported cases of chronic health problems are observed daily among radiological workers as a result of poor usage and provision of safety devices.

RESEARCH QUESTIONS

The following research questions were formulated for the study.

1. What is the physical hazard among medical radiological workers in Port Harcourt metropolis of Rivers State?
2. What is the chemical hazard of medical radiation workers among medical radiological workers in Port Harcourt metropolis of Rivers State?
3. What is the biological hazard among medical radiological workers in Port Harcourt metropolis of Rivers State?
4. What is the ergonomic hazard among medical radiological workers in Port Harcourt metropolis of Rivers State.?
5. What is the psychosocial hazard among medical radiological workers in Port Harcourt metropolis of Rivers State?
6. What is the mechanical hazard among medical radiological workers in Port Harcourt metropolis of Rivers State?

METHODOLOGY

The area of the study was Port Harcourt metropolis of Rivers State, Nigeria. There are several medical and X-ray diagnostic facilities in the metropolitan city of Port Harcourt that carry out radiological medical diagnosis such as X-ray, CT scan, MR scan among others. The medical radiological and diagnostic centres are located in different places in Aba Road, Rumukurushi, Eneka, Rukpokwu, Rumueme, Rumuluomeni, Ogbogoro, Rumuadomaya, Rumuigbo, Ozuoba, Mgbosumini, Ikwerre road for Obio/Akpor while Azuabie, Borokiri, Amadi-Ama, Mile 3 among others. The population of medical radiological workers in Port Harcourt metropolis was not certain. The sample size 314 was determined using Cochran formula (Cochran, 1977).

Formula:

$$n = \frac{p(1-p)z^2}{e^2}$$

n= sample size

p=the proportion of the population (0.80)

e= acceptable sampling error (e=0.05)

z= value at reliability level or significance 95% for 1.96 at 0.05 level of significance.

Simple random sampling technique was used to select 20 X-ray/ CT scan centres both government owned and private facilities in both selected local government areas for the study respectively the respondents.

The instrument for eliciting information for this study was structured questionnaire titled Questionnaire on Assessment of Occupational Hazards among Medical Radiological Workers (QAOHSPMRW). Section A reveals the information on the assessment of occupational hazards such as physical, biological, chemical, psychosocial, ergonomic, and mechanical hazards with the response item of Yes and No. A test re-test method was employed to determine the reliability coefficient of the validated instrument. The Reliability coefficient value of 0.82 was obtained using Pearson Products Moment Correlation Coefficient. Hence the instrument was reliable and used for the study. Collected data were coded and analyzed using SPSS (version 25.0). Descriptive statistical tools such as mean, percentage, frequency and standard deviation were used.

RESULTS

The return rate of the instrument after filed work was 95.5% of which 300 questionnaire was retrieved out of 314.

Research question 1: What is the physical hazard among medical radiological workers in Port Harcourt metropolis of Rivers State?

Table 1. Physical Hazard

S/N	Items	Yes Freq %	No Freq %
1	I work in a harsh workplace due to exposure to heat.	262(83.4)	52(16.6)
2	I experience shock due to return of current.	232(73.9)	82(26.1)
3	I experience ionize radiation from CT scan.	259(82.5)	55(17.5)
4	I have been exposed to vibration from x-ray machine.	257(81.8)	57(18.2)
5	I have been exposed to solar radiation high tension cable.	275(87.6)	39(12.4)
6	I have been exposed to slippery floor which causes serious injury in the office.	266(84.7)	48(15.3)
7	I have injury due to poor illumination of light?	277(88.2)	48(15.3)
8	I know that too much exposure to radiation in men can cause health problems?	250(79.6)	64(20.4)
9	I have eyes strain resulting from too much view of computer monitor?	299(95.2)	15(4.8)
10	I have injury when tensioning cable?	308(98.1)	4(1.3)
11	I have been exposed radiographic material?	279(88.9)	35(11.1)
12	I have fallen due to improper positioning of the x-ray room?	275(87.6)	39(12.4)
Grand total		269(85.7)	45(14.3)

Decision: >50% High, <50% Low

Table 1 shows the physical hazard among medical radiological workers in Port Harcourt metropolis of Rivers State. The result showed that 269(85.7%) of the respondents had high physical hazards and 45(14.3%) had low physical hazards.

Research question 2: What is the chemical hazard of medical radiation workers among medical radiological workers in Port Harcourt metropolis of Rivers State?

Table 2: Chemical Hazard

S/N	Items	Yes Freq %	No Freq %
1	I experienced respiratory problem due to inhalation of developing solutions.	264(84.1)	50(15.9)
2	I know that radiograph solution can evaporate.	242(77.1)	72(22.9)
3	I have been in contact with developing chemicals.	222(70.7)	92(29.0)
4	I experienced irritation of eyes often when applying chemicals.	244(77.7)	70(22.3)
5	I develop scaly skin and strong palm after work due prolong fixing of the radiograph.	230(73.2)	84(26.8)
6	I have been exposed to solvents and stains.	235(74.8)	79(25.2)
Grand total		231(73.6)	83(26.4)

Decision: >50% High, <50% Low

Table 2 shows the chemical hazard of medical radiation workers among medical radiological workers in Port Harcourt metropolis of Rivers State. The result showed that 231(73.6%) of the respondents had high chemical hazards and 83(26.4%) had low chemical hazards.

Research question 3: What is the biological hazard among medical radiological workers in Port Harcourt metropolis of Rivers State?

Table 3: Biological Hazard

S/N	Items	Yes Freq %	No Freq %
1	Exposure to radiation can cause cancer	259(82.5)	55(17.5)
2	I have been exposed to absorbable substances at workplace.	279(88.9)	35(11.1)
3	I have been exposed to microorganism when touching fluid or holding patient.	264(84.1)	50(15.9)
4	I had irritation of the skin from work.	308(98.1)	6(1.9)
5	I have been diagnosed of respiratory illness.	271(86.3)	43(13.7)
6	I have been exposed to germs at work place (fungi, bacteria and spores) that leads to ill health.	256(81.5)	58(18.5)
7	I have been exposed to radiation-containing material	273(86.9)	41(13.1)
Grand total		273(86.9)	41(13.1)

Decision: >50% High, <50% Low

Table 3 shows the biological hazard among medical radiological workers in Port Harcourt metropolis of Rivers State. The result showed that 273(86.9%) of the respondents had high biological hazards and 41(13.1%) had low chemical hazards.

Research question 4: What is the ergonomic hazard among medical radiological workers in Port Harcourt metropolis of Rivers State?

Table 4: Ergonomic Hazard

S/N	Items	Yes	No
		Freq %	Freq %
1	Do you develop back pains after daily work?	291(92.7)	23(7.3)
2	Do you experience falls due to poor positioning or placing of legs?	245(78.0)	69(22.0)
3	Do you know that lifting of cone head of the x-ray machine which causes musculoskeletal pains?	272(86.6)	42(13.4)
4	Do you have eye strain during work due to light from viewing the radiograph?	238(75.8)	76(24.2)
5	Have you experienced pain and probably dislocation due to lifting of heavy x-ray machine?	269(85.7)	45(14.3)
6	Do you experience falls due to repetitive movement in the x-ray room?	254(80.9)	60(19.1)
7	Do you have awkward movement during work, due to prolonged daily x-ray proceedings?	256(80.9)	60(19.1)
Grand total		260(82.8)	54(17.2)

Decision: >50% High, <50% Low

Table 4 shows the ergonomic hazard among medical radiological workers in Port Harcourt metropolis of Rivers State. The result showed that 260(82.8%) of the respondents had high ergonomic hazards and 54(17.2%) had low ergonomic hazards.

Research question 5: What is the psychosocial hazard among medical radiological workers in Port Harcourt metropolis of Rivers State?

Table 5: Psychosocial Hazard

S/N	Items	Yes Freq %	No Freq %
1	Quarrel among co- workers is very high and poor cooperation of co-workers	164(52.2)	150(52.2)
2	Do you suffer for delay in payment after daily work?	86(27.4)	228(72.4)
3	Have you experienced humiliation and ridicule by your supervisors or superiors during work?	78(24.8)	236(75.2)
4	Have you been tasked with work that is below your level of competence?	75(23.9)	239(76.1)
5	Has an unfounded allegation been made on you before?	93(29.6)	221(70.4)
6	Have you been teased by an employer?	113(36.0)	201(64.0)
7	Have you employer impose unreasonable workloads on you before?	84(26.8)	230(73.2)
8	Have you ever made any threats of violence or engaging in overload?	93(29.6)	221(70.4)
9	Have you ever spread gossip or rumours on your supervisors or colleagues?	51(16.2)	263(83.8)
10	Have you been pierced by sharp objects while working at night?	91(29.0)	223(71.0)
	Grand total	76(24.2)	238(75.2)

Decision: >50% High, <50% Low

Table 5 shows the psychosocial hazard among medical radiological workers in Port Harcourt metropolis of Rivers State. The result showed that 76(24.2%) of the respondents had high psychosocial hazards and 238(75.2%) had low psychosocial hazards.

Research question 6: What is the mechanical hazard among medical radiological workers in Port Harcourt metropolis of Rivers State?

Table 6: Mechanical Hazard

S/N	Items	Yes Freq %	No Freq %
1	Have you experience injury during repairing of machine?	215(68.5)	99(31.5)
2	Have you experience injury when smoothening of board wood?	204(65.0)	110(35.0)
3	Do you experience injury from using x-ray machine?	239(76.1)	75(23.9)
4	Are aware that standing position in the x-ray room may leads to exposure to health threat?	217(69.1)	97(30.9)
5	Have you been expose to pressure from x-ray medical machines?	226(72.0)	88(28.0)
	Grand total	220(70.0)	94(30.0)

Decision: >50% High, <50% Low

Table 6 shows the mechanical hazard among medical radiological in Port Harcourt metropolis of Rivers State. The result showed that 220(70.0%) of the respondents had high mechanical hazards and 94(30.0%) had low mechanical hazards.

DISCUSSION OF FINDINGS

The result in table 1 showed that 269(85.7%) of the respondents had high physical hazards and 45(14.3%) had low physical hazards. The result of this study was expected because workers in radiological department are working with X-ray devices that definitely emit hazardous substances that have long term health effects on the client and workers. The result of this study is in line with the study of Cha et al. (2020) that regular exposure to doses of x-ray radiation creates the tendency for health care problems to occur. Also, the result of this is finding is in consonance with Ogenyi et al. (2018) that medical radiation workers are to a large extent exposed to wide range of occupational hazards such as vibration from x-ray machines, heat, among others, contribute immensely to chronic health problems. Kawthalkar et al. (2019) buttressed that medical radiation or radiological workers are affected by the exposure to slip and falls leading to injuries and was significantly correlated with physical hazards ($P < 0.05$). Salama et al. (2016) affirmed that both radiation workers and clients were exposed to X-ray, CT- scan radiation and tools used in the radiological laboratory. Lee, et al (2018) revealed that several health problems such as cancer have been attributed to exposure to radiation from the x-ray during diagnostics. It is plausible because radiation workers are the ones manipulating the radiological machines to perform diagnostic procedure. Hence, physical hazards are prevalent among medical radiological workers.

The result in table 2 illustrated that 231(73.6%) of the respondents had high chemical hazards and 83(26.4%) had low chemical hazards. The findings of this study are expected because certain chemicals and solutions are used for fixing and developing the radiograph and films after taking the x-ray which require the use hands to manipulate the chemicals hence causing skin and health problems to the workers. The result of this study is in credence with Amfo-Out and Agyemang (2016) that workers in an occupation like this are exposed to chemical hazards such as fumes, acid and base that may cause dermatological disorders to the individual. Boschman et al. (2011) added that chemical hazards are more prevalent among those who operate in the medical facility especially in laboratory unit such X-ray department. Lee et al. (2014) and O'Sullivan et al. (2010) whose studies buttressed that radiological workers carrying out diagnostic imaging investigation are exposed to chemical substances during the process of developing the radiograph. In spite of the use of hand gloves, medical radiological workers are exposed to chemicals that are dangerous to health such as acid and base which are mostly used in the x-ray department after taking the imaging. It is plausible that medical radiological workers must use these chemicals to prepare the films before viewing it. There were no prior studies that are in contrary with the findings of the study.

The result in table 3 showed that 273(86.9%) of the respondents had high biological hazards and 41(13.1%) had low biological hazards. The result of this study is required because during diagnostic they might be exposed to fluid like water, saliva, blood and substance that may contain pathogen like fungi, virus, and bacteria among others which are hazardous to health of the staff. The result of this study is in credence with findings of Ogenyi et al. (2018) which illustrated that most radiological workers are exposed to bodily fluids and splashes from infected pains which constitute hazards and are significant with all forms of occupational hazards. The result of this study is in line with studies of Naithani et al. (2021) which revealed that medical radiation workers are 2 times more likely to touch fluid from the patient during diagnostic procedure. Abuzaid et al.

(2019) affirmed that x-ray workers are more likely to encounter microbes especially due to poor adherence to radiation measures and occupational health standard. It is pertinent to note that medical radiological workers are always at risk of hazards and risky conditions to provide health threat especially when working directly with the patient. As at the time of this study, there was no prior findings that contradict with the outcome of this study. Hence, medical radiological workers are exposed to biological hazards.

The result in table 4 showed that 260(82.8%) of the respondents had high ergonomic hazards and 54(17.2%) had low ergonomic hazards. With regard to this result, medical radiation workers are more likely to suffer for mismatch and poor positioning in the workplace resulting in falls and accidents. The result of this study is in line with studies of Naithani et al. (2021) that medical radiological workers are exposed to ergonomic hazard and statistically significant with occupational hazards. Biswas et al. (2021) buttressed that more than average percentage of medical workers suffer for musculoskeletal disorders such pains at the back and neck which was significantly associated with occupational hazards ($P < 0.05$). Al-Abdulsalam and Brindhaban (2014) added that suffer for poor positioning and mismatch with their duty in the workplace resulting in health care problems. Siyiza et al. (2013) buttressed that exposure to heavy object lifting, frequent bending of the back or rapid movement of limbs causes body pain (30%). Kawthalkar et al. (2019) affirmed in their study that the prevalence of neck pain, low back pain, and shoulder pain ($P < 0.05$). It could be clear because medical diagnostic procedure is vigorous and stress that at the end of every daily activity's workers complain of health problems. Hence, medical radiological workers are exposed to ergonomic hazards.

The result in table 5 showed that 76(24.2%) of the respondents had high psychosocial hazards and 238(75.2%) had low psychosocial hazards. The result of this study is required because workers are likely to face verbal abuse and poor relationship with patients/guardians as it endangers their health. The result of this study is in corroboration with studies of Biswas et al. (2021) that slightly above average number (59%) of medical radiological workers are exposed to psychological/psychosocial occupational hazard such as work stress, bullying and discrimination. Foley et al. (2013) affirmed that workers are stressed when patients are inattentive during diagnostic procedure. Günalp et al. (2014) and O'Sullivan et al. (2010) reported that medical radiological workers are exposed to psychosocial hazards such as exposure to stress, verbal abuse, poor communication skill and social problems from patients and colleagues. Awadghanem et al. (2020) and Siyiza, et al. (2013) buttressed that psychological problems are major issues faced by radiological and radiation workers in medical settings. There was no variation between the previous findings and current study especially as at the time of the study.

The result in table 6 showed that 220(70.0%) of the respondents had high mechanical hazards and 94(30.0%) had low mechanical hazards. The result of this study is required because the radiation device must be repaired and fixed to carry out the diagnostic imaging procedure which in turn may cause injury and accidents. The result of this study is in line with studies of Kawthalkar et al. (2019) which indicated that faulty x-ray machines and radiological devices are hazardous to radiation workers which is traceable to mechanical hazards. Also, Salama et al. (2016) added that there was a significant association between the levels of radiation exposure in all selected hospitals concerning imaging and waiting X-ray and CT-scan operating room ($P < 0.01$). Recently, Cha et al. (2020) affirmed that radiation risks of cerebrovascular diseases and ischaemic heart disease were non-significantly increased due to exposure to occupational hazards including mechanical hazard. It is plausible that medical radiological workers handle equipment

and devices in the laboratory which in turn can be hazardous to them. There was no variation between previous studies and current findings.

CONCLUSION

With regard to the findings, it was concluded that medical radiographers in Port Harcourt metropolis are exposed to different forms of occupational hazards such as physical, chemical, biological, psychosocial, ergonomic and mechanical hazards. Hence, there is need to ensure total compliance with safety devices during and after medical diagnosis such as radiological examinations.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations were made:

1. Ministry of Health through hospital management board should form a monitoring and inspection team to check for compliance with safety precautionary measures in different health facilities including medical radiological centres.
2. Workers should comply with safety protocols and ensure that client use lead apron and other safety devices to reduce the rate of exposure to hazards during medical diagnostic proceedings to prevent health problems associated with radiation hazards.
3. Medical Association should organize quarterly training for medical workers such as radiologists, technician, and technologists on new innovation and current trend to improve and promote safety in the workplace.
4. Managers of health and medical diagnostic facilities should implement radiation safety protocols for workers and ensure strict compliance with use of personal protective equipment.

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