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# Perception of Non-radiation Healthcare Workers about Radiation in Cape Coast Metropolis, Ghana

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**Abstract** The patient management team includes a wide category of healthcare workers, who in one way or the other interact to render services, including radiation-based services. It becomes imperative that every healthcare worker must have appreciable knowledge and opinions on radiation issues for effective service delivery. Hence, this study assesses the perception of non-radiation healthcare workers about radiation. This was a prospective questionnaire-based study involving 340 consented participants from four hospitals in Cape Coast. A stratified sampling method was employed for the number of respondents from each hospital. The responses obtained from Google Forms WhatsApp-administered questionnaires, were systematically selected to obtain the sample size. Data obtained were analysed with Statistical Package for Social Sciences (SPSS Inc., Chicago, IL version 20.0) and the results were presented in appropriate tables and charts. Statistical significance level was set at $p \leq 0.05$. The majority of the 340 participants were males. The average age was 32.26±7.618 years. Nurses constituted majority 166 (48.8%) of respondents, followed by allied health professionals. The knowledge of participants about radiation issues was high with over 65% of responses. There were statistically significant associations between gender, educational level, work experience and willingness to accept postings to radiology departments. We conclude that, the majority of non-radiation healthcare workers had a high level of knowledge about radiation issues. The perception of non-radiation healthcare workers was positive from suggestions and recommendations they offered.

**Keywords** Perception, Radiation, Cape Coast Metropolis, Non-radiation Healthcare Workers

# 1. Introduction

The use of radiation has increased in recent years with an associated increase in exposure of patients and healthcare workers (HCWs) to radiation hazards from a variety of sources [1]. Radioactive materials and ionizing radiation, especially X-rays contribute the largest portion of radiation exposure to mankind [2]. Perhaps one of the best-known environmental sources of ionizing radiation is naturally occurring radon, which has consistently been associated with an increased risk for the development of caner of the lung [3]. Ionizing radiation has a widespread application for a variety of beneficial purposes [4]. The demand for diagnostic and therapeutic radiological procedures has increased in medicine, as X-ray imaging reports constitute about 30–50% of medical diagnosis [5]. Radiation based modalities like digital radiography/mammography and Computed Tomography Scan were reported in Ghana as the most available [6, 7]. Therefore, exposure of patients and radiation workers to ionizing radiation is inevitable, making the use of radiation in medical practice a source of exposing patients and radiation workers to the potential hazards of radiation [8]. Human systems such as reproductive, immune, hematopoietic and others are seriously affected by exposure to ionizing radiation. Also, leukemia, cataracts, and other malignant lesions are some other adverse effects of ionizing radiation [9, 10].

Awareness of and concerns over exposure to radiation and radiation-induced ionization have significantly increased in the past decade [11]. Public concerns regarding medical exposure to radiation are comparatively high, as the risks regarding this exposure are generally unclear [12]. The knowledge gap and perception about the dangers of radiation among radiation experts and the general public are substantially wide, partly because the mass media which is the source of information to the general public, and may distort and misinterpret technical knowledge about radiation [13]. The perception of individuals about the various types of radiation risks differs. Studies in the United States and other places have consistently reported a perception of a lower risk of radiation sources such as naturally occurring radon gas and medical X-rays to people, compared to nuclear waste and power, which is contrary to what radiation experts perceive [14]. There is inadequate knowledge about the dangers of exposure to radiation and the appropriate steps to minimize those hazards in some HCWs [15]. The patients, HCWs, and the general public have been progressively sensitized about radiation exposure issues whether from therapeutic and diagnostic examinations [16]. The understanding of the perception of radiation, the sentiments that influence the perception and the factors that influence these sentiments are necessary to effectively communicate health risk information. Various studies assessing the knowledge, attitude and practices of different HCWs working in the radiation units have shown different findings [17].

Although it is believed that non-radiation HCWs do not possess a good comprehension of radiation and its associated risks, few studies have investigated this assertion. There is a wide variation in the attitudes of patients undergoing diagnostic examination using ionizing radiation [18]. The acceptance of radiation-based examinations is closely influenced by the perception of patients about radiation issues [19]. Healthcare professionals are reliable sources of accurate information concerning radiation issues to their patients. Additionally, they play important roles in communicating the risks associated with radiation by sympathizing with and adequately dealing with patients' anxiety about radiation even though their also perceived by the public as sources of medical errors as reported in Australia by Kim et al [20, 21]. The aim of this study was to determine what the non-radiation HCWs knew about radiation, through the assessment of the following specific objectives;

- To determine the level of knowledge of non-radiation HCWs about radiation.
- To find out the thoughts and practices of non-radiation HCWs about radiation.
- To evaluate the attitude of non-radiation HCWs about radiation.
- To determine any possible associations between socio-demographic characteristics and perception of respondents.

# 2. Methods

### Study design

This was a cross-sectional design, which considered non-radiation HCWs in four hospitals in the Cape Coast metropolis of the Central Region of Ghana from July to October 2020. All HCWs at the radiology department were excluded.

### Study site

The study was conducted in four facilities in the Cape Coast metropolis: University of Cape Coast Hospital (UCCH), Cape Coast Teaching Hospital (CCTH), Ankaful General Hospital (AGH), and Cape Coast Metropolitan Hospital (CCMH). These are the facilities with X-ray departments. CCTH, which is the largest public health institution in Cape Coast Metropolis of the Central Region of Ghana, offers training and tertiary services. It is situated in the central part of Cape Coast. UCCH and CCMH, both secondary healthcare institutions are located in the south-western side of Cape Coast and AGH at the north-western side of Cape Coast.

### Sampling and Data Collection

The target population for the study was all non-radiation

HCWs including doctors, nurses, allied health staffs and supportive staffs from all the four facilities. From the human resource records of these hospitals, there were about 1507, 293, 259, and 210 non-radiation HCWs from CCTH, UCCH, CCMH and AGH respectively giving a total of 2,269. In estimating the sample size of a population of 10, 000 or less, 10-30% of the total population is regarded as a good representation of the target population [22]. Based on that, 340(15%) of the total population was used as the total sample size for this study. With simple proportion, 226, 44, 39, and 31 respondents were sampled respectively from CCTH, UCCH, CCMH and AGH totaling 340 (Table 1).

**Table 1.** Sample Size Determination for each Site

| Facility | Total Non-radiation Healthcare workers | Number of participants at each site(simple proportion) |
|---|---|---|
| CCTH | 1507 | 226 |
| UCCH | 293 | 44 |
| CCMH | 259 | 39 |
| AGH | 210 | 31 |
| Total | 2269 | 340 |

Due to bans and restrictions in Ghana against public gatherings as a result of the Corona Virus Disease 2019 (Covid-19) pandemic, an online-based questionnaire was created in English, using Google Forms, to ensure participants' convenience and avoid face to face administration of the questionnaire. The questionnaire was pretested with 20 respondents from various facilities to check for reliability, clarity and validity. The questionnaire was grouped into three categories- socio-demographic characteristics; knowledge, attitude, thoughts and practices on radiation; suggestions to radiation HCWs based on respondents' perception and recommendations to healthcare authorities on radiation protection issues. Due to the heterogeneous nature of the non-radiation HCWs, the staffs were categorized under five professional groups namely; Administrative Staff, Doctors, Allied Health Staff, Nurses, and Pharmacy Staff and the link for the questionnaire was shared through their professional WhatsApp platforms. The purpose of the survey was clearly stated at the beginning of the questionnaire to thoroughly inform the participants. The inclusion and exclusion criteria were also indicated. Anonymity and confidentiality were guaranteed. Before responding to the survey, a section was provided at the beginning of the questionnaire for the participants to indicate as to which health facility they work at. Completion and submission of the questionnaire were indicated to imply an informed consent to participate in this study. All the responses obtained were stratified under the various health facilities where the participants work at. After which a systematic sampling (selecting every other response) was used to repeatedly select the responses until the targeted sample size for each facility was reached.

### Data analysis

The data obtained was sorted, organized, edited, and coded. The analyses were done with IBM Statistical Package for Social Sciences (SPSS Inc., Chicago, IL version 20.0) for computation of descriptive statistics, including means, percentages, frequencies and standard deviations and presented in appropriate tables and charts. A chi-squared test was employed in determining the association between gender, educational level, profession, work experience and willingness to accept posting to the radiology department. Statistical significance for all tests was set at $p \leq 0.05$.

### Ethical Considerations

Ethical approval was issued by the CCTH Ethical Review Board with approval number [CCTHERC/EC/2020/058] and dated 2nd June 2020. Anonymity and confidentiality were maintained throughout the study. The protocols of this study complied with the 1975 Declaration of Helsinki.

## 3. Results

### Characteristics of Participants

**Table 2.** Characteristics of Participants

| Item | Count (%) |
|---|---|
| **Age** | |
| Minimum | 18 |
| Maximum | 60 |
| Mean (SD) | 32.26 (7.618) |
| **Gender** | |
| Male | 174 (51.2%) |
| Female | 166 (48.8%) |
| **Educational Qualification** | |
| Certificate | 51 (15.0%) |
| Diploma | 102 (30.0%) |
| Bachelor's Degree | 143 (42.1%) |
| Masters | 37 (10.9%) |
| PHD | 5 (1.5%) |
| Others | 2 (0.6%) |
| **Profession** | |
| Doctor | 57 (16.8%) |
| Nurse | 166 (48.8%) |
| Allied health Staff | 63 (18.5%) |
| Administrative Staff | 34 (10.0%) |
| Pharmacy Staff | 20 (5.9%) |
| **Working Experience** | |
| 5 years or below | 189 (55.6%) |
| 6 -10 years | 83 (24.4%) |
| 11 -15 years | 26 (7.6%) |
| 16 - 20 years | 18 (5.3%) |
| 21 years and above | 24 (7.1%) |

SD=Standard Deviation

Out of the 340 non-radiation HCWs surveyed, the majority (51.2%) were males. The ages of the participants ranged from 18 to 60 years with the mean age 32.6 ±7.618 years. Majority of the respondents 189 (55.6%) had worked for 5 years or less. The characteristics of the respondents including their educational qualifications, professional categories and the number of years of working experience are shown in Table 2.

## Opinions of Respondents on Radiation

We solicited for respondents' opinions about the types, the roles and the effects of radiation in human life. Most participants indicated that only two types of radiation (Ionizing and Non-ionizing) exist with the majority (76.2%) of the participants concerned about the adverse effects of the former. Responses revealed that, majority 184(54.1%) of non-radiation HCWs would accept posting to the radiology department. However, most 297(87.4%) of the HCWs would discourage pregnant HCWs from accepting posting to the department. The health benefits and implications as per respondents' opinions are shown in Table 3.

**Table 3.** Opinions of Respondents on Radiation

| Item | Response | Count (%) |
|---|---|---|
| **There are two types of radiation, ionizing and non-ionizing radiation.** | Yes | 228(67.1%) |
| | No | 11(3.2%) |
| | Don't Know | 101(29.7%) |
| **If Yes, which one should you be concerned about?** | Ionizing | 215(94.3%) |
| | Non-ionizing | 13(5.7%) |
| **Do you think radiation has any beneficial effects to mankind?** | Yes | 259(76.2%) |
| | No | 30(8.8%) |
| | Don't Know | 51(15.0%) |
| **If Yes please state any you know of?** | Medical diagnosis and treatments | 221(85.7%) |
| | Energy sources | 31(12.0%) |
| | Industrial uses | 6(2.3%) |
| **Will you accept a posting to the radiology department?** | Yes | 184(54.1%) |
| | No | 156(45.9%) |
| **If Yes, why?** | For better working conditions | 68(37.0%) |
| | Acquisition of knowledge | 42(22.8%) |
| | Services to humanity | 56(30.4%) |
| | Interest in the field | 18(9.8%) |
| **Will you advise a pregnant woman to work in the radiology department?** | Yes | 43(12.6%) |
| | No | 297(87.4%) |
| **If Yes, why?** | Speciality / duty | 8(18.6%) |
| | It's safe due to availability of PPE | 29(67.4%) |
| | Services to humanity | 3(7.0%) |
| | No Suggestion | 3(7.0%) |
| **If No why?** | Dangerous to the fetus | 220(74.1%) |
| | Harmful to the health of the pregnant women | 77(25.9%) |

**Table 4.** Association between Participant's Characteristics and whether they will accept posting to the radiology department

| Item | Will you accept a posting to the radiology department? | | $\chi 2$ | P-value |
|---|---|---|---|---|
| | Yes | No | | |
| **Gender** | | | | |
| Male | 110(63.2%) | 64(36.8%) | 11.887 | 0.001* |
| Female | 74(44.6%) | 92(55.4%) | | |
| **Educational Qualification** | | | | |
| Certificate | 19(37.3%) | 32(62.7%) | | |
| Diploma | 51(50%) | 51(50%) | | |
| Bachelor's Degree | 89(62.2%) | 54(37.8%) | 14.002 | 0.016* |
| Masters | 22(59.5%) | 15(40.5%) | | |
| PHD | 3(60.0%) | 2(40.0%) | | |
| Others | 0(0.0%) | 2(100.0%) | | |
| **Profession** | | | | |
| Doctor | 33(57.9%) | 24(42.1%) | | |
| Nurse | 80(48.2%) | 86(51.8%) | | |
| Allied health Staff | 41(65.1%) | 22(34.9%) | 8.437 | 0.077 |
| Administrative Staff | 16(47.1%) | 18(30.0%) | | |
| Pharmacy Staff | 14(70.0%) | 6(30.0%) | | |
| **Working Experience** | | | | |
| 5 years or below | 89(47.1%) | 100(52.9%) | | |
| 6 -10 years | 50(60.2%) | 33(39.8%) | | |
| 11 -15 years | 20(76.9%) | 6(23.1%) | 12.998 | 0.011* |
| 16 - 20 years | 13(72.2%) | 5(27.8%) | | |
| 21 years and above | 12(50.0%) | 12(50.0%) | | |

*Statistically significant. Chi-squared ($\chi 2$) was used to examine the relationship between gender, educational qualification, profession, working experience and the willingness to accept posting to the radiology department. $P \leq 0.05$ is statistically significant.

A Chi squared analysis revealed that, a significant proportion 110(63.2%) of those willing to accept posting to the radiology department were males (p=0.001). Educational qualification (p=0.016) and working experience (p=0.011) also showed a significant correlation with willingness to accept posting to the radiology department. However, the willingness to accept posting to the radiology department was not significantly associated with the professional category to which the HCWs belonged (p=0.077) as shown in Table 4.

## General Knowledge on Radiation

An assessment of respondents understanding on radiation was done on a five point Likert scale. Majority (88.9%) agreed and strongly agreed that, the use of lead apron and other protective equipment can reduce the harmful effect of radiation. The non-radiation HCWs also disagreed that the exposure to ionizing radiation has no effects on the human body. Other findings are also presented in Table 5.

**Table 5.** General Knowledge on Radiation (Protection/Safety, Harmful effects and Benefits)

| Items | Count (%) | | | | |
|---|---|---|---|---|---|
| | SA | A | N | D | SD |
| **The sun is a source of radiation.** | 203(59.7%) | 113(33.2%) | 15(4.4%) | 4(1.2%) | 5(1.5%) |
| **Ionizing radiation may cause cancer or other blood diseases such as leukemia, or death.** | 178(52.4%) | 121(35.6%) | 32 (9.4%) | 9(2.6%) | 0(0.0%) |
| **Ionizing radiation may cause sterility.** | 135(39.7%) | 129(37.9%) | 65(19.1%) | 10(2.9%) | 1(0.3%) |
| **Wearing lead apron and other protective equipment can reduce the harmful effect of radiation.** | 193(56.8%) | 109(32.1%) | 23(6.8%) | 10(2.9%) | 5(1.5%) |
| **Ionizing radiation may cause genetic mutations or behavioral damages** | 144(42.4%) | 118(34.7%) | 70(20.6%) | 6(1.8%) | 2(0.6%) |
| **Ionizing radiation may cause baldness and skin burns.** | 107(31.5%) | 130(38.2%) | 84(24.7%) | 14(4.1%) | 5(1.5%) |
| **Exposure to ionizing radiation has no effects on the human body.** | 22(6.5%) | 21(6.1%) | 50(14.7%) | 93(27.4%) | 154(45.3%) |
| **Ionizing radiation is a secure source of energy.** | 34(10.0%) | 83(24.4%) | 132(38.8%) | 51(15.0%) | 40(11.8%) |
| **The effect of radiation is more severe on the fetus and growing child.** | 181(53.2%) | 97(28.5%) | 41(12.1%) | 14(4.1%) | 7(2.1%) |

SA – Strongly Agree, A – Agree, N – Neutral, D – Disagree, SD – Strongly Disagree

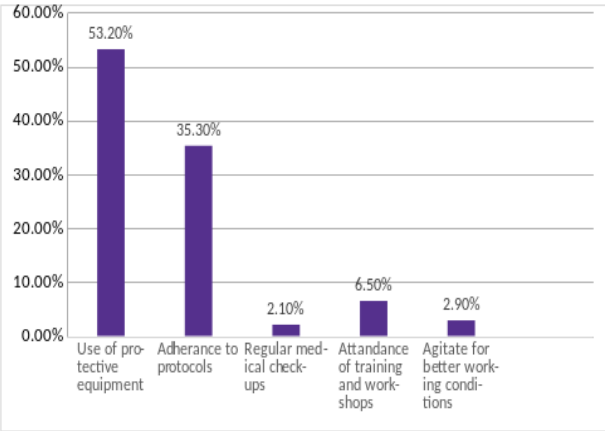


**Figure 1.** Suggestions to the radiology Staff based on respondents' perception.

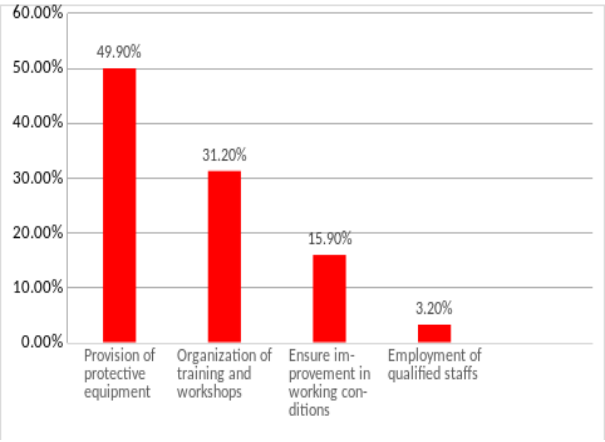


**Figure 2.** Recommendations to the hospital management/Ministry of health on radiation protection issues

## 4. Suggestions and Recommendation

For the staff of the radiology department, most respondents suggested the frequent use of protective equipment (53.2%) and adherence to protocols (35.3%). Majority recommended adequate supply of these protective equipment (49.9%), either by the hospital management or Ministry of health. Other suggestions and recommendations are illustrated in Figures 1 and 2 respectively.

## 5. Discussion

The central idea on which the study was conducted was to determine the level of knowledge of non-radiation HCWs on radiation in medical practice. The results of this study showed that, most participants had a high level of knowledge on radiation in terms of the types, benefits and effects (Table 3). In contrast, a study by Chun-sing et al., and others showed that physicians and interns had poor knowledge of radiation related to radiological imaging [23-31]. These studies considered all HCWs including radiologists. But in our study, all HCWs apart from those from the radiology department were recruited. However, in those studies, they found that, the level of knowledge of the radiologists who in reality should have a higher level of knowledge on radiation related issues was unsatisfactory.

The knowledge and awareness regarding safety issues on ionizing radiation were high in our study (Table 5). But numerous studies have highlighted the low level of awareness among HCWs regarding their understanding of

ionizing radiation. The lack of knowledge on the safety issues associated with ionizing radiation in other reports is in contrast to our findings [32-34]. This means non-radiation HCWs will be able to efficiently protect themselves or their patients against ionizing radiation, in compliance with the principle of as low as reasonably achievable (ALARA) routinely used in medical imaging should they find themselves in the radiology department [35]. This explains why the majority (54.1%) of the respondents in our study were willing to accept posting to the radiology department given the opportunity. Furthermore, we found out that acceptance of posting to the radiology department had significant associations with the gender of participants, educational qualification and work experience as those willing to accept posting to the radiology department had practised for more than five years, which could be a factor for the high level of awareness of ionizing radiation (Table 4). When asked whether they would advise pregnant women to work at the radiology department, the majority (87.4%) answered "No" whilst 12.6% answered "Yes". Both sides gave convincing reasons to justify their responses (Table 3). The authors assert that fear of radiation is highly entrenched, which can negatively affect patient care. Systematic education about radiation is therefore needed to address unnecessary anxiety [36]. The degree of knowledge regarding the use of personal protective equipment (PPE) was high with 88.9% of the respondents appreciating the need for such equipment (Table 5). A study among nurses working in a radiology department in Kuwait revealed that the majority of nurses had low knowledge of radiation protection protocols and risk of radiation [37]. Takanami et al., investigated the need to protect against radiation exposure and reported that in response to the question, "How do you protect yourself against radiation exposure?", nurses responded with, "I do not approach the room where radiation is irradiated" and "I do not care for patients who undergo radiation treatment or diagnostic tests because a radiological technologist cares for the patient" [38]. Likewise, in Ghana, a study on nurses' knowledge on ionizing radiation reported inadequate knowledge in majority of nurses and erroneous beliefs about radiation sources and protection against radiation [39].

The risk of radiation has long been recognized as a major public health burden because of its potential for acute and chronic health effects [40]. Recommendations to the health authorities on radiation protection issues and suggestions to the radiology staff obtained from the non-radiation HCWs were similar (Figures 1, 2). The majority of participants recommended provision of adequate protective equipment and suggested strict adherence to safety protocols as a means of reducing their exposure to radiation. Other studies found that some operating rooms lack protective equipment to protect HCWs from the adverse effects of radiation. A recent study in South Africa among interventionalists found inconsistent use of PPE and their existence were not always available [41]. Similarly, in a study in Trinidad, the authors reported 80% lack of availability of PPE such as thyroid shields and lead aprons, even though there was constant exposure to ionizing radiation from various sources [42, 43]. The next most common recommendation proposed by the respondents from our study on radiation protection issues was to provide training and education through the organization of workshops. In a study among health professionals in Trinidad, it was startling that the simple knowledge regarding radiation exposure and safe machine usage was insufficient among participants [42]. Szarmach et al., in 2015 reported that HCWs should undergo periodic training regarding radiological protection irrespective of their position and length of service [44].

### Limitation

A notable limitation of this study included the fact that the responses obtained were selected alternately based on the order in which they appeared. This had the potential to skew the responses. Also the sample size considered for this study was relatively lower, hence, further studies with larger sample sizes may be required in future.

## 6. Conclusions

The observations made in this study suggest that, the majority of non-radiation HCWs had a high level of knowledge and awareness about radiation and its types, effects of ionizing radiation and radiation safety issues. This implies that, the non-radiation HCWs will be able to efficiently protect themselves or their patients against ionizing radiation should they find themselves in the radiology department in conformity with ALARA principle. The perception of non-radiation HCWs was generally positive since they offered tangible suggestions and recommendations regarding radiation protection issues to radiation workers and their willingness to accept posting to the radiology department which is laudable. The acceptance of posting to the radiology department was significantly associated with gender, educational status and working experience, this can be a valuable guide to the human resource departments of healthcare facilities during recruitment and/or poaching of healthcare workers.

## Authors' Contribution

Emmanuel Kobina Mesi Edzie, Klenam Dzefi-Tettey, Philip Narteh Gorleku, Adu Tutu Amankwa and Ewurama Andam Idun made substantial inputs to the conception, design, implementation, drafting of the manuscript,

revising and approving the manuscript for publication Edmund Kwakye Brakohiapa, Eric Aidoo, Julius John Essoun, Frank Quarshie, Henry Kusodzi and Abdul Raman Asemah all made significant contributions in designing, implementing, analyzing, literature searches, revising and approving the manuscript for publication.

## Data Availability

Data used to support the findings of this study may be obtained upon request to the Head of the Research Unit of the Cape Coast Teaching Hospital. Postal address is as follows: P.O. Box CT I363, Cape Coast, Ghana. E-mail is ccthresearch@gmail.com.

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## Conflict of Interest

None to declare.

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