ASSESSMENT OF THE LEVEL OF AWARENESS OF RADIOGRAPHY CLINICAL YEAR STUDENTS TOWARDS RADIATION DOSE LIMITS AND REGULATORY GUIDELINES.

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OCTOBER,2025

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A PROJECT SUBMITTED TO THE DEPARTMENT OF RADIOGRAPHY,
SCHOOL OF BASIC MEDICAL SCIENCES,
IN PARTIAL FULFILLMENT FOR THE REQUIREMENT OF THE
AWARD OF BACHELOR DEGREE IN RADIOGRAPHY (B.RAD),
UNIVERSITY OF BENIN, BENIN CITY, NIGERIA

SUPERVISED BY
AKPOBASAHAN E. A. (DR.)

OCTOBER,2025

CERTIFICATION

This is to certify that the project on **ASSESSMENT OF THE LEVEL OF AWARENESS OF RADIOGRAPHY CLINICAL YEAR STUDENTS TOWARDS RADIATION DOSE LIMITS AND REGULATORY GUIDELINES**. written by **MOHAMMED JEMILAT OMOYEMHE** with Matriculation number BMS2005196 in partial fulfillment of the Bachelor of Radiography (B.Rad) degree in the Department of Radiography, School of Basic Medical Science, College of Medical Sciences, University of Benin.

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DR. E.A AKPOBASAHAN Date
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MRS F.O IGBINEDION Date
(Head of Department)

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EXTERNAL SUPERVISOR Date

APPROVAL

PROJECT TITLE: ASSESSMENT OF THE LEVEL OF AWARENESS OF RADIOGRAPHY CLINICAL YEAR STUDENTS TOWARDS RADIATION DOSE LIMITS AND REGULATORY GUIDELINES done and submitted BY MOHAMMED JEMILAT OMOYEMHE with MATRICULATION NUMBER BMS2005196 in partial fulfillment of the award of bachelor of radiography (B.RAD) degree in The Department of Radiography, School Of Basic Medical Sciences, College Of Medical Science, University Of Benin, has been examined , accepted and approved and is here by recommended for final oral defense.

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DR.E. A AKPOBASAHAN Date

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MRS F. O. IGBINEDION Date

(Head of Department)

DEDICATION

This work is dedicated to God Almighty my Creator and strong pillar, my parent and lovely siblings who believed in me.

ACKNOWLEDGMENT

I sincerely express my gratitude to God Almighty for granting me the strength, wisdom, and perseverance to complete this research.

My heartfelt appreciation goes to my supervisor, Dr AKPOBASAHAN E.A, whose guidance, patience, and constructive feedback were invaluable throughout this study. Your expertise and support helped shape this work into what it is today.

I also extend my gratitude to my HOD, MRS FANNY IGBINEDION, my lecturers and academic mentors for their dedication and for imparting knowledge that has been instrumental in this research.

Special thanks to my family, my parents Mr. and MRS MOHAMMED and My Siblings - Aishat, Semirat, Maryam, Nimatallah and Ruth, for their unwavering support, encouragement, and understanding during this journey. Your words of motivation kept me going even during the most challenging moments. Finally, I acknowledge all the healthcare professionals, patients, and data sources that contributed to this study. Your willingness to share knowledge and provide information made this research possible. To everyone who played a role, directly or indirectly, in the successful completion of this work, I am truly grateful.

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ABSTRACT

Ionizing radiation is widely used in medical imaging but requires strict adherence to safety standards. This study assessed the awareness of radiation dose limits and regulatory guidelines among 234 radiography clinical-year students at the University of Benin. Only 36.4% correctly identified the recommended public dose limit of 1 mSv, while 44% admitted not knowing it. Mean knowledge score was moderate (66.8%), though Confidence towards radiation protection was high (87.1%). Students who attended radiation protection courses scored significantly higher (76.1%) than non-attendees (48.1%). These findings highlight a gap between positive safety Confidences and technical knowledge, emphasizing the need for strengthened curriculum and structured trainings.

Keywords: Radiography, Radiation Protection, Dose Limits, Awareness.

CHAPTER ONE

INTRODUCTION

1.1 Background of Study

According to the International Atomic Energy Agency (IAEA), ionizing radiation is radiation with sufficient energy to remove electrons from atoms or molecules, leading to the formation of ions and atomic-level changes when interacting with matter (IAEA, 2025). Ionizing radiation may be directly or indirectly ionizing and includes both particulate and electromagnetic forms such as alpha and beta particles, neutrons, X-rays, and gamma rays. Due to their penetrating ability, X-rays and gamma rays are widely used in medical imaging and radiotherapy (Bushberg et al., 2012; IAEA, 2025).

Despite the widespread application of ionizing radiation in healthcare, concerns remain regarding the level of awareness of radiation dose limits, associated risks, and regulatory guidelines among healthcare trainees, particularly radiography students who are routinely exposed during clinical training. Inadequate knowledge of radiation protection principles may increase the risk of unnecessary radiation exposure to both patients and healthcare professionals.

Evidence from previous studies supports this concern. A cross-sectional study by Shafiq et al. (2024) among clinical medical students at Northern Border University, Saudi Arabia, reported generally poor baseline knowledge of radiation hazards and protection. The study further demonstrated that students who had undergone radiation safety training showed significantly higher knowledge levels than those without prior training, highlighting the importance of structured radiation education.

These findings underscore the need to evaluate the level of knowledge, perception, and confidence regarding ionizing radiation exposure among radiography clinical-year students at the University of Benin, where similar gaps in radiation safety awareness may exist.

1.2 Statement of Problem

At the University of Benin, radiography clinical-year students are routinely exposed to ionizing radiation during training, yet there is little empirical evidence documenting their level of knowledge of radiation dose limits, associated risks, and regulatory guidelines. This lack of locally generated data makes it difficult to determine whether students are adequately prepared to practice safely and in compliance with radiation protection standards. At the national level, similar concerns have been reported in Nigeria. Eddy et al. (2025), in a case study exploring the health effects, economic impacts, and regulatory challenges associated with ionizing radiation in Nigeria, highlighted gaps in radiation safety awareness, regulatory compliance, and effective implementation of radiation protection measures. These findings suggest that deficiencies in knowledge and adherence to radiation protection principles remain a significant issue within the Nigerian context, particularly among individuals who are routinely exposed to ionizing radiation. Evidence from international settings further supports the existence of this knowledge gap. A cross-sectional study by Alkhaldi et al. (2022) among 426 medical students in Saudi Arabia found that only 32.4% could correctly identify radiation doses for common imaging procedures, 68% could not distinguish between ionizing and non-ionizing radiation, over 70% underestimated CT-related radiation risks, and fewer than 40% were aware of occupational dose limits.

Taken together, these findings emphasize the likelihood of similar knowledge deficiencies among radiography clinical-year students at the University of Benin and underscore the necessity of assessing their knowledge, perception, and confidence regarding radiation dose limits, associated risks, and radiation protection guidelines.

1.3 Research Question

The following questions were raised and addressed in this study;

1. What is the level of Awareness of Radiography Clinical year students in University of Benin regarding radiation dose limits?
2. To what extent is Radiography clinical year students is educated about national and international radiation regulatory guidelines (e.g. ICRP, NNRA, IAEA)?
3. How confident are clinical year students in applying radiation protection practices during clinical procedures?

1.4 Hypothesis

The following hypotheses were tested during the course of this study:

Null Hypothesis H_0: Educational courses on Radiation Protection does not significantly influence Clinical year students' awareness of radiation risks and regulatory standards.

Alternate Hypothesis H_1: Educational courses on Radiation Protection significantly influences Clinical year Students' awareness of radiation risks and regulatory standards.

1.5 Aim of the study

The aim of the study is to assess the level of Awareness of Radiography Clinical year students towards dose limit and regulatory guidelines.

1.6 Objectives of study

The objective of this study is:

1. To determine the level of awareness of Radiography Clinical year students in University of Benin regarding radiation dose limits.
2. To evaluate the extent to which Radiography clinical "-year" students are Educated about national and international radiation regulatory bodies and guidelines (e.g., NNRA, ICRP, IAEA).
3. To assess the Level of confidence of students in applying radiation protection practices during clinical practices.

.1. 7 Significance of Study

This study is significant as it addresses a critical gap in knowledge and awareness regarding ionizing radiation among radiography clinical-year students and their understanding of dose limits and regulatory guidelines. In an era where radiation is widely used in diagnostic and therapeutic settings, producing well-informed future radiographers is essential for ensuring

Formatted[SM-N950U]: Underline color: Custom Color (RGB(209,52,52)) patient safety, occupational safety, and environmental protection. By evaluating the level of awareness among clinical students at the University of Benin, the study will identify areas of strong competence as well as critical knowledge deficiencies that require targeted educational intervention.

Beyond the University of Benin, the findings have important implications for radiography education and clinical practice across Nigeria. Evidence generated from this study can inform national training institutions on the adequacy of current radiation protection teaching within radiography curricula, potentially prompting curriculum review and standardization across universities and colleges of health technology. The results may also support regulatory and professional bodies in Nigeria in strengthening compliance with radiation protection standards by identifying gaps in students' preparedness before entering full professional practice.

In clinical practice, improved awareness and confidence in applying radiation protection principles can translate into better adherence to dose optimization strategies, justification of procedures, and safer use of imaging equipment. This has direct implications for reducing unnecessary radiation exposure to patients, workplace exposure to healthcare workers, and radiation-related risks to the general public. From a policy perspective, the study can provide empirical evidence to guide the development of institutional and national policies on mandatory radiation safety training, periodic competency assessments, and continuous professional development requirements for radiography students and practicing radiographers in Nigeria.

Ultimately, the study contributes to strengthening radiation safety culture at institutional, professional, and national levels.

1.8 Scope of the study

The study was conducted within the department of Radiography in the University of Benin, Benin city, Edo State, Nigerian. It began on the 6th of June, 2025 and continued till 28th of September, 2025.It will focus specifically on Clinical year students' level of awareness toward radiation dose limits and regulatory guidelines. The target population consisted of 300lv to 500lv students in the department. Only Participants who were available during the period of data collection and gave informed consent to take part in the study were studied.

This study explored participants' understanding of radiation dose and dose limits, their familiarity with relevant regulatory bodies such as NNRA, ICRP and IAEA and radiation safety practices. Participants' Demographic information such as age, gender and departmental were gathered to evaluate how these factors may influence awareness levels.

1.9 Operational Definition of terms

1. Ionizing Radiation: In this study, ionizing radiation refers to high-energy radiation (such as X-rays or gamma rays) that can remove tightly bounded electrons from atoms, which can cause biological damages
2. Radiation Dose Limit: This is the maximum amount of radiation a person can legally or safely be exposed to within a specific period, as defined by regulatory authorities such as the NNRA or ICRP.

3. Regulatory Guidelines: These are formal rules or standards set by national and international bodies (e.g., NNRA, IAEA, ICRP) that govern the safe use of ionizing radiation to protect individuals and the environment.
4. Awareness: For the purpose of this study, awareness refers to the extent to which in which Radiography Clinical year students have heard of, understand, or can identify radiation dose limits and relevant regulatory guidelines.
5. Clinical year students: Clinical year students are radiography students who have completed their basic pre-clinical courses, 300level to 500level. And are now undergoing practical hospital-based training with direct patient exposure.
6. Confidence: For the purpose of this study, it is the student belief in their ability and judgement in applying radiation protections.

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CHAPTER TWO

LITERATURE REVIEW

2.1 Conceptual review

This conceptual review provides a comprehensive foundation for the understanding of variables that are central to this study. These include ionizing radiation, radiation dose limit, safety guidelines, bodies responsible for radiation safety, public awareness and Confidence towards radiation exposure. These interrelating concepts are very essential to evaluating how the Clinical year students in University of Benin perceives and respond to radiation exposure risks.

According to the International Atomic Energy Agency (IAEA), Ionizing radiation is a type of radiation with an energy that can remove electrons from atoms or molecules; this causes the production of charged atoms called ions, hence the name "Ionization". These ions cause changes at the atomic level when interacting with matter. Ionizing radiations can be directly or indirectly ionizing. Directly Ionizing radiation is particulate radiation that ionizes atoms directly through electrostatic interactions as they pass through matter while indirectly Ionizing radiations contain electromagnetic radiation and neutrons. They interact with atoms to produce secondary charged particles that then cause Ionization. (IAEA, 2025.) This ionization process can damage living tissues, potentially causing skin burns, organ damage, cancer, and genetic mutations, depending on the intensity and duration of exposure (Bushberg et al., 2012)

Ionizing radiation exists in two broad categories: particulate radiation and electromagnetic radiation. Particulate radiation includes Alpha particles, beta particles and neutrons. Alpha particles consist of two protons and two neutrons and they're emitted from the nucleus of heavy atoms such as uranium and radium. Alpha particles are highly ionizing and they have low penetration power. Hence, they can be stopped by a sheet of paper, or the outer layer of human skin. Beta particles are jungle energetic electrons or positrons. They have higher penetration than Alpha particles hence they can pass through human skin, few millimeters of Aluminum. Neutrons are uncharged particles, but they are highly penetrating. They required materials containing hydrogen such as water or concrete to be stopped.

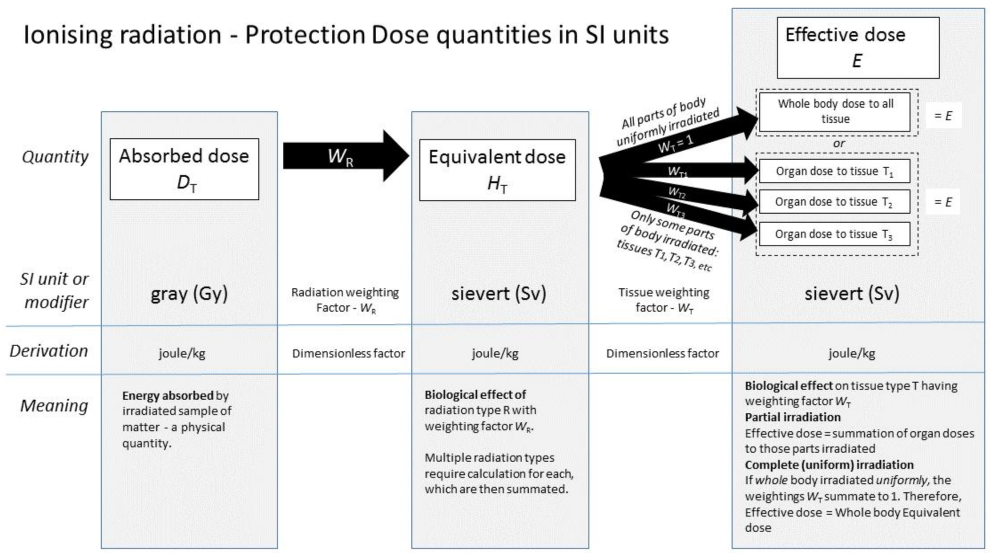
Electromagnetic ionizing radiation primarily includes X-rays and gamma rays. These are forms of high-frequency electromagnetic waves that carry sufficient energy to remove tightly bound electrons from atoms. X-rays are typically generated by electron interactions with metal targets in diagnostic machines, while gamma rays are emitted from the decay of radioactive isotopes such as cobalt-60 or cesium-137(IAEA,2025). Both types of radiation are deeply penetrating and widely used in medical imaging, cancer therapy, and industrial radiography (Bushberg et al., 2012).

Sources of ionizing radiation in Nigeria originates from both natural and human-made resources. These are influenced by geological formation industrial activities and medical practices. Locations such as Bauchi and Jos plateau contains elevated concentrations of natural radionuclides such as, Thorium-232, potassium-40 etc. These have an effect of increased terrestrial radiation exposure to the local population. (Eddy et al.,2025). A report by (Omotehinse et al.,2019*)* inferred that the mining of Tin in the Jos plateau significantly contributes to increased exposure to Ionizing radiation. Radon Gas, decay products of uranium is another major source of ionic radiation exposure. A report by (Onwumechili et al., 2023) Inferred that the concentration of radon in some Nigerians exceeded international safety guidelines. While a report done by (Adeleke et al., 2023) inferred that cosmic source of radiation in Nigeria is relatively low, which could be as a result of its position on the planets equator, yet it still remains a source of environmental radiation

Human-made sources of ionizing radiation in Nigeria include sources from medical imaging technologies such as X-rays, CT scans and radiotherapy. This plays a dominant role in radiation exposure. In a study by (Adeleke et al., 2023*)* it was inferred that many patients were exposed to radiation doses exceeding international diagnostic reference levels, especially for CT and Fluoroscopy procedures. This study identified significant variations across hospitals, it inferred that these increase in dose are often due to outdated equipment and inconsistencies in imaging procedures.

Diverse sources of ionized radiation are present throughout Nigeria from natural formation like the Jos plateau and Radon in homes, to medical exposures.

A radiation dose is the amount of energy absorbed by a medium, especially human tissue when exposed to ionizing radiation. This is usually measured in units such as grays (Gy) for absorbed



dose, and Sieverts (SV) for equivalent and effective dose (ICRP, 2024)

Figure 2.1: Schematic diagram showing Ionizing radiation dose quantities and their SI units (Bushberg et al., 2012).

The Biological effect of radiation depends on several factors which includes type of radiation, duration of exposure and tissue sensitivity. Even repeated low doses can result in Stochastic effects such as Cancer (Fontolan et al., 2022). While high radiation doses can cause deterministic effects such as radiation burns, acute radiation poisoning especially when the dose exceeds the internationally recommended dose limits.

Through the 2023 annual report of The Nigerian Nuclear Regulatory Authority (NNRA), the national framework for radiation protection built on international standards such as those of the

IAEA and ICRP. Central to this framework is the Nigeria basic ionizing radiation regulation (NiBIRR) which prescribes safety limits occupational and public exposure. For workers in radiation prone environment, the dose limit is set at 20 milisieverts (mSv) per year, averaged over 5 years. While the general public is limited to 1mSv per year. All facilities that use ionizing radiation whether for medical, industrial or research purpose is mandated to obtain licenses and adhere to these dose limits.

The NNRA emphasize the adherence to the ALARA principle in the medical sector to minimize unnecessary radiation exposure during diagnostic and therapeutic procedures. These guidelines bring about the need for properly calibrated imaging equipment, trained personnel and standard protocols. Regular inspections are carried out to assess adherence, with particular attention to high-dose procedures such as CT scans and fluoroscopy. The NNRA also monitors facilities for the management of naturally occurring radioactive materials (NORM), which can pose hidden risks.

Additionally, the NNRA promotes radiation safety through public education where radiation safety officers engage in public awareness campaign to improve understanding of radiation risks and protective practice. However, the success of this initiative depends on how well they implemented on the local level. In cities like Benin, evaluating public awareness of these safety measures is crucial, especially given the growing reliance on medical imaging and the risk of poor regulatory compliance.

2.2 Empirical studies

A cross-sectional study conducted by Inmutto (2020) assessed the awareness of radiation protection and knowledge of radiation doses among 47 fifth-year medical students and 18 radiology residents at Maharaj Nakorn Chiang Mai Hospital, Thailand, during July 2019. The results revealed notable discrepancies in self-perceived versus actual knowledge: 48.9% of the medical students and 61.1% of the radiology residents claimed they had sufficient knowledge of ionizing radiation protection. However, objective assessment showed something different. On a 16-point test, students scored an average of 6.2 ± 2.2, while residents scored 7.9 ± 2.1. Only 14.9% of students and 38.9% of residents recognized stochastic radiation damage, yet awareness of the "As Low as Reasonably Achievable (ALARA)" concept was higher—57.4% of students and 88.9% of residents.

Furthermore, half of the students (50%) incorrectly believed that MRI and ultrasound involve ionizing radiation. These findings underscore a substantial gap in knowledge, even among future specialists and indicate that enhanced theoretical and practical radiation protection training is essential (Inmutto, 2020).

In another cross-sectional study by (Alreshidi et al., 2020) examined the knowledge of clinical-year medical students at the University of Hail regarding imaging modalities, radiation risks, and safety principles. The study surveyed 145 respondents (51.7% female, 48.3% male) across years 4 to 6. 37.9% in year 4, 26.2% in year 5, and 35.9% in year 6. Overall mean scores were low: 4.10 ± 2.03 out of 10 for knowledge of common imaging modalities; 3.17 ± 1.95 out of 13 for understanding radiation risks; and 0.79 ± 0.92 out of 8 for radiation safety principles. Notably, only 10.3% of the students had attended a radiation protection course. Knowledge improved with clinical progression: year 6 students scored significantly higher (mean total 10.92 ± 3.22) compared to years 4 (6.18 ± 3.59) and 5 (6.84 ± 3.37) ($p < 0.001$). Attendance at a radiation protection course was associated with significantly better scores in safety principles (1.33 vs. 0.72; $p = .015$). These findings indicate that, despite some improvement with higher level and training, the students' comprehension of radiation related risks and safety remains inadequate, underscoring the pressing need to integrate structured radiation protection education into medical training (Alreshidi et al., 2020).

A comprehensive cross-sectional survey by (Faggioni et al.,2017) evaluated awareness of radiation protection and knowledge of dose levels among medical students (MS), radiography students (RS), and radiology residents (RR) at an academic hospital in Italy. The survey included 243 participants (77 MS, 93 RS, 73 RR). Results showed striking disparities in knowledge across the groups. Overall, RS and RR significantly outperformed MS in recognizing radiation exposure from common imaging procedures. Only 18% of medical students correctly identified CT as a high-dose examination, compared with 54% of radiography students and 67% of residents. Furthermore, over 70% of MS underestimated the radiation dose from chest CT, while nearly half of all participants believed MRI involved ionizing radiation, reflecting a widespread misconception. Awareness of radiation protection regulations and dose optimization strategies was particularly poor among MS, with fewer than 20% reporting familiarity with national or European radiation safety guidelines. The Study concluded that knowledge gaps are pervasive, especially among medical students, and emphasized the urgent need for integrating structured radiation protection teaching across medical curricula to ensure safer imaging practices (Faggioni et al., 2017).

A cross-sectional study by Kada (2010) investigated the awareness and knowledge of radiation dose and associated risks among final-year medical students in Norway. The study surveyed 127 students using a structured questionnaire that assessed their understanding of radiation risks, dose levels of common imaging modalities, and regulatory safety principles. Results revealed a substantial knowledge gap: only 15% of respondents correctly estimated the radiation dose from a chest CT, while nearly two-thirds underestimated the carcinogenic risks associated with repeated imaging. Furthermore, about 40% incorrectly believed that MRI involved ionizing radiation, demonstrating a common misconception also reported in similar international studies. Awareness of national and international radiation protection guidelines was poor, with less than 20% of students familiar with key recommendations from bodies such as the ICRP. The study concluded that despite medical students' heavy reliance on imaging in clinical practice, their limited knowledge of radiation doses and risks could compromise patient safety. And study strongly recommended integration of radiation protection into the core medical curriculum to ensure safer clinical decision-making (Kada, 2010).

A cross-sectional study in Japan (Nakao et al., 2025) investigated the effectiveness of radiation education for medical students prior to clinical clerkship. The study targeted pre-clinical medical students who were about to start clinical rotations, a stage where they become increasingly exposed to diagnostic imaging and potential radiation risks. The intervention included lectures on radiation exposure, practical use of radiation dosimeters, and safety guidelines. Findings showed that students' awareness of ionizing radiation risks significantly improved post-training, with knowledge scores increasing by over 30% compared to baseline. Additionally, more than 70% of participants reported increased confidence in recognizing radiation hazards and applying protective measures in clinical settings. The study emphasized that radiation safety education should be introduced earlier in the medical curriculum to ensure adequate preparedness before clinical exposure. This study highlights the importance of structured radiation protection training in bridging existing knowledge gaps among future healthcare professionals. (Nakao et al.,2025)

A cross-sectional study by (Prajapati et al., 2022) was conducted among 140 radiography students at Teerthanker Mahaveer University, India, to evaluate their knowledge about personnel radiation monitoring devices such as film badges and thermoluminescent dosimeters (TLDs). The sample consisted of 61% males and 39% females, including both Bachelor of Radiological Imaging Technology (BRIT) and Master of Radiological Imaging Technology (MRIT) students.

Findings revealed varying levels of awareness across academic years. MRIT second-year students demonstrated the highest knowledge (81%), followed by MRIT first-year (80%), while BRIT students scored lower (65% for third-year and 66% for second-year). Overall, students displayed medium-level awareness, with postgraduate students outperforming undergraduates. The study emphasized that despite exposure to radiation safety courses, many students lacked comprehensive understanding of monitoring devices. The study recommended stronger integration of radiation protection training into radiography curricula to ensure students are well-prepared for clinical practice (Prajapati et al., 2022).

A longitudinal study by (Abuzaid et al., 2024) evaluated occupational radiation exposure among undergraduate radiography students at the University of Sharjah, UAE. Over the 2015–2023 period, thermoluminescent dosimeters (TLDs) were used to measure shallow (HP (0.07)) and deep (HP (10)) radiation doses across approximately 384 hours of clinical placement per student. The study collected data from 599 TLD readings, representing an average of 74 students per year. Results revealed that the average effective deep dose (HP (10)) was 0.227 mSv, and the shallow dose (HP (0.07)) was 0.222 mSv—both values remaining well below international occupational dose limits. The findings demonstrate that existing training and safety protocols effectively protect students from overexposure during clinical training, reinforcing the effectiveness of continuous monitoring and education in sustaining safe clinical radiation practices. (Abuzaid et al., 2024)

The overall findings in these studies underscores the urgent need for targeted courses to help improve students' understanding and ensure better adherence to safety standards concerning radiation use. These studies create a foundation that justifies further investigation into the level of awareness of Radiography Clinical year students in University of Benin.

The reviewed literatures consistently indicate that radiography students exhibit significant gaps in knowledge and awareness regarding radiation doses, associated risks, and safety guidelines. While many students recognize the importance of radiation protection in principle, they frequently underestimate doses from common imaging modalities and misunderstanding risks that radiation carried. These findings underscore the urgent need for enhanced curriculum integration, early and continuous radiation protection training. Highlighting a likely similar gap among radiography clinical-year students at UNIBEN and the importance of addressing it to ensure patient safety, professional competence, and regulatory compliance.

CHAPTER THREE

RESEARCH METHODOLOGY

This chapter outlines the methodology used for this study. The purpose of this study is to Assess the level of Awareness of Radiography clinical -students towards radiation dose limit and regulatory guidelines in University of Benin. This study employs a cross-sectional survey design to collect and measure data from Students in the Radiography department.

3.1 Research Setting

The study was conducted at the department of Radiography, University of Benin, Benin City. Radiography department in the university of Benin started her admission in December, 2019, ushering a new era of Clinical Radiography into the University of Benin. Fully accredited by RRBN in 2025, The department had graduated a single set of students from its inception, and had sent numerous students into multiple clinical centers all over Benin City and beyond for clinical postings. The department currently admitted 622 students across all levels. This makes it an ideal location for this study.

3.2 Study Design

This study employs a descriptive Cross-sectional study design. This design was chosen so that data can be collected at a single point in time, from a defined population of clinical students in the department. This design was suitable for determining the level of awareness and for examination of potential patterns or association with various variables such as Age, Gender and Departmental level.

3.3 Target Population

The target population for this study included students from 300level to 500 levels in Radiography department, University of Benin. The focus of the study was on students who had had preclinical trainings and are attending clinical postings.

3.4 Sampling Technique and Sample Size

This study Adopted a stratified sampling technique, students from each level were divided into strata and a sample will be randomly selected from individual strata. This technique reduced bias and ensured proper representation from all levels Only individuals who gave consent were assessed. The sample size was determined by Yamane Taro formula for calculating sample size (Yamane, 1967)

Formula: $n = N/(1+N(e^2))$

Where:

n = sample size

N= total population (427)

e = margin of error (commonly 5% → 0.05)

Therefore, sample size is $427/ (1+427 (0.05)^2) = 206.5$ approximately 207 students

To account for Errors or incomplete data, a 10% attrition will be added giving the sample size at approximately 228 respondents. This adjustment was made to ensure that an adequate number of valid responses would be obtained for meaningful statistical analysis

Respondents were divided into three strata for each level from 300 -500 lv

Samples from individual strata would be calculated using proportional allocation formula (Singh et al., 1996)

$nh= n(Nh/N)$

nh = sample size to be drawn from stratum

n = total sample size (across all strata-228)

Nh = population size of stratum- 153, 148 and 126 for individual stratum

N = total population size (sum of all strata -427)

Sample size for first stratum (300lv) = 228(153/427) = 81.7 approximately 82 respondents from 300 lv

Sample size for second stratum (400lv) = 228(148/427) = 79 respondents from 400lv

Sample size for third stratum (500lv) = 228(126/427) = 67 respondents from 500lv.

Since the 300-evel had 153 students, the 400level had 148 students, and the 500level had 126 students, the sample sizes of 82, 79, and 67 respondents, respectively, thereby reflect the proportions allocational formulae used

This approach was chosen to ensure that the sample reflects the actual composition of the student population across the three levels, rather than selecting respondents arbitrarily. The percentages for each level are therefore proportional to the size of the population in that level, ensuring fairness and representativeness in the study sample

3.5 Instrument for data collection

The primary instrument for data collection for this study was a structured Questionnaire. This tool was designed to gather relevant information from the participants and the Questionnaire was developed based on the objectives of the study, and insights gathered from previous related research.

The Questionnaire was divided into four sections

A. Demographics: Collects Demographic information such age, gender, and year of study to classify participants.

B. Awareness of Radiation Dose Limits: Assesses students' knowledge and understanding of radiation dose limits.

C. Knowledge of Regulatory Bodies: Evaluates familiarity with NNRA, IAEA, and ICRP, and their roles in radiation protection.

D. Confidence and Confidence: Uses a Likert scale to measure students' Confidences and confidence in applying radiation protection practices during clinical work. (e.g. strongly agree to strongly disagree) to assess perceptions and measure Confidences and behaviours (Likert, 1932).

3.6 Validity of the Instrument

The instrument was constructed to be in line with the objectives of this study and on existing literature on this topic (Abuzaid et al.,2024). The validity of the instrument was ensured through the expert review of statisticians and my supervisor. The Questionnaire was further reviewed by professionals in radiography and researchers. Their feedbacks were used to refine the questions for clarity, relevance and appropriateness.

3.7 Reliability of the Instrument

The instrument used in this study was adapted from a previously validated and reliable tool designed to assess similar study.

The instrument used by this study was adapted from a Reliable instrument (Abuzaid et al.,2024). This provided sufficient assurance of its internal consistency, and its reliability for Assessing level of awareness of Radiography Clinical year students towards radiation dose limits and

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regulatory guidelines. As this study adopts this instrument with only minor contextual adjustments, a separate reliability test such as Cronbach's Alpha was deemed unnecessary

3.8 Method of data Collection

Data for this study was collected through distribution of structured Questionnaires to the Participants. The bulk of the Questionnaire was distributed online via Dedicated WhatsApp Group chats, so as to reach wide varieties of participants while other Questionnaires were administered in person across various locations such as Departmental lecture halls, hallways and other areas around the departmental buildings where Radiography students can be found. Consent was seeked before the questionnaires are given. The entire process took place over several weeks, beginning in the month of August.

3.9 Method of Data Analysis

After the appropriate data have been collected, the responses were reviewed and encoded with Microsoft Excel and then entered into the Statistical Package for the Social Sciences (SPSS 31.0.1.0) for analysis.

Descriptive statistics such as frequency percentage mean and standard deviation were used to summarize demographic data, and the response was related to the knowledge and Confidence towards radiation dose limits and regulatory guidelines. Inferential statistics was used to address research questions and test hypothesis. Mann-Witney test was used to examine association between educational course and awareness of radiation risks. A significance (alpha) of 0.05 was considered statistically significant. The result of the analysis was presented and interpreted in line with the objective and hypothesis of this study.

3.10 Ethical Considerations

Ethical approval for this study was obtained from the College of Medical Science Ethical center. Participation in the study was entirely voluntary, and informed consent was obtained from all participants prior to data collection. The rights of the participants, including the right to withdraw at any time without penalty was clearly explained. Anonymity and confidentiality of all respondents was strictly maintained. Data collected for this research was used solely for research purposes and stored securely to prevent unauthorized access

CHAPTER FOUR

RESULTS AND DISCUSSION

This chapter presents the statistical analysis of the collected data, focusing on mean comparisons, Mann-Witney tests and post hoc analyses where applicable. The results are presented in tables for clarity and interpretation.

4.1 Presentation of Results

Table 4.1: Distribution of Respondents by Level, Demographic Characteristics, Course Exposure, Awareness of Dose Limit Response, and Performance Scores

Variables	300Level	400Level	500level	Total
Sample distribution	78 students (33%)	83 students ((36%)	73 Students (31%)	234 Students
Age Distribution				
16-20	15 (19.2%)	5 (6%)	4 (5.5%)	24 (10.2%)
21-25	46 (59.0%)	62 (74.7%)	49 (67.1%)	155 (66.2%)
26-30	17 (21.8%)	16 (19.3%)	20 (27.4%)	53 (22.6)
Gender Distribution				
Male	39 (50.0%)	53 (63.9%)	50 (68.5%)	142 (60.7%)
Female	39 (50.0%)	30 (36.1%)	23 (31.5%)	92 (39.3%)
Radiation Course Attendance				
Yes	51 (65.4%)	52 (62.7%)	52 (71.2%)	155(66.24%)
No	27 (34.6%)	31 (37.3%)	21 (28.8%)	79 (33.76%)
Clinical Posting Experience				
Yes	41 (52.6%)	44 (53.0%)	45 (61.6%)	130 (55.6%)
No	37 (47.4%)	39 (47%)	28 (38.4%)	104 (44.4%)
Awareness of Dose Limit Response				
I don't know	34 (43.6%)	40 (48.2%)	29 (39.7%)	103 (44%)
1mSv(correct)	28 (35.9%)	36 (43.4%)	24 (32.9%)	88 (36.4%)
0.1mSv	10 (12.8%)	6 (7.2%)	16 (21.9%)	32 (13.7%)

10mSv	6 (7.7%)	1 (1.2%)	4 (5.5%)	11 (4.7%)
Performance Scores				
Knowledge of radiation regulatory bodies Score	9.19/14 (65.7% ± 3.79)	8.88/14 (63.4% ± 4.24	9.97/14 (71.2% ± 4.07)	_
Confidence in applying radiation Protection Score	22.03/25 (88.1% ± 4.67)	21.58/25 (86.3% ± 4.69)	21.73/25 (86.9% ± 5.23)	_

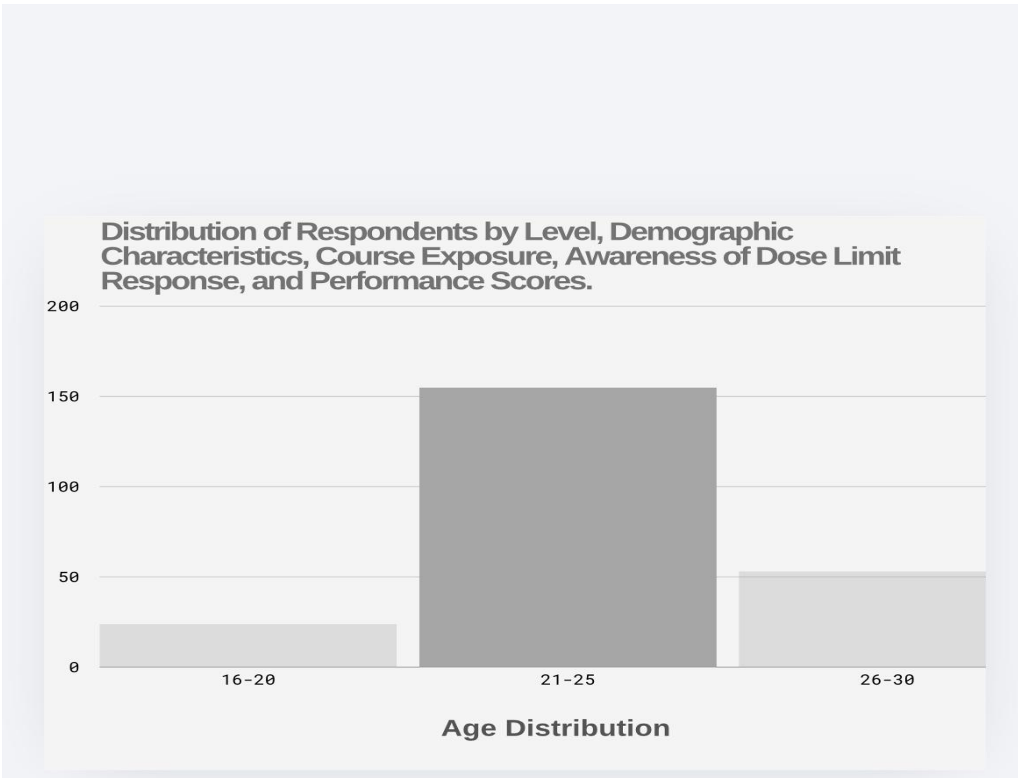

Fig 4.1: distribution of respondent by level, demographic characteristics, course exposure, awareness of those limit responses and performance scores.

Table 4.1 presents the distribution of the 234 respondents across academic levels, demographic variables, radiation course attendance, clinical posting experience, dose limit responses, and performance scores. The sample comprised 78 (33%) 300-level students, 83 (36%) 400-level students, and 73 (31%) 500-level students.

By age, the majority were in the 21–25 years group (66.2%), followed by 26–30 years (22.6%), and 16–20 years (10.2%). Males constituted 60.7% (142/234), while females were 39.3% (92/234).

In terms of exposure, 66.2% (155/234) had attended a radiation protection course, and 55.6% (130/234) reported clinical posting experience. Regarding Awareness of dose limits, only 36.4% (88/234) correctly identified the recommended dose of 1 mSv, while 44% (103/234) reported not knowing the limit, 13.7% (32/234) selected 0.1 mSv, and 4.7% (11/234) selected 10 mSv.

For performance, mean Knowledge of radiation regulatory bodies Scores were 9.19/14 (65.7%) at 300 level, 8.88/14 (63.4%) at 400 level, and 9.97/14 (71.2%) at 500 level. Confidence in applying radiation Protection scores were relatively higher across all levels, with means of 22.03/25 (88.1%), 21.58/25 (86.3%), and 21.73/25 (86.9%), respectively.

Table 4.2: Descriptive Statistics of Knowledge of radiation regulatory bodies and Confidence in applying radiation Protection Scores.

Statistic	Knowledge Score	Knowledge %	Confidence Score	Confidence %
Mean	9.34	66.76	21.79	87.16
Median	10	71.43	22	88
Std Dev	4.05	28.97	4.86	9.72
Min	0	0	14	Y
Max	14	100	25	100
Skewness	-0.60	-0.60	-0.61	-0.61
Kurtosis	-0.85	-0.85	0.03	0.0

Category	Group Count	Percentage	Mean_Knowledge _Score	Mean_ Knowledge _Percentage	Std_Knowledge Score	Std_Knowledge _Percentage
Attendance Yes	155	66.24	10.65	76.05	3.5	24.97
Attendance No	79	33.76	6.73	48.1	3.83	27.36

Table 4.2 presents the descriptive statistics of knowledge and Confidence Scores among the respondents. The mean knowledge score was 9.34 (66.8%), with a median of 10 (71.4%) and a standard deviation of 4.05 (29.0%). Knowledge scores ranged from 0 to 14, with a negative skewness (-0.60) indicating a slight left-tail distribution, and a kurtosis of -0.85 suggesting a relatively flatter distribution.

For Confidence, the mean score was 21.79 (87.2%), with a median of 22 (88.0%) and a standard deviation of 4.86 (9.7%). Confidence Scores ranged from 14 (56%) to 25 (100%). The distribution showed a mild negative skewness (-0.61) and near-normal kurtosis (0.03 for raw scores; 0.0 for percentages). Overall, the data suggest relatively higher and more consistent scores for Confidence compared to knowledge.

Table 4.3: Confidence in applying radiation Protection and Categories by Academic Level

	300 level	400 level	500 level	Overall
Count	78	83	73	234
Mean_Confidence_Score	44.1	43.2	43.5	43.6
Median_Confidence_Score	45	44	45	46
Std_Confidence_Score	4.67	4.7	5.2	4.9
Mean_Confidence_Percentage	88.1%	83.2%	86.9%	87.1%
Median_Confidence_Percentage	90%	88%	90%	88%
Std_Confidence_Percentage	9.3%	9.4%	10.5%	9.7%
Excellent Count	40	35	37	112
Excellent Percentage	51.3%	42.2%	50.7%	47.9%
Good Count	24	34	19	77
Good Percentage	30.8%	41%	26%	32.9%
Fair Count	13	9	13	35
Fair Percentage	16.7%	10.8%	17.8%	15%
Poor Count	1	5	4	10
Poor Percentage	1.3%	6%	5.5%	4.3%

Table 4.3 shows the distribution of Confidence Scores and categories among 300, 400, and 500 level students (n = 234). The overall mean Confidence Score was 43.6 (87.1%), with a median of 46 (88%) and a standard deviation of 4.9 (9.7%). Across levels, mean Confidence percentages ranged from 83.2% at 400 level to 88.1% at 300 level, while medians remained high (88–90%).

In terms of Confidence categories, nearly half of the respondents were rated Excellent (47.9%, 112/234), followed by Good (32.9%, 77/234), Fair (15.0%, 35/234), and Poor (4.3%, 10/234). The 300 and 500 level groups had the highest proportions of Excellent ratings (51.3% and 50.7%

respectively), while the 400-level group showed the highest proportion of good responses (41.0%) and the highest percentage of Poor responses (6.0%).

Table 4.4: Knowledge of regulatory body Scores and Awareness of Dose Limit Responses by Academic Level

	300 level	400 level	500 Level	Total
Count	78	83	73	234
Correct dose limit response (%)	28 (35.9%)	36 (43.4%)	29 (39.7%)	93 (39.7%)
Incorrect response (%)	50 (64.1%)	47 (56.6%)	44 (60.3%)	141 (60.3%)
Knowledge score Mean (%)	9.19 (65.7%)	8.9 (71.3%)	10 (71.3%)	9.3 (66.6%)
Knowledge score median (%)	9.5 (67.9%)	10 (85.2%)	12 (85.7%)	10 (71.4%)
Knowledge score std (%)	3.8 (27.1%)	4.2 (29.1%)	4.1 (29.1%)	4.1 (29%)

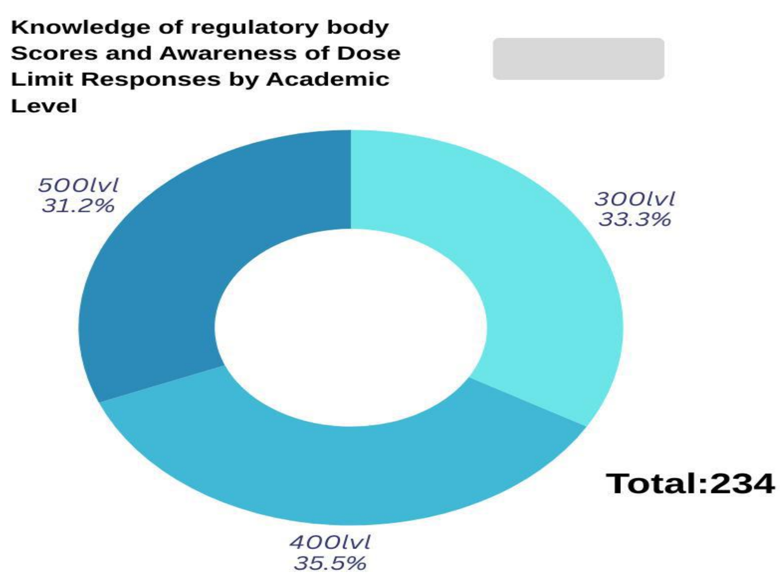

Fig 4.2 : Knowledge of regulatory bodies scores and awareness of those limit responses by academic levels

Table 4.4 presents the distribution of knowledge scores and responses to dose limit questions across 300, 400, and 500 level students (n = 234). Out of the total participants, 39.7% (93/234) correctly identified the dose limit, while 60.3% (141/234) responded incorrectly. Among 300 level students (n = 78), 35.9% (28/78) provided correct responses, compared to 43.4% (36/83) at 400 level and 39.7% (29/73) at 500 level. Knowledge score means ranged from 8.9 (71.3%) at 400 level to 10.0 (71.3%) at 500 level, with the overall mean being 9.3 (66.6%). Median knowledge scores were highest in the 500-level group (12, 85.7%), while the 300-level group recorded the lowest median (9.5, 67.9%). Standard deviations were consistent across groups (≈ 27–29%), indicating similar variability in knowledge scores.

Table 4.5: Comparison of Knowledge of radiation regulatory bodies Scores between students who attended and did not attend the course

Group	N	Mean Score	Median	Standard Deviation	Range
Attended Course	155	76.05%	85.7%	±24.97%	7.1% – 100%
Did Not Attend	79	48.10%	42.9%	±27.36%	0% – 100%

Table 4.5 shows the descriptive statistics of knowledge scores for students who attended the course (n = 155) and those who did not (n = 79). The mean score of attendees was 76.05%, which is 27.94 percentage points higher than the non-attendees' mean of 48.10%. The median score was 85.7% among attendees compared to 42.9% among non-attendees. Both groups showed substantial variability, with standard deviations of ±24.97% for attendees and ±27.36%

for non-attendees. The score ranges also differed, spanning 7.1%–100% for attendees and 0%–100% for non-attendees.

Table 4.6: Test of Assumptions and Non-Parametric Comparison of Knowledge Scores

Step	Test	Statistic	p-value	Decision	Interpretation
Normality (Attended)	Shapiro-Wilk	W = 0.84	< 0.001	Fail	Data not normally distributed
Normality (Did not attend)	Shapiro-Wilk	W = 0.96	0.01	Fail	Data not normally distributed
Equal Variances	Levene's Test	W = 1.95	0.16	Pass	Variances are equal
Selected Test	Mann–Whitney U	U = 9504	< 0.001	Reject H_0	Significant difference between groups
Effect Size	r	0.45	–	Medium	Practical significance present

Table 4.6 summarizes the results of assumption testing and the selected statistical analysis. The Shapiro–Wilk test of normality indicated non-normal distributions for both attendees (W = 0.84, p < 0.001) and non-attendees (W = 0.96, p = 0.01). Levene's test for equality of variances was not significant (W = 1.95, p = 0.16), suggesting that the assumption of homogeneity of variance was met. Given the violation of normality, the Mann–Whitney U test was selected as the appropriate non-parametric alternative. Results showed a significant difference in knowledge scores between attendees and non-attendees (U = 9,504, p < 0.001), with an effect size of r = 0.45, indicating a medium practical effect.

4.2 Discussion of Results

The demographic distribution of the respondents (Table 4.1) showed that majority were within the 21–25 years age group (66.2%), which is consistent with the typical age range for clinical-year students. Data were gotten from more males (60.7%) than females (39.3%) students, reflecting a male dominance also reported in related studies by (Faggioni et al., 2017) in Italy and (Alreshidi et al.,2020) in Saudi Arabia.

In terms of exposure, 66.2% of students reported attending a course in radiation protection, while 55.6% had clinical posting experience. These figures suggest that while the majority have been exposed to training in radiation protection, a considerable portion (one-third) do not have any formal radiation safety education. This correlates with the findings of (Alreshidi et al.,2020), where only 10.3% of medical students had attended a radiation protection course at the University of Hail, and attendance was strongly associated with improved knowledge scores. The relatively higher proportion of trained students in UNIBEN compared to international reports may reflect growing emphasis on radiation safety in Nigeria, but the persisting gaps needs further integration of radiation safety courses across all levels.

A significant finding in the Level of Awareness regarding dose limits from this study showed that only 36.4% of respondents correctly identified the recommended public dose limit of 1 mSv per year, while 44% admitted not knowing the limit and the rest provided incorrect responses (Table 4.1 & 4.4). This indicates a low level of Awareness of dose limits among clinical year students in the University of Benin, despite their advanced stage of training. Similar trends have been documented globally. For instance, (Alkhaldi et al.,2022) reported that fewer than 40% of Saudi medical students could identify radiation doses from common imaging procedures, while (Kada, 2010) in Norway found that only 15% of final-year medical students correctly estimated CT chest dose levels.

The observed deficiency in dose awareness in this study is concerning, particularly given that the Nigerian Nuclear Regulatory Authority (NNRA, 2023) prescribes dose limits in line with ICRP recommendations, which is 20 mSv annually for occupational workers (averaged over 5 years) and 1 mSv for the general public. Without adequate knowledge of these figures, radiography students in UNIBEN may be unable to adhere to or enforce safety standards during clinical practice.

The Mean Knowledge of radiation regulatory bodies Scores across academic levels ranged between 63.4% and 71.2%, with an overall average of 66.8% (Table 4.2). While these scores inferred a moderate knowledge of radiation protection and the regulatory bodies, they show that the extent at which Radiography clinical year are educated about national and international radiation regulatory guidelines (e.g. ICRP, NNRA, IAEA) are suboptimal, compared to international expectations for clinical radiography trainees. (Nakao et al., 2025) demonstrated that even brief educational interventions improved knowledge scores by over 30%, which underscores the role of curriculum design in bridging knowledge gaps.

Interestingly, confidence scores were markedly higher, with means consistently above 86% across levels (Table 4.3). Nearly half (47.9%) of respondents demonstrated feeling very confident in applying radiation protection practices during clinical procedures, compared to only 39.7% who correctly identified dose limits. This mismatch suggests that while students feel capable of practicing radiation protection, they lack the technical knowledge to translate such confidence into effective action. This disparity has also been highlighted by Shafiq and Mehmood (2024), who reported that students' confidence was favorable but their knowledge remained poor, limiting their capacity to implement ALARA (As Low as Reasonably Achievable) principles.

A critical finding of this study is the significant difference in Knowledge of radiation regulatory bodies Scores between students who attended radiation protection courses and those who did not. Attendees achieved a mean score of 76.05%, compared to 48.1% for non-attendees (Table 4.5). The Mann–Whitney U test confirmed this difference was statistically significant ($p < 0.001$), with a medium effect size ($r = 0.45$). This strongly supports the hypothesis that educational courses on Radiation Protection significantly influences Clinical year Students' awareness of radiation risks and regulatory standards.

These findings reflect the results of (Nakao et al., 2025) in Japan, where knowledge scores improved by over 30% following training, and (Abuzaid et al.,2024) in the UAE, where systematic monitoring and education ensured that radiography students' radiation exposures remained below international dose limits. Collectively, these studies demonstrate that targeted educational interventions not only improve theoretical knowledge but also enhance practical safety outcomes.

The study also found that final-year (500 level) students did not significantly outperform their juniors in terms of awareness of dose limit, although they recorded slightly higher mean knowledge scores (71.2%). Only 39.7% of final-year students correctly identified the dose limit, compared to 43.4% of 400-level students (Table 4.4). This suggests that seniority alone do not guarantee improved awareness, unless reinforced by structured, continuous and personal training. (Kada, 2010) similarly reported no significant advantage in knowledge among final-year medical students in Norway compared to earlier cohorts, further reinforcing this observation.

The findings of this study have important implications for radiography as a course at the University of Benin and other Nigerian institutions. The consistent gaps in Knowledge of radiation regulatory bodies despite feeling very Confident in applying radiation Protection highlights the need to revise and strengthen curriculum.

CHAPTER FIVE

CONCLUSION, RECOMMENDATION, LIMITATION AND SUGGESTED AREAS FOR FURTHER RESEARCH

5.1 Conclusion

This study assessed the level of awareness of radiography clinical-year students at the University of Benin regarding radiation dose limits and regulatory guidelines. The results revealed that while students generally feel very Confident in applying radiation protection, their technical knowledge of dose limits and regulatory frameworks remained inadequate. Only 36.4% of respondents correctly identified the annual public dose limit of 1 mSv, as recommended by the (ICRP, 2007) and adopted by the (NNRA, 2023). This finding is consistent with previous international studies, such as (Alkhaldi et al., 2022) in Saudi Arabia and (Kada, 2010) in Norway, which both reported low awareness of radiation dose levels among medical students.

Although, mean knowledge scores across levels (63–71%) suggest moderate level awareness, these scores remain below desirable levels for clinical-year radiography students. In contrast, Confidence Scores were consistently high (above 86%), which means students feel very confident in applying radiation protection practices, similar to the findings of (Shafiq & Mehmood, 2024) and (Faggioni et al.,2017). The gap between knowledge and confidence highlights possible overconfidence, where students perceive themselves as competent despite lacking the technical knowledge required for safe practice, creating a potential safety risk.

The study also confirmed that structured radiation protection courses significantly improve knowledge of radiation protection. As Students who had attended such courses achieved mean scores of 76.1%, compared to 48.1% among non-attendees, with a statistically significant difference ($p < 0.001$). This finding aligns with (Nakao et al., 2025) in Japan and (Abuzaid et al., 2024) in the UAE, both of which demonstrated measurable improvements in awareness and reduced exposure following targeted trainings.

Overall, the results highlight the need to strengthen the radiography curriculum at UNIBEN by integrating more comprehensive and practical training on radiation protection. Doing so will ensure that students are adequately prepared to uphold international safety standards, minimize unnecessary exposure, and comply with regulatory requirements.

5.2 Recommendation

1. Strengthening of Radiation Protection Curriculum.

   Radiation protection modules should be integrated more thoroughly at all levels of training. This is in line with recommendations by (UNSCEAR, 2022) and (Thierry-Chef et al., 2022), which emphasize curriculum-based training as key to global radiation safety.

2. Regular Training and Awareness Campaigns

   Continuous professional education on radiation safety should be provided for students and staff. Similar to (Alreshidi et al.,2020), this study found that course attendance significantly improves awareness.

3. Practical Demonstration of Dose Monitoring

Students should be exposed to radiation monitoring devices such as TLDs and film badges during clinical postings, as emphasized by (Prajapati et al., 2022) in their study of Indian radiography students.

4. Regular Assessment and Feedback

Periodic evaluation of knowledge and Confidences should be conducted, and results used to refine teaching strategies, consistent with approaches recommended by (Faggioni et al., 2017).

5.3 Limitations of the Study

The study had limitations that should be considered when interpreting the findings:

1. Single-Institution Data:

   The study was conducted solely within the Department of Radiography, University of Benin. Therefore, the findings may not fully represent the awareness levels of radiography students in other universities across Nigeria.

2. Cross-Sectional Design:

   The use of a cross-sectional design captures data at a fixed point in time, thereby making it impossible to assess changes in awareness or knowledge over time

3. Likely Biased Data:

   This study relied on participants' self-reported responses, which may be influenced by bias or the tendency to provide socially desirable answers rather than reflecting their true knowledge.

5.4 Suggested Areas for Further Research

This study should be replicated in other Nigerian universities to evaluate national awareness levels. Knowledge changes should be accessed from pre-clinical to post-graduate levels to highlight discrepancies in long-term knowledge retention. Different clinical training environments should be accessed to study their influence on awareness as (Abuzaid et al., 2024) suggested that institutional monitoring practices affects exposure outcomes.

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APPENDIX

QUESTIONNAIRE

Dear respondents

I am a final year student in the department of Radiography, University of Benin, Benin City. I am currently conducting research on **"ASSESSMENT OF THE LEVEL OF AWARENESS OF RADIOGRAPHY CLINICAL YEAR STUDENTS TOWARDS RADIATION DOSE LIMITS AND REGULATORY GUIDELINES."** This questionnaire aims to collect relevant information for this study. Kindly answer the following questions to the best of your knowledge. Your responses are crucial to this study, so I would appreciate your honest response. All information provided would be treated with confidentiality and would be used solely for research purposes. Thank you for your time and participation

Section A: Demographic Information

Age: [ ] 16–20   [ ] 21–25   [ ] 26 - 30

Gender: [ ] Male   [ ] Female

Level of Study: [ ] 300 Level   [ ] 400 Level   [ ] 500 Level

Have you ever attended a lecture/course on radiation protection? [ ] Yes   [ ] No

Have you participated in clinical postings involving ionizing radiation? [ ] Yes   [ ] No

Section B: Awareness of Radiation Dose Limits

Have you heard of "radiation dose limits"? [ ] Yes [ ] No

Can you define what radiation dose limit means? [ ] Yes [ ] No [ ] Not sure

The annual dose limit for the general public is:

[ ] 0.1 mSv [ ] 1 mSv [ ] 10 mSv [ ] Don't know

The occupational dose limit for radiation workers is:

[ ] 1 mSv [ ] 10 mSv [ ] 20 mSv [ ] Don't know

Are you aware that children are more sensitive to radiation than adults? [ ] Yes [ ] No

Do you know that repeated imaging tests increase cumulative dose? [ ] Yes [ ] No

Are you aware that CT scans deliver higher doses than standard X-rays? [ ] Yes [ ] No

Have you ever been informed of the radiation dose a patient received during an exam? [ ] Yes [ ] No

Have you heard of the ALARA principle? [ ] Yes [ ] No

Do you believe that even low levels of ionizing radiation can cause long-term effects?

[ ] Yes [ ] No [ ] Not sure

Section C: Knowledge of Regulatory Bodies & Guidelines

Have you heard of the Nigerian Nuclear Regulatory Authority (NNRA)? [ ] Yes [ ] No

Have you heard of the International Atomic Energy Agency (IAEA)? [ ] Yes [ ] No

Have you heard of the International Commission on Radiological Protection (ICRP)? [ ] Yes [ ] No

Do you know that these bodies set international dose limit standards? [ ] Yes [ ] No

Are all facilities using ionizing radiation required to obtain a license? [ ] Yes [ ] No

Section D: Attitudes and Confidence in Radiation Protection Practices (10 questions, Likert Scale: [ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree)

	Strong Agree	Agree	Neutral	Disagree	Strongly Disagree
I feel confident applying radiation protection during clinical procedures.					
I always consider dose limits before imaging.					
Proper radiation protection reduces risks for both patients and staff.					
My department provides adequate training on dose limits and safety guidelines.					
I am willing to attend more radiation protection training.					
I believe radiographers should educate patients about radiation risks.					
Protective equipment (e.g., lead apron) is essential in all procedures.					
Radiation safety is the responsibility of both professionals and students.					
I believe radiation dose should be included in every imaging report.					
I think many radiography students underestimate radiation risks.					

RESEARCH ETHICS COMMITTEE
COLLEGE OF MEDICAL SCIENCES
UNIVERSITY OF BENIN, BENIN CITY, NIGERIA.

Chairman: Prof. F. A Imarhiagbe
MBChb, FMCP
Cert Clin Res and ethics (NIH), MD.
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P.M.B 1154, BENIN CITY
Email: researchethics.cms@gmail.com

Our Ref: CMS/REC/01/VOL.2/814 **Date:** 17th October, 2025

Re: ASSESSMENT OF THE LEVEL OF AWARENESS OF RADIOGRAPHY CLINICAL YEAR STUDENTS TOWARDS RADIATION DOSE LIMITS AND REGULATORY GUILDELINES.

Name of Principal Investigator: **MOHAMMED JEMILAT OMOYEMHE**
Department Of Radiography,
School of Basic Medical Science
College of Medical Sciences,
University of Benin

REC Approval No: CMS/REC/2025/814

This is to inform you that the research described in the submitted proposal, the Informed Consent Forms and other participant information materials have been reviewed and approved by the College Research Ethics Committee, University of Benin.

This approval dates from **17th October, 2025 to 16th October, 2026.** In multi-year research, Endeavour to submit your annual report to the REC early in order to obtain renewal of your approval and avoid disruption of your research.

The National Code of Health Research Ethics requires you to comply with all institutional guidelines, rules and regulations and with the tenets of the code including ensuring that all adverse events are reported promptly to the REC. No, changes are permitted in the research without prior approval by REC except in circumstances outlined in the code. REC reserves the right to conduct compliance visit to your research site without prior notice. Thank you.

PROF. F.A IMARHIAGBE
Chairman, REC

Promoting best ethical & scientific standard for research in Nigeria