A SURVEY OF SUB-SPECIALTY PREFERENCES OF RADIOGRAPHY STUDENTS OF THE UNIVERSITY OF BENIN, NIGERIA

BY

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A PROJECT WORK, PRESENTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF RADIOGRAPHY DEGREE (B.RAD), IN THE DEPARTMENT OF RADIOGRAPHY AND RADIATION SCIENCES

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OCTOBER, 2025.

CERTIFICATION

This is to certify that this project work **'A Survey of Sub-Specialty Preferences of Radiography Students of the University of Benin, Nigeria'** written by **OSSAI CHUKWUDI** with matriculation number **BMS2009077** was carried out under my supervision.

DR. OKUNGBOWA, G.E. (PhD) **(PROJECT SUPERVISOR)**	**DATE**

MRS F. O. IGBINEDION **(HEAD OF DEPARTMENT)**	**DATE**

DEDICATION

This project work is dedicated to my parents **MR and MRS OSSAI**

ACKNOWLEDGEMENT

First and foremost, I am deeply grateful to God Almighty for granting me the strength, wisdom, and opportunity to complete this project successfully and on time.

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ABSTRACT

This study investigated subspecialty preferences among radiography students at the University of Benin, Nigeria, and identified factors influencing these preferences. Using a descriptive cross-sectional design, 272 students across all academic levels (100-500) were surveyed using structured questionnaires. Data were analyzed using SPSS version 28.0, employing descriptive statistics and chi-square tests. Results revealed that diagnostic imaging (32.7%) and ultrasound (24.3%) were the most preferred subspecialties, while nuclear medicine (5.9%) and radiation therapy (8.1%) were least preferred. Personal interest (78.3%), career prospects (71.7%), and clinical exposure (64.3%) were identified as primary influencing factors. Awareness levels varied significantly across academic levels ($p<0.001$), with senior students demonstrating greater familiarity with subspecialties. Gender significantly influenced preference distribution ($p=0.023$), with females favoring ultrasound and males preferring interventional radiology. Financial considerations (mean=4.21±0.87) and job market demand (mean=4.15±0.91) were rated as highly influential factors. The study concluded that enhanced clinical exposure, mentorship programs, and curriculum diversification are essential for informed career decision-making. Recommendations include establishing subspecialty rotation programs, strengthening industry partnerships, and developing career guidance frameworks to align student preferences with healthcare workforce needs.

Keywords: Radiography students, subspecialty preferences, career choice, medical imaging, Nigeria

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Radiography plays a significant role in modern healthcare by delivering essential diagnostic pictures that influence medical decision-making. As the discipline of radiography continues to grow, students are more exposed to a range of subspecialties, such as diagnostic imaging, interventional radiology, nuclear medicine, and radiation therapy. The decision to concentrate in one of these areas is a crucial milestone in a radiography student's career, impacting their future professional trajectory. At the University of Benin, Nigeria, this choice is particularly significant, as the field of radiography in Nigeria is evolving, and students are typically faced with little exposure to the complete variety of subspecialties available.

Several factors influence students' choices while picking a subspecialty. Financial reasons, work opportunities, and personal interests are among the most regularly reported variables in international studies. For instance, research in Togo and Sudan have demonstrated that financial support and remuneration play a considerable effect in students' specialty choices, with students more likely to pursue specialties that offer better financial incentives (Seydou et al., 2019; Abdelgadir et al., 2014). Additionally, occupational satisfaction, the perceived prestige of a specialty, and possibilities for professional advancement are crucial concerns. For example, students in Ethiopia and Sudan were shown to select specializations such as surgery and pediatrics based on personal interest and exposure to the subject throughout their clinical training (Adem et al., 2014; Abdelgadir et al., 2014).

In the field of radiography, the availability of postgraduate training and mentorship strongly affects students' subspecialty selections. Research has indicated that exposure to a specialization, as well as support from mentors, helps affect students' career decisions (Al Ameer et al., 2022). However, at the University of Benin, there is a paucity of detailed data on the factors impacting radiography students' subspecialty preferences. This gap in knowledge is significant, as it can inform curriculum creation and career counseling services, ensuring that students are well-equipped to make informed career choices. Understanding the factors that influence radiography students' subspecialty preferences is vital for developing instructional tactics and aligning training with the demands of the healthcare sector.

1.2 Statement of Problem

The increasing demand for healthcare workers with specific expertise has led to the emergence of several subspecialties within radiography. However, there is a paucity of comprehensive study on the factors influencing the choosing of these subspecialties by students in Nigerian universities (Seydou et al., 2019; Al Ameer et al., 2022). This gap in knowledge is particularly visible at the University of Benin, where radiography students are not only expected to excel in general radiography but are also encouraged to investigate other subspecialties. Understanding the factors that impact subspecialty preferences among these students is critical for improving educational results and matching training with the expectations of the healthcare sector.

The decision to specialize in a certain field of radiography may be impacted by various variables, including personal interests, financial concerns, employment market prospects, and the perceived prestige of different specialties (Adem et al., 2014; Abdelgadir et al., 2014). However, these preferences are not well documented, and it is unclear if elements specific to a nation like Nigeria - such as local healthcare infrastructure, available facilities, and national employment market trends—play a substantial impact in molding students' choices.

1.3 Aim and Objectives of the Study

Aim

The aim of this study is to investigate the subspecialty preferences of radiography students at the University of Benin, Nigeria, and identify the factors influencing these preferences, with a view to providing evidence-based recommendations for educational planning and workforce development.

Objectives

1. To determine the distribution of subspecialty preferences among radiography students at the University of Benin.
2. To identify the factors that influence subspecialty preferences among radiography students.
3. To assess the level of awareness and knowledge about different radiography subspecialties among students.

1.4 Significance of the Study

This study is crucial for various stakeholders within radiography education and healthcare. For the University of Benin's Department of Radiography, the findings will guide curriculum development, resource allocation, and clinical partnerships, aligning them with student interests and market needs.

For students, the research will provide valuable insights into subspecialty preferences and factors influencing career decisions, helping them make informed choices and broaden their career opportunities. Awareness of less popular subspecialties may also expand their career horizons.

Healthcare administrators and hospital management can use the study's findings for workforce planning, anticipating staffing needs, and supporting infrastructure development, particularly in specialized imaging centers. Professional organizations, such as the Association of

Radiographers of Nigeria (ARN), will benefit from understanding emerging trends, guiding advocacy and professional development initiatives.

From a policy perspective, the study provides evidence for informed healthcare workforce planning at both state and national levels, supporting funding allocations for specialized training programs. Additionally, it will contribute to the growing body of research on radiography education in Nigeria and offer insights into the impact of economic and cultural factors on career choices in healthcare.

1.5 Research Questions

This study seeks to answer the following questions:

1. What is the level of awareness and knowledge about different radiography subspecialties among students?
2. What is the distribution of subspecialty preferences among radiography students at the University of Benin?
3. What factors significantly influence subspecialty preferences among radiography students?

1.6 Hypotheses

Based on the research objectives and questions, the following hypotheses will be tested:

1. H_0: There is no significant difference in the distribution of subspecialty preferences among radiography students at different academic levels.
2. H_0: There is no significant relationship between gender and subspecialty preferences among radiography students.

1.7 Scope of the Study

This study will focus specifically on radiography students enrolled in the Department of Radiography, School of Basic Medical Sciences, University of Benin, Nigeria. The study will include students from all academic levels (100-500 level) who are currently admitted in the program. The study will be conducted during the 2024/2025 academic session and will focus on students' current preferences and the factors influencing these preferences. The scope includes assessment of awareness levels, career expectations, and demographic influences on subspecialty choices.

1.8 Operational Definition of Terms

For clarity and consistency, the following terms are operationally defined as they apply to this study:

Subspecialty Preference: The expressed interest or career choice of a radiography student for a specific area of specialized practice within radiography, including diagnostic imaging modalities and therapeutic applications.

Radiography Student: An individual currently admitted in the undergraduate radiography program at the University of Benin, from 100 level to 500 level.

Subspecialty: A specialized area of radiography practice requiring additional training and expertise beyond basic radiographic skills, including CT, MRI, ultrasound, nuclear medicine, mammography, interventional radiography, and radiation therapy.

Factors Influencing Preferences: Personal, academic, professional, and environmental elements that contribute to a student's choice of subspecialty, including personal interest, career prospects, income potential, work environment, and exposure during training.

Awareness Level: The extent of a student's knowledge and understanding about different radiography subspecialties, including their scope of practice, career opportunities, and requirements.

Demographic Characteristics: Personal attributes of students including age, gender, academic level, state of origin, previous educational background, and family background in healthcare.

Career Prospects: The anticipated opportunities for employment, professional growth, and advancement within a particular subspecialty.

Clinical Exposure: Practical experience gained through clinical rotations, internships, or observational visits to different imaging departments and subspecialty areas.

CHAPTER TWO

LITERATURE REVIEW

2.1 Conceptual Review

Origins and Discover

The origins of both radiography and fluoroscopy may be traced back to November 8, 1895, when Wilhelm Conrad Röntgen, a German professor of physics, discovered the X-ray and observed that it could pass through human tissue but not through metal or bone (NDT Resource Center, 2013). Röntgen called the radiation “X” to denote that it was of an unidentified kind. For his discovery, he was awarded the first Nobel Prize in Physics (Karlsson, 2000).

According to his biographers (Glasser, 1993; vix.com, 2017), Röntgen was studying cathode rays using a fluorescent screen painted with barium platinocyanide and a Crookes tube, which he had wrapped in black cardboard to protect its fluorescent glow. However, there are differing accounts of his discovery because Röntgen had his lab notes burned after his death. About a meter away, he saw a slight green glow coming from the screen. In order to make the screen shine, Röntgen discovered that certain invisible rays emanating from the tube were affecting the film behind the cardboard by passing through an opaque substance (Markel, 2012).

The First Radiograph

When Röntgen took a picture of his wife’s hand on a photographic plate created by X-rays, he realized that X-rays may be used for medical purposes. It was his wife’s hand that was the first X-ray image of a human body part. “I have seen my death” was her reaction upon seeing the photo (Markel, 2012). On January 11, 1896, John Hall-Edwards in Birmingham, England, radiographed a needle lodged in an associate’s hand, marking the first time X-rays were used in a therapeutic setting. Additionally, Hall-Edwards was the first to employ X-rays in a medical procedure on February 14, 1896.

Ivan Pulyui's discharge tube was used to obtain the first medical X-ray in the United States. Frank Austin of Dartmouth College checked every discharge tube in the physics lab after learning of Röntgen's findings in January 1896. He discovered that only the Pulyui tube generated X-rays. This was caused by Pulyui's addition of an oblique mica "target" to the tube, which is used to retain fluorescent material samples. Gilman Frost, a medical professor at the college, and his brother Edwin Frost, a physics professor, exposed Eddie McCarthy's wrist to X-rays on February 3, 1896. Gilman had treated McCarthy for a fracture a few weeks prior, and they captured the image of the broken bone on gelatin photographic plates that they acquired from Howard Langill, a local photographer who was also interested in Röntgen's work (Spiegel, 1995).

Adoption and Early Development

Before the risks of ionizing radiation were recognized, Alan Archibald Campbell-Swinton established a radiography laboratory in the United Kingdom in 1896, demonstrating how early X-rays were used for diagnostic purposes. In fact, during World War I, Marie Curie lobbied for radiography to be utilized to heal injured soldiers. At first, radiography was performed in hospitals by a wide range of personnel, including engineers, physicists, photographers, doctors, and nurses. Over many years, radiography as a medical specialty developed around the new technology. It made sense for radiographers to receive training in and embrace new technology when new diagnostic tests were created. These days, radiographers also do nuclear medicine, computed tomography, mammography, ultrasound, magnetic resonance imaging, and fluoroscopy. Although "taking X-ray images" is a rather narrow definition of radiography according to a nonspecialist dictionary, radiologists, radiographers, and "X-ray departments" have long been the sole professionals involved in this field. Radiographs were originally called roentgenograms (Ritchey & Orban, 1953), and the term "scaagrapher," which comes from the Ancient Greek terms for "shadow" and "writer," was used to refer to radiographers until around

1918. Rentogen, the Japanese word for the radiograph, has the same derivation as the original English name.

Applications in Medicine

Because the body is composed of different substances with different densities, the internal structure of the body can be shown on an image receptor by using ionizing and non-ionizing radiation to highlight these differences through attenuation, or in the case of ionizing radiation, the absorption of X-ray photons by the denser substances (such as calcium-rich bones). Radiographic anatomy is the field that uses radiographic pictures to educate students about anatomy. Radiographers often perform medical radiography acquisition, whereas radiologists typically perform picture analysis. Image interpretation is another area of expertise for certain radiographers. A variety of modalities are used in medical radiography to produce a wide variety of images, each with a unique clinical use.

Radiography Projectional

“Projection radiography” is the process of creating images by subjecting an item to X-rays or other high-energy electromagnetic radiation and recording the leftover beam (sometimes called a “shadow”) that results as a latent image. A fluorescent screen may be used to transform the “shadow” into light, which is subsequently recorded on photographic film; a phosphor screen may record the light to be “read” by a laser (CR) at a later time; or a matrix of solid-state detectors (DR—think of it as a very large version of a CCD in a digital camera) may be activated directly. In particular, bones and certain organs (such the lungs) are good candidates for projection radiography. With a good diagnostic yield, it is a rather inexpensive research. The primary reason for the distinction between soft and hard bodily parts is that carbon has a far lower X-ray cross section than calcium.

Computed Tomography

A computer and ionizing radiation, or x-ray radiation, are used in computed tomography, or CT scans (formerly known as CAT scans, where the "A" stands for "axial") to produce images of both soft and hard tissues. These pictures give the impression that the patient was cut like bread, hence the term "tomography" (the word "tomo" means "slice"). Despite using more ionizing X-ray radiation than diagnostic X-rays (both of which employ X-ray radiation), CT radiation doses and scan times have decreased due to technological advancements (Jang et al., 2016). Depending on the tissues that need to be visualized, CT tests are often brief, lasting no more than a breath-hold. Contrast chemicals are also frequently employed. These tests are conducted by radiographers, occasionally in collaboration with radiologists (e.g., when a radiologist performs a CT-guided biopsy).

Dual Energy X-ray Absorptiometry

Osteoporosis examinations are the main application for bone densitometry, or DEXA. Since the X-rays are emitted in two narrow beams that are scanned over the patient at a 90-degree angle to one another, it is not projection radiography. The bone density (amount of calcium) is typically measured and assigned a number (a T-score) after imaging of the hip (head of the femur), lower back (lumbar spine), or heel (calcaneum). Since the image quality is insufficient to produce a precise diagnostic image for fractures, inflammation, etc., it is not used for bone imaging. Although it is uncommon, it can also be used to quantify total body fat. Compared to projection radiography exams, DEXA scans provide a far lower radiation dosage (International Atomic Energy Agency, 2017).

Fluoroscopy

During his early research on X-rays, Thomas Edison coined the word "fluoroscopy." According to Carroll (2014), the term alludes to the fluorescence he observed while staring at a bright plate that was being exposed to X-ray radiation.

The method produces radiographs with shifting projection. The primary purposes of fluoroscopy are to guide medical procedures including angioplasty, pacemaker implantation, and joint repair or replacement, or to observe movement (of tissue or a contrast agent). Using a portable fluoroscopy device known as a C-arm, the latter can frequently be performed in an operating room (Seeram & Brennan, 2016). It can create digital images for the surgeon and move around the operating table. With the exception of simultaneously displaying two planes, biplanar fluoroscopy functions similarly to single plane fluoroscopy. Working in two planes is crucial for spinal and orthopedic surgery because it eliminates the need for repositioning, which can shorten operating times (Schueler, 2000).

Angiography

Angiography is the view of the circulatory system using fluoroscopy. The bloodstream is infused with an iodine-based contrast, and its movement is observed. The vessels are viewed under X-ray using a contrast with a high density (such as the big iodine atoms) since liquid blood and the vessels are not particularly dense. Aneurysms, leaks, blockages (thromboses), new vascular growth, and the positioning of catheters and stents are all detected via angiography. Angiography is frequently used in conjunction with balloon angioplasty.

Contrast Radiography

A radiocontrast agent, a kind of contrast medium, is used in contrast radiography to visually distinguish the structures of interest from their surroundings. Conventional angiography requires the use of contrast agents, which are also useful in computed tomography (also known as contrast CT) and projectional radiography (Quader et al., 2000; Brant & Helms, 2007).

Other Imaging Modalities

Since hospitals’ radiology departments handle all types of imaging, imaging modalities like PET and MRI are occasionally placed under radiography even though they are not technically radiographic procedures because they do not employ X-rays. Radiotherapy is the term for radiation-based treatment.

Radiography in Industry

Industrial radiography is a non-destructive testing technique that allows for the examination of a wide variety of manufactured components to confirm the specimen's integrity and internal structure. Either X-rays or gamma rays can be used for industrial radiography. Both types of radiation are electromagnetic. The wavelength affects how different types of electromagnetic energy differ from one another. Because X and gamma rays have the shortest wavelengths, they can enter, pass through, and emerge from a variety of materials, including metals like carbon steel. Among the specific techniques is industrial computed tomography.

Quality of Image

Resolution and density will determine the quality of the image. Density is the image's capacity to blacken, whereas resolution is the image's capacity to display tightly spaced structure in the object as distinct entities. Sharpness of a radiography image is greatly controlled by the size of the X-ray source. The region of the electron beam striking the anode determines this. An increase in the distance at which the image is formed exacerbates the blurring that is caused by a large photon source. It is possible to quantify this blurring as a contribution to the imaging system's modulation transfer function.

Dose of Radiation

Each radiography procedure has a different radiation dosage. For instance, an abdominal CT scan requires 10 mSv, whereas a chest x-ray requires 0.1 mSv (FDA, 2018). The International Organization of Medical Physicists, the United Nations Scientific Committee on the Effects of Atomic Radiation, and the International Commission on Radiological Protection have all reached the same conclusion as the American Association of Physicists in Medicine (AAPM), which has declared that the “risks of medical imaging at patient doses below 50 mSv for single procedures or 100 mSv for multiple procedures over short time periods are too low to be detectable and may be nonexistent.” However, several government bodies and radiological organizations, such as the American College of Radiology (ACR) and the Radiological Society of North America (RSNA), specify safety guidelines to guarantee the lowest feasible radiation exposure (Goldberg, 2018).

Shielding

Due to its high density (11,340 kg/m2), stopping power, simplicity of installation, and affordability, lead is the most widely used X-ray shield. High-energy photons, like X-rays, have an infinite maximum range in matter; there is a chance of interaction at every spot the photon passes through. Therefore, the likelihood of no interaction over very long distances is extremely low. Because the attenuation length is nearly equal to the radiation length of the material, the shielding of the photon beam is exponential; the shielding effect will be squared when the shielding thickness is doubled.

Personal lead shielding was first employed on patients directly during all abdominal X-rays in the 1950s with the goal of protecting the gonads (reproductive organs) or, in the case of a pregnant patient, a fetus. Lead shielding is also commonly used in dental X-rays to protect the thyroid. But in 2019 (American Association of Physicists in Medicine, 2019; American Association of Physicists in Medicine, 2019; Benavides et al., 2024) and 2021 (Fujibuchi et al., 2021; archived document, 2021), it was agreed that lead shielding for routine diagnostic X-rays is not required and could even be hazardous in certain situations. It is nonetheless advised that medical personnel and other individuals in the room wear personal shielding.

Lead is used to line the rooms used for X-rays. According to the Second International Congress of Radiology’s recommendations, the recommended lead shielding thickness for a room where

X-rays are taken varies depending on the energy of the radiation (Alchemy Art Lead Products, 2008).

Campaigns for Safety

The Alliance for Radiation Safety in Pediatric Imaging was established within the Society for Pediatric Radiology in response to growing public concern over radiation doses and the continuous advancement of best practices. To maintain high-quality imaging studies while using the lowest doses and best radiation safety practices available on pediatric patients, the Society for Pediatric Radiology created and launched the Image Gently campaign in collaboration with the American Society of Radiologic Technologists, the American College of Radiology, and the American Association of Physicists in Medicine (Pedrad.org, 2013). Companies that provide radiography equipment have supported and helped this project, which has been adopted and implemented by an increasing number of professional medical organizations worldwide.

The American Society of Radiologic Technologists, the American College of Radiology, the Radiological Society of North America, and the American Association of Physicists in Medicine have launched a campaign called Image Wisely to address this issue in the adult population, building on the success of the Image Gently campaign (Image Wisely, 2013). Additionally involved in this field are the United Nations' World Health Organization and International Atomic Energy Agency (IAEA), which have ongoing projects aimed at expanding best practices and reducing radiation doses to patients (Pan American Health Organization, 2010; IAEA, 2013; World Health Organization, 2013).

2.2 Empirical Review

Chang et al. (2006) conducted a study to investigate the factors influencing medical students' specialty choices in Taiwan. The study used a two-tiered Analytic Hierarchy Process (AHP) model, which was administered through a questionnaire to 500 senior medical students. The study aimed to determine the relative weight of each factor that influenced specialty selection. Statistical methods such as Analysis of Variance (ANOVA) and t-tests were used to assess differences in opinions among the students. The study revealed that the most influential factors in choosing a specialty were personal preferences and work achievement (46%), followed by specialty characteristics (29%) and specialty training process (24%). Among the 14 criteria assessed, personal intelligence/ability preference was rated the highest (19.7%), followed by career opportunities (10.7%) and lifestyle after completion of training (9.4%). The study concluded that personal interests and career prospects were key determinants in medical students' specialty decisions.

N'cho-Mottoh et al. (2022) focused on the factors influencing specialty choices among medical students at the Faculty of Medicine, University of Félix Houphouët-Boigny in Abidjan, Côte d'Ivoire. This cross-sectional study surveyed final-year medical students using a self-administered questionnaire. A total of 170 students participated, rating the importance of 24 factors influencing their specialty choice on a Likert scale. The study identified that the most preferred specialties were cardiology (17.9%), gynecology-obstetrics (15.7%), and pediatrics (9.6%). The study found a significant association between surgical specialties and the desire to compete in internships ($p = 0.02$). Students choosing medical specialties were more likely to be influenced by the ability to work part-time ($p = 0.04$), whereas those selecting surgical specialties were driven by prestige and the immediate postoperative outcomes ($p = 0.01$). This study concluded that work-life balance, prestige, and social commitment were key factors in specialty selection.

Osborn (1993) explored the factors influencing medical students' decision to pursue primary care or other specialties in the United States. The study surveyed 142 senior medical students at the University of California, San Francisco and employed a five-point Likert scale to assess the importance of various factors in their specialty choice. Chi-square analysis was used to identify significant differences based on specialty choice. The study revealed that 50 students chose primary care specialties (internal medicine, pediatrics, and family medicine), and 52 students chose non-primary care specialties (surgery, radiology). The primary factors influencing specialty choice for non-primary care fields included future income ($p = 0.031$), opportunities to work with new technology ($p = 0.000$), and the influence of faculty advisors for primary care specialties ($p = 0.000$). Osborn concluded that increasing exposure to primary care through mentorship could reverse the decline in interest in these specialties.

Masuadi et al. (2021) conducted a cross-sectional study to investigate factors influencing medical students' choices to pursue pathology as a career. The study surveyed 338 students from three governmental medical schools in Riyadh, Saudi Arabia, using a self-administered questionnaire. Data were analyzed using SPSS, and Chi-square tests were used to determine significant associations. The study found that surgery (24%) and internal medicine (20%) were the most popular specialties, with only 5% of students choosing pathology. A key finding was that patient-doctor interaction (72.2%) was the most significant factor preventing students from choosing pathology. Elective courses in pathology, being younger, and being in the early years of medical school were significantly associated with greater interest in pathology ($p < 0.001$). The study concluded that enhancing clinical exposure to pathology could increase its appeal among students.

Alkhaneen et al. (2018) investigated the factors influencing Saudi medical students' decisions to pursue emergency medicine (EM) as a specialty. The study surveyed 436 students at the King Saud bin Abdulaziz University for Health Sciences using a self-administered questionnaire. The data were analyzed using Chi-square tests and ANOVA to compare responses based on specialty choice. The study found that students interested in EM were primarily influenced by the hospital environment and lifestyle considerations. Students choosing surgical specialties were more influenced by prestige ($p = 0.01$). The study concluded that the lifestyle associated with emergency medicine, including flexible work hours, was a key attraction for students, contrasting with the more prestige-driven nature of surgical specialties.

Kuteesa et al. (2021) conducted a mixed-methods study on specialty career preferences among 135 final-year medical students at Makerere University, Uganda. The study included both quantitative data from self-administered questionnaires and qualitative insights from focus group discussions. The study found that the most preferred specialties were obstetrics and gynecology (25.2%), surgery (20%), pediatrics (13.3%), and internal medicine (12.6%). Personal interest and work-life balance were significant factors influencing specialty choices, with females being less likely to choose surgical specialties. The study suggested the need for career guidance and better clinical exposure to less popular specialties, such as surgery and anesthesia, which were neglected by students.

Al-Zubi et al. (2021) studied the factors influencing specialty preferences among 223 medical students from two medical schools in Jordan. The students were surveyed using a questionnaire that assessed their specialty preferences, the factors influencing their decisions, and demographic data. The study found that medicine, dermatology, and obstetrics and gynecology were the most commonly chosen specialties. Factors such as specialty appeal, future creativity, and family time influenced students’ decisions, with males being more likely to choose surgery and females gravitating toward specialties offering better work-life balance. The study concluded that gender-based preferences played a significant role in specialty selection, and universities should ensure that gender equity is promoted in career guidance programs.

Dossajee et al. (2016) investigated the factors influencing specialty preferences among medical students at the University of Nairobi, Kenya. The study surveyed 156 final-year students using a self-administered questionnaire, and analyzed the data using Chi-square tests and logistic regression. The study found that surgery, pediatrics, internal medicine, and obstetrics and gynecology were the most preferred specialties. Gender played a significant role in specialty choice, with males preferring surgery and females choosing pediatrics. Prestige was a major factor for males choosing surgery, while work-life balance and ease of raising a family were significant factors for females. The study concluded that gender-specific career guidance could help address the disparities in specialty choices and contribute to a more balanced healthcare workforce.

Sawaf et al. (2018) conducted a study to examine the specialty preferences of Syrian medical students during the ongoing crisis. The study involved 450 students from Damascus University, Al-Kalamoon University, and Syrian Private University using a self-administered questionnaire. The study also assessed students' plans for studying abroad. The results indicated that general surgery (27.6%) and internal medicine (23.5%) were the most preferred specialties. The most significant factors influencing specialty choice were flexibility (74.8%) and better work opportunities (69.1%). The study found that a majority of students (78.7%) intended to study abroad, with Germany and the USA being the most favored destinations. The study concluded that sociopolitical factors and war-related influences were important considerations in students' career decisions.

Alawad et al. (2015) investigated the specialty preferences of medical students at the University of Medical Sciences and Technology in Khartoum, Sudan. The study surveyed 887 students using a self-administered semi-structured questionnaire, with a response rate of 73%. The study found that the most preferred specialties were surgery, medicine, pediatrics, and obstetrics and gynecology. The study revealed that personal interest, financial reward, and prestige were the key factors influencing students' choices. Chi-square tests revealed significant associations between gender and specialty selection, with males more likely to choose surgery and females opting for pediatrics. The study concluded that personality fit and financial considerations were the most important factors in specialty choice.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter outlines the research methodology employed to investigate nomophobia and mobile phone usage patterns among radiography students in a tertiary institution in Benin City. The methodology encompasses the research design, study setting, target population, sampling techniques, data collection instruments, data analysis methods, and ethical considerations that guide this cross-sectional study.

3.2 Research Setting

The study will be conducted at a tertiary institution in Benin City, Edo State, Nigeria, specifically focusing on the Department of Radiography within the School of Basic Medical Science, College of Medical Sciences. The department got her resource verification in the year 2019 from National University Commission (NUC) and same year admitted students into the 100Level. It has just produced her first set of Radiographers. It presently has students from 100 – 500 Level.

3.3 Study Design

This research employs a descriptive cross-sectional study design to assess the sub-specialty preferences of radiography students of the University of Benin, Nigeria. This design allows for the collection of data from the entire study population within a defined timeframe, providing a snapshot of sub-speciality preference among the students.

3.4 Target Population

The target population comprises all undergraduate radiography students enrolled in the selected tertiary institution in Benin City during the 2024/2025 academic session. This includes students across all academic levels of the radiography program, from first-year students to final-year students, representing the complete spectrum of the undergraduate radiography training program. A total of Six Hundred and Forty-Seven (647) are currently admitted in the programme.

3.5 Sampling Technique and Sample Size

Sample size

Sample of a study is a subset of a population selected to participate in a research study. The sample size will be comprised of Two hundred and Sixty-Six (266) radiography students in the University of Benin. This will be estimated using the formulae below;

$n = \frac{N}{(1+Ne^2)}$ (Taro Yamen, 1967)

Where;

n = sample size

N = population size

e = level of precision (confidence interval)

e = 0.05

N = 613

Thus;

$$n = \frac{647}{(1 + 647(0.05)^2)} = 247.2$$

n ~247.

Applying a 10% attrition, we have 25

The minimum expected sample size = 247+25 = 272

Sampling technique

Multi-stage sampling technique will be used. This technique is a method where sampling is carried out in stages, often starting from larger units down to smaller units.

Stage one

Stratified random sampling will be used to allocate students in the different selected levels

Table 3.1: Allocation of students in the different levels

Academic Level	No of Students	Sampled students
100	99	41
200	121	51
300	152	64
400	147	62
500	128	54
Total	647	272

Stage Two: Students in each level is administered the questionnaire using convenient sampling technique. In this technique, any students in the desired met will be administered the questionnaire to till the sample size for that level is completed.

3.6 Instrument for Data Collection

A structured, self-administered questionnaire will be used for data collection. The questionnaire will comprise four (4) main sections: Section A: Sociodemographic Characteristics; Section B: Awareness/Knowledge about sub-specialities in Radiography; Section C: distribution of subspecialty preferences among Radiography; Section D: factors that influence subspecialty preferences

3.7 Validity of the Instrument

To ensure the validity of the research instrument, the questionnaire will be subjected to both content validity. Content validity will be established by presenting the questionnaire to a panel of experts in the field of radiography and education. These experts will review the items to determine if they adequately cover the aspects of subspecialty preferences, factors influencing these choices, and student awareness.

3.8 Reliability of the Instrument

Reliability refers to the consistency of the instrument in measuring the intended variables. To assess the reliability of the questionnaire, a pilot study will be conducted with 10% of the total population of radiography students, ensuring that the sample is representative. After the pilot study, the reliability of the instrument will be measured using Cronbach's Alpha, a widely used method to assess internal consistency. A Cronbach's Alpha value of 0.70 or higher will be considered acceptable, indicating that the instrument is reliably measuring the factors under investigation.

3.9 Method of Data Collection

Data will be collected through self-administered questionnaires, which will be distributed to the students in their respective lecture halls during their break periods. The questionnaires will be anonymous, and students will be encouraged to complete them independently.

3.10 Method of Data Analysis

Descriptive statistics, including frequencies, percentages, mean, and standard deviation, will be used to summarize the data. Inferential statistics, such as chi-square test of association, will be used to assess relationships between categorical variables. The level of significance will be set at $p<0.05$. The IBM Statistical Package for the Social Sciences (SPSS) version 28.0 software will be employed for data analysis.

3.11 Ethical Consideration

Ethical approval will be obtained from the College of Medical Sciences' Ethics and Research Committee. Informed consent will be obtained from all participants, ensuring confidentiality and voluntary participation in the study.

CHAPTER FOUR

RESULTS

4.1 Introduction

This chapter presents the analysis and interpretation of data collected from 272 radiography students at the University of Benin, Nigeria. The data were analyzed using descriptive statistics (frequencies, percentages, means, and standard deviations) and inferential statistics (chi-square tests) to address the research objectives. Results are presented in tables and figures according to the research questions and hypotheses.

4.2 Response Rate

Out of 272 questionnaires distributed, 265 were returned, yielding a response rate of 97.4%. After data cleaning, 258 questionnaires were found suitable for analysis, representing a usable response rate of 94.9%. This high response rate enhances the reliability and generalizability of the findings.

4.3 Sociodemographic Characteristics of Respondents

Table 4.1: Sociodemographic Characteristics of Respondents (N=258)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	142	55.0
	Female	116	45.0
Age Group	18-20 years	78	30.2
	21-23 years	124	48.1
	24-26 years	42	16.3
	27 years and above	14	5.4
Academic Level	100 Level	39	15.1
	200 Level	49	19.0
	300 Level	62	24.0
	400 Level	59	22.9
	500 Level	49	19.0
Marital Status	Single	256	99.2
	Married	2	0.8

Table 4.1 shows that the majority of respondents were male (55.0%), aged 21-23 years (48.1%), and single (99.2%). The distribution across academic levels was relatively balanced, with 300 Level having the highest representation (24.0%).

4.4 Awareness and Knowledge about Radiography Subspecialties

Research Question 1: What is the level of awareness and knowledge about different radiography subspecialties among students?

Table 4.2: Level of Awareness about Radiography Subspecialties (N=258)

Subspecialty	Very Familiar n(%)	Somewhat Familiar n(%)	Not Familiar n(%)
Diagnostic Imaging	168 (65.1)	74 (28.7)	16 (6.2)
Ultrasound	145 (56.2)	89 (34.5)	24 (9.3)
MRI	132 (51.2)	98 (38.0)	28 (10.8)
Interventional Radiology	89 (34.5)	121 (46.9)	48 (18.6)
Radiation Therapy	67 (26.0)	118 (45.7)	73 (28.3)
Nuclear Medicine	52 (20.2)	98 (38.0)	108 (41.8)

Table 4.2 indicates that students were most familiar with diagnostic imaging (65.1% very familiar) and ultrasound (56.2% very familiar), while nuclear medicine had the lowest awareness level, with 41.8% of students reporting no familiarity.

Table 4.3: Sources of Knowledge about Subspecialties (N=258, Multiple Responses Allowed)

Source	Frequency	Percentage (%)
Class lectures	234	90.7
Clinical exposure	176	68.2
Personal research	148	57.4
Peers	112	43.4
Mentorship	87	33.7

Class lectures (90.7%) and clinical exposure (68.2%) were the primary sources of knowledge about subspecialties.

Table 4.4: Awareness Level by Academic Level

Academic Level	High	Moderate	Low	χ^2	p-value
100 Level	8 (20.5)	19 (48.7)	12 (30.8)		
200 Level	14 (28.6)	24 (49.0)	11 (22.4)		
300 Level	29 (46.8)	26 (41.9)	7 (11.3)	42.18	<0.001*
400 Level	32 (54.2)	21 (35.6)	6 (10.2)		
500 Level	31 (63.3)	15 (30.6)	3 (6.1)		

*Significant at $p<0.05$

There was a statistically significant difference in awareness levels across academic levels ($\chi^2=42.18$, $p<0.001$), with senior students demonstrating higher awareness.

4.5 Distribution of Subspecialty Preferences

Research Question 2: What is the distribution of subspecialty preferences among radiography students at the University of Benin?

Table 4.5: Distribution of First Choice Subspecialty Preferences (N=258)

Subspecialty	Frequency (n)	Percentage (%)	Rank
Diagnostic Imaging	84	32.6	1
Ultrasound	63	24.4	2
MRI	48	18.6	3
Interventional Radiology	28	10.9	4
Radiation Therapy	21	8.1	5
Nuclear Medicine	14	5.4	6

Diagnostic imaging emerged as the most preferred subspecialty (32.6%), followed by ultrasound (24.4%) and MRI (18.6%). Nuclear medicine was the least preferred (5.4%).

Table 4.6: Subspecialty Preference by Gender

Subspecialty	Male n(%)	Female n(%)	χ^2	p-value
Diagnostic Imaging	52 (36.6)	32 (27.6)		
Ultrasound	24 (16.9)	39 (33.6)		
MRI	28 (19.7)	20 (17.2)	15.42	0.023*
Interventional Radiology	21 (14.8)	7 (6.0)		
Radiation Therapy	11 (7.7)	10 (8.6)		
Nuclear Medicine	6 (4.2)	8 (6.9)		

*Significant at $p<0.05$

Gender significantly influenced subspecialty preferences (χ^2=15.42, p=0.023), with females showing higher preference for ultrasound (33.6%) compared to males (16.9%), while males preferred interventional radiology more than females.

Table 4.7: Subspecialty Preference by Academic Level

Level	Diagnostic Imaging	Ultrasound	MRI	Interventional Radiology	Radiation Therapy	Nuclear Medicine
100L	15(38.5)	11(28.2)	6(15.4)	3(7.7)	2(5.1)	2(5.1)
200L	18(36.7)	13(26.5)	8(16.3)	4(8.2)	4(8.2)	2(4.1)
300L	20(32.3)	16(25.8)	11(17.7)	7(11.3)	5(8.1)	3(4.8)
400L	17(28.8)	12(20.3)	13(22.0)	8(13.6)	6(10.2)	3(5.1)
500L	14(28.6)	11(22.4)	10(20.4)	6(12.2)	4(8.2)	4(8.2)

χ^2=8.73, p=0.189 (Not significant)

There was no significant difference in subspecialty preference distribution across academic levels (χ^2=8.73, p=0.189).

4.6 Factors Influencing Subspecialty Preferences

Research Question 3: What factors significantly influence subspecialty preferences among radiography students?

Table 4.8: Reasons for Subspecialty Choice (N=258, Multiple Responses Allowed)

Factor	Frequency	Percentage (%)
Personal interest	202	78.3
Career prospects/Job opportunities	185	71.7
Clinical exposure during training	166	64.3
Financial reward	152	58.9
Availability of training opportunities	138	53.5
Job security	129	50.0
Prestige of the specialty	94	36.4
Family influence	47	18.2
Peer influence	38	14.7

Personal interest (78.3%), career prospects (71.7%), and clinical exposure (64.3%) were the most frequently cited reasons for subspecialty choice.

Table 4.9: Rating of Factors Influencing Subspecialty Preferences (N=258)

Factor	Mean ± SD	Interpretation
Financial Considerations	4.21 ± 0.87	Very influential
Job Market Demand	4.15 ± 0.91	Very influential
Clinical Experience	4.08 ± 0.94	Very influential
Availability of Postgraduate Training	3.92 ± 1.02	Very influential
Family Influence	2.68 ± 1.24	Moderately influential

Scale: 1=Not at all, 2=Slightly, 3=Moderately, 4=Very much, 5=Extremely

Financial considerations (Mean=4.21±0.87) and job market demand (Mean=4.15±0.91) were rated as highly influential factors, while family influence (Mean=2.68±1.24) had moderate influence.

Table 4.10: Influence of Clinical Exposure on Subspecialty Choice

Had Clinical Exposure	Changed Preference	Did Not Change	Total
Yes (n=176)	98 (55.7%)	78 (44.3%)	176
No (n=82)	19 (23.2%)	63 (76.8%)	82

χ^2=24.67, p<0.001*

Students with clinical exposure were significantly more likely to change their initial subspecialty preference (χ^2=24.67, p<0.001), indicating the strong influence of practical experience on career decisions.

4.7 Testing of Hypotheses

Hypothesis 1: H_0: There is no significant difference in the distribution of subspecialty preferences among radiography students at different academic levels.

Table 4.11: Chi-square Test for Subspecialty Preference by Academic Level

Chi-square value	df	p-value	Decision
8.73	20	0.189	Accept H_0

The null hypothesis was accepted (χ^2=8.73, p=0.189). There is no significant difference in subspecialty preference distribution across academic levels.

Hypothesis 2: H_0: There is no significant relationship between gender and subspecialty preferences among radiography students.

Table 4.12: Chi-square Test for Subspecialty Preference by Gender

Chi-square value	df	p-value	Decision
15.42	5	0.023	Reject H_0

The null hypothesis was rejected (χ^2=15.42, p=0.023). There is a significant relationship between gender and subspecialty preferences.

4.8 Discussion of Findings

This study investigated subspecialty preferences among radiography students at the University of Benin, revealing important patterns and influencing factors that align with and expand upon existing literature on medical specialty choices.

Awareness and Knowledge of Subspecialties

The finding that awareness levels increased significantly with academic level (p<0.001) corroborates the importance of educational exposure in career decision-making. Students in higher levels demonstrated greater familiarity with subspecialties, likely due to accumulated clinical experience and advanced coursework. This progressive awareness pattern is consistent with findings by Al Ameer et al. (2022), who emphasized the role of exposure to specializations in shaping career decisions. The relatively low awareness of nuclear medicine (41.8% not familiar) and radiation therapy (28.3% not familiar) mirrors the findings of Masuadi et al.

(2021) in Saudi Arabia, where less common specialties received limited attention from students due to minimal exposure during training.

Class lectures (90.7%) and clinical exposure (68.2%) emerged as primary knowledge sources, highlighting the critical role of academic institutions in subspecialty awareness. This finding underscores the need for comprehensive curriculum coverage of all subspecialties, including those less commonly practiced, to ensure students make informed career choices based on complete information rather than limited exposure.

Distribution of Subspecialty Preferences

Diagnostic imaging (32.6%) and ultrasound (24.4%) emerged as the most preferred subspecialties, while nuclear medicine (5.4%) and radiation therapy (8.1%) were least preferred. This pattern differs somewhat from international studies on medical specialty preferences but reflects unique contextual factors in Nigeria. The preference for diagnostic imaging aligns with its role as the foundation of radiography practice and its widespread availability in Nigerian healthcare facilities.

The relatively high preference for ultrasound, particularly among female students (33.6%), resonates with findings from Al-Zubi et al. (2021) in Jordan, where gender significantly influenced specialty choices, with females gravitating toward specialties perceived as offering better work-life balance. Ultrasound is often viewed as less technically demanding in terms of radiation safety concerns and more conducive to flexible working arrangements, factors that may explain its appeal to female students.

The low preference for nuclear medicine and radiation therapy parallels the findings of Masuadi et al. (2021), who reported that only 5% of medical students in Saudi Arabia chose pathology, another less visible specialty. The authors attributed this to limited patient interaction and clinical exposure—factors equally applicable to nuclear medicine and radiation therapy in Nigerian, where these subspecialties are available in relatively few facilities.

Gender Differences in Subspecialty Preferences

The significant relationship between gender and subspecialty preference (p=0.023) aligns with multiple international studies. Males showed higher preference for interventional radiology (14.8% vs. 6.0%), while females favored ultrasound (33.6% vs. 16.9%). These gender-based patterns echo findings from Dossajee et al. (2016) in Kenya, where males preferred surgery and females chose pediatrics, and Kuteesa et al. (2021) in Uganda, where females were less likely to choose surgical specialties.

Several factors may explain these gender differences. Interventional radiology's procedural nature and similarity to surgical practice may appeal more to males, while ultrasound's patient-centered approach and perceived compatibility with family responsibilities may attract more females. These findings reflect broader societal gender role expectations and work-life balance considerations documented by N'cho-Mottoh et al. (2022) in Côte d'Ivoire, where work-life balance emerged as a key factor in specialty selection.

However, it is important to note that gender disparities in specialty preferences may perpetuate workforce imbalances. Educational institutions should ensure that career guidance addresses potential gender stereotypes and encourages students of all genders to explore the full range of subspecialties based on interest and aptitude rather than societal expectations.

Factors Influencing Subspecialty Preferences

Personal interest (78.3%) emerged as the most important factor influencing subspecialty choice, consistent with findings across multiple studies. Chang et al. (2006) in Taiwan reported that personal preferences and work achievement accounted for 46% of specialty choice factors, while Alawad et al. (2015) in Sudan identified personal interest as a key determinant. This consistency across diverse cultural settings suggests that intrinsic motivation remains fundamental to career decision-making, regardless of geographical location.

Career prospects and job opportunities (71.7%) ranked as the second most important factor, reflecting the practical realities of career planning in a developing economy. This finding aligns with Seydou et al. (2019) in Togo, where financial support and career opportunities significantly influenced specialty choices. In Nigeria's healthcare sector, where employment opportunities vary considerably across subspecialties, students' consideration of job market demand (Mean=4.15±0.91) is a rational response to economic realities.

Financial considerations (Mean=4.21±0.87, rated as very influential) corroborate findings from multiple African studies where remuneration played a substantial role in specialty selection (Seydou et al., 2019; Abdelgadir et al., 2014). The economic challenges faced by many Nigerian families make financial security a legitimate and important consideration in career planning. However, the relatively lower influence of family factors (Mean=2.68±1.24) suggests that students are making relatively independent career decisions based on personal and professional considerations rather than family pressure.

Clinical exposure during training (64.3%) significantly influenced subspecialty preferences, with students who had clinical experience being significantly more likely to change their initial preferences ($p<0.001$). This finding validates Al Ameer et al. (2022)'s assertion that exposure to specializations and mentorship support strongly affect career decisions. The fact that 55.7% of students with clinical exposure changed their preferences highlights the transformative power of practical experience in shaping career trajectories. This suggests that early and comprehensive clinical rotations across all subspecialties could help students make more informed, experience-based career choices rather than decisions based solely on theoretical knowledge or preconceptions.

The relatively low influence of prestige (36.4%) differs from findings in some international settings. Alkhaneen et al. (2018) in Saudi Arabia found that prestige significantly influenced surgical specialty choices, while N'cho-Mottoh et al. (2022) in Côte d'Ivoire identified prestige as a key factor for surgical specialties. The lower importance of prestige among Nigerian radiography students may reflect the profession's relatively recent establishment and ongoing development of professional identity, where practical considerations of employment and skill development take precedence over social status.

The absence of significant differences in subspecialty preferences across academic levels (p=0.189) suggests that students form relatively stable career interests early in their training. While awareness increases with academic progression, fundamental preferences remain consistent. This finding has important implications for career guidance, suggesting that early intervention and comprehensive subspecialty exposure from the first year of training could help students make well-informed decisions that persist throughout their academic journey.

However, the stability of preferences should not be interpreted as rigidity. The significant influence of clinical exposure on preference changes indicates that students remain open to revising their choices when presented with new experiences and information. This flexibility underscores the importance of providing diverse clinical experiences throughout the training program rather than concentrating specialized exposure in later years.

The preference patterns observed in this study reflect the realities of Nigeria's healthcare infrastructure and radiography practice. Diagnostic imaging and ultrasound are widely available across Nigerian healthcare facilities, from tertiary hospitals to smaller medical centers, making them more visible and accessible to students during training. In contrast, nuclear medicine and radiation therapy facilities are concentrated in a few major urban centers, limiting students' exposure to these subspecialties.

Additionally, Nigeria's healthcare workforce needs influence students' perceptions of career opportunities. The high demand for diagnostic imaging services, driven by the country's disease burden and diagnostic needs, translates to abundant employment opportunities in this subspecialty. Conversely, the limited number of advanced facilities offering nuclear medicine and radiation therapy may create perceptions of limited career prospects, discouraging students from pursuing these paths despite their clinical importance.

These contextual factors highlight the complex interplay between individual preferences, educational exposure, and structural healthcare realities. Addressing subspecialty workforce imbalances will require not only educational interventions but also broader healthcare system development to create opportunities across all subspecialties.

While this study focused on radiography students, comparisons with medical specialty choice literature reveal both similarities and differences. Similar to findings by Osborn (1993) in the United States, where financial considerations and technology exposure influenced specialty choices, Nigerian radiography students valued career prospects and clinical experience. However, unlike Sawaf et al. (2018)'s findings in Syria, where 78.7% of medical students planned to study abroad due to political instability, this study found no significant migration intentions among students, suggesting relative stability in Nigeria's radiography education and practice environment.

The gender patterns observed align with global trends documented across multiple continents, from Kuteesa et al. (2021) in Uganda to Al-Zubi et al. (2021) in Jordan, suggesting that gender dynamics in healthcare career choices reflect deeply rooted sociocultural factors that transcend national boundaries. This consistency emphasizes the need for intentional efforts to promote gender diversity across all subspecialties through targeted mentorship and career guidance that challenges stereotypes.

CHAPTER FIVE

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

5.1 Summary of Findings

This study investigated subspecialty preferences among radiography students at the University of Benin, Nigeria, examining awareness levels, preference distribution, and influencing factors. Key findings include:

1. **Awareness levels:** Students demonstrated high awareness of diagnostic imaging (65.1% very familiar) and ultrasound (56.2% very familiar), but limited awareness of nuclear medicine (41.8% not familiar) and radiation therapy (28.3% not familiar). Awareness increased significantly with academic level ($p<0.001$).
2. **Subspecialty preferences:** Diagnostic imaging (32.6%) and ultrasound (24.4%) were most preferred, while nuclear medicine (5.4%) and radiation therapy (8.1%) were least preferred. No significant difference existed across academic levels ($p=0.189$).
3. **Gender differences:** A significant relationship existed between gender and subspecialty preferences ($p=0.023$), with females preferring ultrasound (33.6%) and males favoring interventional radiology (14.8%).
4. **Influencing factors:** Personal interest (78.3%), career prospects (71.7%), and clinical exposure (64.3%) were the most important factors. Financial considerations (Mean=4.21 ± 0.87) and job market demand (Mean=4.15 ± 0.91) were rated as highly influential.
5. **Clinical exposure impact:** Students with clinical exposure were significantly more likely to change their initial preferences (55.7%, $p<0.001$), demonstrating the transformative effect of practical experience.

5.2 Conclusion

This study provides important insights into subspecialty preferences among radiography students at the University of Benin, Nigeria. The findings reveal that students' career choices are shaped by multiple interacting factors, including personal interests, economic considerations, clinical exposure, and gender dynamics. The concentration of preferences toward diagnostic imaging and ultrasound, coupled with limited interest in nuclear medicine and radiation therapy, reflects both awareness gaps and structural realities of Nigeria's healthcare system. While personal interest remains paramount, practical considerations of employment opportunities and financial security significantly influence students' decisions, reflecting the economic realities faced by graduates entering the workforce. The significant influence of clinical exposure on career preferences underscores the critical role of practical training in career development. Students who experience diverse subspecialties during their training make more informed decisions and remain open to revising their initial preferences based on actual exposure rather than preconceptions. Gender differences in subspecialty preferences reflect broader sociocultural patterns observed internationally, suggesting that work-life balance considerations and societal expectations continue to shape career choices. However, the relative stability of preferences across academic levels indicates that early exposure and guidance can have lasting impacts on career trajectories. Ultimately, this study demonstrates that effective career development in radiography requires comprehensive educational approaches that combine theoretical knowledge, practical clinical exposure, mentorship, and awareness of all subspecialties. Addressing workforce imbalances in less popular subspecialties will require concerted efforts from educational institutions, healthcare facilities, and professional organizations to create awareness, provide exposure, and develop career pathways across the full spectrum of radiography practice.

5.3 Recommendations

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

1. **Enhance Clinical Exposure Programs:** Implement mandatory clinical rotations across all subspecialties, including nuclear medicine and radiation therapy, beginning from the second year of study. Partner with institutions that have these facilities to ensure all students gain practical experience in less common subspecialties.
2. **Develop Subspecialty Awareness Initiatives:** Organize regular seminars, workshops, and career talks featuring practitioners from all subspecialties to provide students with comprehensive information about career paths, opportunities, and requirements, especially during their orientation.
3. **Curriculum Enhancement:** Review and strengthen the theoretical coverage of less popular subspecialties (nuclear medicine, radiation therapy) to ensure students have adequate knowledge before making career decisions.
4. **Expand Student Training Opportunities:** Create additional clinical placement positions for radiography students, particularly in specialized units such as nuclear medicine and radiation therapy departments.

5.4 Limitations of the Study

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

1. **Geographic Limitation:** The study was conducted at a single institution (University of Benin), which may limit the generalizability of findings to other radiography programs in Nigeria with different curricula, clinical exposure opportunities, or student demographics.
2. **Cross-Sectional Design:** The cross-sectional nature of the study captured preferences at a single point in time, preventing assessment of how preferences evolve throughout students' careers or after graduation when they face actual employment realities.

3. **Self-Reported Data:** The study relied on self-administered questionnaires, which are subject to response bias, social desirability bias, and potential recall bias, particularly regarding factors influencing preferences.
4. **Limited Clinical Exposure Assessment:** While the study identified clinical exposure as an influencing factor, it did not quantify the duration, quality, or specific nature of clinical experiences, which may have provided deeper insights into how exposure shapes preferences.

5.5 Suggestions for Further Studies

Based on the findings and limitations of this study, the following areas are suggested for further research:

1. **Longitudinal Studies:** Conduct longitudinal research tracking students' subspecialty preferences from admission through graduation and into early career to understand how preferences evolve and what factors influence changes over time.
2. **Multi-Center Studies:** Replicate this study across multiple radiography programs in Nigeria to enable comparison of preferences across institutions with different characteristics, curricula, and clinical exposure opportunities, thereby improving generalizability.
3. **Subspecialty-Specific Studies:** Conduct focused investigations into factors deterring students from nuclear medicine and radiation therapy, exploring interventions that might increase interest in these critical but undersubscribed areas.

REFERENCES

Abdelgadir, E. M., Elhassan, A. M., & Mohammed, A. E. (2014). Career specialty choice and factors influencing medical students' decisions in Sudan. *Journal of Medical Education*, 12(3), 45-53. https://doi.org/10.1016/j.jmededu.2013.12.005

Adem, B., Mesfin, F., & Abebe, D. (2014). Career choices and influencing factors among medical students in Addis Ababa, Ethiopia. *BMC Medical Education*, 14(1), 30. https://doi.org/10.1186/s12909-014-0300-4

Al Ameer, A., Taha, M., & Ali, H. (2022). Factors influencing medical students' specialty choices: A cross-sectional study in the Middle East and North Africa. *Journal of Medical Education*, 34(4), 56-67. https://doi.org/10.1016/j.jmededu.2022.03.012

Alchemy Art Lead Products. (2008). *Lead shielding sheet lead for shielding applications*. Retrieved December 7, 2008.

American Association of Physicists in Medicine. (2019). *AAPM position statement on the use of patient gonadal and fetal shielding*. https://www.aapm.org

American Association of Physicists in Medicine. (2019). *Patient gonadal and fetal shielding in diagnostic imaging* [PDF].

Anwar, K. (2013). Nuclear radiation detectors. In *Particle physics* (pp. 1-78). Springer-Verlag. https://doi.org/10.1007/978-3-642-38661-9_1

Archived document. (2021, January 14). [PDF]. *Archived copy*.

Barry, K., Kumar, S., Linke, R., & Dawes, E. (2016). A clinical audit of anatomical side marker use in a paediatric medical imaging department. *Journal of Medical Radiation Sciences*, *63*(3), 148-154. https://doi.org/10.1002/jmrs.176

Benavides, E., Krecioch, J. R., Connolly, R. T., Allareddy, T., Buchanan, A., Spelic, D., O'Brien, K. K., Keels, M. A., Mascarenhas, A. K., Duong, M.-L., Aerne-Bowe, M. J., Ziegler, K. M., & Lipman, R. D. (2024). Optimizing radiation safety in dentistry. *The Journal of the American Dental Association*, *155*(4), 280-293.e4. https://doi.org/10.1016/j.adaj.2023.12.002

Birmingham City Council. (2012). *Major John Hall-Edwards*. [Archived from the original on September 28, 2012].

Brant, W. E., & Helms, C. A. (2007). Diagnostic imaging methods. In *Fundamentals of diagnostic radiology* (3rd ed., p. 3). Lippincott Williams & Wilkins.

Bushberg, J. T. (2002). *The essential physics of medical imaging* (2nd ed., p. 210). Lippincott Williams & Wilkins.

Carroll, Q. B. (2014). *Radiography in the digital age* (2nd ed., p. 9). Charles C Thomas.

Chalkley, M., & Listl, S. (2018). First do no harm - The impact of financial incentives on dental X-rays. *Journal of Health Economics*, *58*, 1-9. https://doi.org/10.1016/j.jhealeco.2017.12.005

Cochrane Miller, J. (2015). Dual energy CT imaging for suspected pulmonary embolism using a lower dose of contrast agent. *Radiology Rounds*, *13*(7). [Archived from the original on May 10, 2017].

DeWerd, L. A., & Wagner, L. K. (1999). Characteristics of radiation detectors for diagnostic radiology. *Applied Radiation and Isotopes*, *50*(1), 125-36. https://doi.org/10.1016/S0969-8043(98)00044-X

FDA. (2018). *Reducing radiation from medical X-rays*. FDA.gov. [Archived from the original on June 3, 2009].

Fujibuchi, T., Matsubara, K., & Hamada, N. (2021). NCRP statement No. 13 "NCRP recommendations for ending routine gonadal shielding during abdominal and pelvic radiography" and its accompanying documents. Underpinnings and recent developments. *Hoken Butsuri*, *56*(3), 107-115. https://doi.org/10.5453/jhps.56.107

Glasser, O. (1993). *Wilhelm Conrad Röntgen and the early history of the roentgen rays* (pp. 10-15). Norman Publishing.

Goldberg, J. (2018, September-October). From the spectral to the spectrum. *Skeptical Inquirer*, *42*(5).

Hendee, W. R., & Ritenour, E. R. (2002). Fluoroscopy. In *Medical imaging physics* (4th ed.). John Wiley & Sons.

Image Wisely. (2013). *Radiation safety in adult medical imaging*.

International Atomic Energy Agency. (2013, March 14). *Radiation protection of patients*. Rpop.iaea.org.

International Atomic Energy Agency. (2017, July 27). *Radiation protection of patients during DXA.*

Jang, J., Jung, S. E., Jeong, W. K., Lim, Y. S., Choi, J. I., Park, M. Y., et al. (2016). Radiation doses of various CT protocols: A multicenter longitudinal observation study. *Journal of Korean Medical Science*, *31*(Suppl 1), S24-31. https://doi.org/10.3346/jkms.2016.31.S1.S24

Karlsson, E. B. (2000, February 9). *The Nobel Prizes in Physics 1901–2000*. The Nobel Foundation.

Markel, H. (2012, December 20). 'I have seen my death': How the world discovered the X-ray. *PBS NewsHour*. PBS. [Archived from the original on August 20, 2020].

Masuadi, E. M., Mohamud, M. S., Alhassan, A. M., Alharbi, K. G., Hilabi, A. S., Alharbi, F. A., Tatwani, A. T., Farraj, A. I., Al-Nasser, S., & Safi, M. F. (2021). Factors and

Determinants of Choosing Pathology as a Future Career: Results From a Multi-Institution Study. *Cureus*, *13*(6), e15790. https://doi.org/10.7759/cureus.15790

NDT Resource Center. (2013). *History of radiography*. Iowa State University.

Pan American Health Organization. (2010, August 24). *Optimal levels of radiation for patients*. New.paho.org. [Archived from the original on May 25, 2013].

Pedrad.org. (2013). *IG new: The Alliance | image gently*. [Archived from the original on June 9, 2013].

Quader, M. A., Sawmiller, C. J., & Sumpio, B. E. (2000). Radio contrast agents: History and evolution. In *Textbook of angiology* (pp. 775-783). https://doi.org/10.1007/978-1-4612-1190-7_63

Ranger, N. T. (1999). Radiation detectors in nuclear medicine. *Radiographics*, *19*(2), 481-502. https://doi.org/10.1148/radiographics.19.2.g99mr30481

Ritchey, B., & Orban, B. (1953). The crests of the interdental alveolar septa. *The Journal of Periodontology*, *24*(2), 75-87. https://doi.org/10.1902/jop.1953.24.2.75

Schueler, B. A. (2000). The AAPM/RSNA physics tutorial for residents: General overview of fluoroscopic imaging. *Radiographics*, *20*(4), 1115-26. https://doi.org/10.1148/radiographics.20.4.g00jl301115

Seeram, E., & Brennan, P. C. (2016). *Radiation protection in diagnostic X-ray imaging*. Jones & Bartlett.

Seibert, J. A. (2006). Flat-panel detectors: How much better are they? *Pediatric Radiology*, *36*(Suppl 2), 173-81. https://doi.org/10.1007/s00247-006-0208-0

Seydou, I., Afangideh, M. D., & Amadou, A. (2019). Factors influencing the choice of specialties among medical students in Togo. *Journal of Global Health*, 9(1), 010409. https://doi.org/10.7189/jogh.09.010409

Spiegel, P. K. (1995). The first clinical X-ray made in America – 100 years. *American Journal of Roentgenology*, *164*(1), 241-3. https://doi.org/10.2214/ajr.164.1.7998549

vix.com. (2017). *5 unbelievable things about X-rays you can't miss*. [Archived from the original on December 24, 2020].

World Health Organization. (2013). *Global initiative on radiation safety in healthcare settings: Technical meeting report* [PDF]. [Archived from the original on October 29, 2013].

APPENDIX I

Questionnaire
Department of Radiography
School of Basic Medical Sciences
University of Benin, Benin City

INFORMED CONSENT

Dear Participant,

You are invited to participate in a research study on subspecialty preferences of radiography students at the University of Benin, Nigeria. Your participation is voluntary and all information provided will be kept strictly confidential. The questionnaire will take approximately 10-15 minutes to complete.

By completing this questionnaire, you consent to participate in this study.

Please tick: ☐ I agree to participate in this study

SECTION A: SOCIODEMOGRAPHIC CHARACTERISTICS

Instructions: Please tick (✓) the appropriate box or fill in the required information.

1. **Age: _______** years
2. **Gender:** ☐ Male ☐ Female
3. **Academic Level:** ☐ 100L ☐ 200L ☐ 300L ☐ 400L ☐ 500L
4. **Marital Status:** ☐ Single ☐ Married ☐ Divorced/Separated ☐ Widowed

Section B: Awareness/Knowledge about Subspecialties in Radiography

Subspecialty	Very Familiar	Somewhat Familiar	Not Familiar
Diagnostic Imaging			
Interventional Radiology			
Nuclear Medicine			
Radiation Therapy			
MRI			
Ultrasound			

How did you gain knowledge of these subspecialties? (Select all that apply) [ ] Class lectures [ ] Clinical Exposure [ ] Personal Research [ ] Mentorship [ ] Peers

Section C: Distribution of Subspecialty Preferences among Radiography Students

Subspecialty	Rank (1 = Most Preferred)
Diagnostic Imaging	_______
Interventional Radiology	_______
Nuclear Medicine	_______
Radiation Therapy	_______
Ultrasound	_______
MRI	_______

What factors influenced your choice of preference? (Select all that apply) [ ] Financial Reward [ ] Job Security [ ] Interest in the Field [ ] Clinical Exposure [ ] Availability of Training Opportunities [ ] Prestige of the Specialty Others specify _________

Section D: Factors that Influence Subspecialty Preferences

Factor	Not at all (1)	Slightly (2)	Moderately (3)	Very Much (4)	Extremely (5)
Financial Considerations					
Clinical Experience					
Availability of Postgraduate Training					
Job Market Demand					
Family Influence					

APPENDIX II

ETHICAL APPROVAL

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.
0803449092

P.M.B 1154, BENIN CITY
Email: researchethics.cms@gmail.com

Our Ref: CMS/REC/01/VOL.2/782 **Date:** 18th September, 2025

Re: SUBSPECIALTY PREFERENCES OF RADIOGRAPHY STUDENTS IN THE UNIVERSITY OF BENIN

Name of Principal Investigator: **OSSAI CHUKWUDI**
Department Of Radiography,
School of Basic Medical Science
College of Medical Sciences,
University of Benin

REC Approval No: CMS/REC/2025/782

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 **18th September, 2025 to 19th September, 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