ASSESSMENT OF THE KNOWLEDGE OF THYROID SHIELD USAGE AMONG FINAL YEAR RADIOGRAPHY STUDENTS AT THE UNIVERSITY OF BENIN

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SCHOOL OF BASIC MEDICAL SCIENCES

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SUPERVISOR: MRS OKEH E.O.

OCTOBER, 2025

CERTIFICATION

We certify that this project work "**ASSESSMENT OF THE KNOWLEDGE OF THYROID SHIELD USAGE AMONG FINAL YEAR RADIOGRAPHY STUDENTS AT THE UNIVERSITY OF BENIN**" was carried out by Omozoya , Flourish, with matriculation number: BMS2101870 of the Department of Radiography and that the work was done under my supervision.

MRS OKEH E.O. DATE

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MRS F. O. IGBINEDION DATE

(HEAD OF DEPARTMENT)

EXTERNAL EXAMINER DATE

DEDICATION

This work is dedicated to God, my loving father and mother, whose support, guidance, and prayers have been my greatest source of strength and motivation.

ACKNOWLEDGEMENT

First and foremost I want to give God the Glory for getting me to this point in my life, I also want to appreciate my parents for their undying love, I also want to give a special thanks to my supervisor, Mrs Okeh E.O for her support through out my Journey, may God bless you all.

ABSTRACT

Thyroid shields are protective devices used in radiography to reduce exposure of the thyroid gland to ionizing radiation. The thyroid is a radiosensitive organ, and shielding it is an important radiation protection practice. However, despite its importance, the consistent use of thyroid shields by radiography students is not always emphasized in training institutions in Nigeria. This study aimed to evaluate the level of knowledge among final-year radiography students regarding the use of thyroid shields at the University of Benin. A descriptive cross-sectional study design was adopted, involving 94 final-year radiography students. Data were collected using a structured self-administered questionnaire. The questionnaire assessed demographic characteristics, knowledge of thyroid anatomy and radiation sensitivity, knowledge of thyroid shield usage, and awareness of institutional practices regarding radiation protection. The collected data were coded and analyzed using descriptive statistics and Spearman's rank correlation to determine the relationship between different knowledge domains. The results showed that students had high theoretical knowledge of thyroid anatomy and radiation sensitivity, with 91.5% correct responses. However, only 25.5% reported applying thyroid shields during practical radiographic procedures. Knowledge of proper shield usage showed a moderate positive correlation with knowledge of thyroid anatomy and radiation sensitivity ($r = 0.465$, $p = 0.000$). Additionally, institutional support was very limited, with fewer than 2% of students reporting the availability of thyroid shields or formal training on their use. Although students demonstrated strong theoretical understanding, their practical application of thyroid shields remains inadequate. Improving hands-on training, increasing access to protective equipment, and implementing formal radiation safety policies are recommended to bridge the gap between knowledge and practice.

Keywords: Thyroid shields, protective devices, radiosensitive organ, Spearman's rank correlation.

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CHAPTER ONE

INTRODUCTION

1.1 Background of study

Health technology is the application of systematic knowledge as devices, drugs, inoculations, procedures, and systems meant to solve health issues and improve the quality of life. Medical technology is a subdivision of health technology that utilizes diverse equipment to either diagnose, monitor or treat medical conditions in human beings. These medical technologies are used to enhance healthcare results, providing an opportunity to diagnose and treat patients earlier, provide an alternative less invasive treatment, and spend less time in a hospital and more time on rehabilitation. As medical science and fast-enabling health technologies developed, diagnostic imaging methods and interventional radiological procedures have become vital in the accurate detection of different diseases and injuries so as to offer life saving treatments in the current healthcare setup (Chun-sing et al., 2012).

Modern medicine through the use of X-rays has greatly enhanced the accurate diagnosis of a disease. Nonetheless, medical X-rays continue to be the biggest single man-made source of radiation to the United Kingdom population with over 46 million X-ray examinations being carried out in the United Kingdom annually. This exposure adds to an average radiation dose of 0.4 mSv per person of a total of 2.7 m Sv of all ionising radiation sources per year. In people exposed to more than one X-ray examination, cumulative exposure is significantly increased (Hart, Hillier & Shrimpton, 2010).

The use of ionizing radiation is done in several medical procedures like angiography, fluoroscopy, computed tomography (CT), and radiographic imaging. Even though radiological imaging is irreplaceable in diagnosis and treatment, it subjects the patient to radiations that could carry health consequences. There can even be instances where dose limits set by international regulatory bodies have been surpassed in the process of undertaking certain interventional procedures (Yurt, Çavuşoğlu & Günay, 2014). In turn, the fundamental radiation protection principles focus on the fact that ionizing radiation exposure should never be below the so-called as low as reasonably achievable (ALARA) principle (Gendelberg, Hennrikus, Slough, Armstrong & King, 2016). This is important since ionizing radiation especially the X-rays would lead to detrimental biological effects: large doses would lead to cell destruction but low doses would cause or modify the DNA of the cells which are being irradiated (Dellie, Admassie & Ewnetu, 2014).

The number of CTs used and the exposure to radiations created by them has been rising dramatically over the last few years creating increased concerns about radiation-related malignancies (Brenner & Hall, 2007). A report of 2004 estimated that about 260 million CT examinations were carried out in the world annually and that CT imaging represents as much as 67% of all medical radiation exposure (Frush & Applegate, 2004). It was reported by Mazonakis et al. (2007) that the thyroid gland is exposed to a dose of between 15.2 and 52.0 mGy during a CT scan of the neck, and this is in addition to the high risk of thyroid cancer, which is estimated at up to 390 cases per one million patients. To address these risks, radiologists and manufacturers of CT have presented different measures to minimize radiation exposure especially on the most vulnerable groups of the population, e.g. infants and children (McCollough et al., 2009).

Moreover, there has been an increasing concern regarding the inadequate degree of knowledge among the radiography students and the upcoming radiographers regarding the use of Radiation Protection accessories like the thyroid shield. Consequently, this issue may impact negatively on the health of patients, since there will be no information regarding radiation protection, and it will later translate to unsafe behavior and negative health outcomes pathways (Bolbol et al., 2021). There is a dearth of Research done in the area of the world which would test the knowledge of thyroid shield usage among the Radiography students in the University of Benin which signifies a required gap which the study would intend to fill since it is targeted to evaluate the knowledge of thyroid shield usage among the University of Benin Radiography students.

1.2 Statement of the Problem

Although the medical technologies are rapidly developing and the diagnostic imaging procedures are becoming more popular, the issue of possible health hazards of receiving ionizing radiations is still present. Despite the fact that the principles of radiation protection (like the ALARA guideline) are highly developed, the lack of understanding of radiation protection and the misuse of protective gadgets (especially the thyroid shield) still seem to be relevant problems among trainees of radiography. This knowledge gap is concerning considering that some of the procedures, like CT scans, may expose vulnerable areas like the thyroid to large amounts of radiation, thereby exposing them to the risk of developing cancerous conditions due to radiation (Mazonakis et al., 2007). The absence of enough knowledge and application of radiation protection measures on radiography students is likely to expose both the patient and practitioners to unwarranted risk. Moreover, there is a research gap in this area where the knowledge of radiography students as to the use of thyroid shield has not been assessed and thus poses a critical gap in the study that aims at filling the gap by determining the level of awareness and practice among Radiography students at the University of Benin.

1.3 Research Questions

1. How much do final-year students of radiography know of thyroid anatomy and radiation sensitivity?
2. What is the knowledge of the final-year radiography students regarding the correct usage of thyroid shields in radiographic processes?
3. What is the knowledge level of final year radiography students on institutional policy and practice regarding radiation and using thyroid shields?

1.4 Hypothesis

Null Hypothesis (H_0): There is no significant relationship between the knowledge of thyroid anatomy and radiation sensitivity and the knowledge of the use of thyroid shield amongst final year students of the University of Benin.

Alternative Hypothesis (H_1): There is a significant relationship between the knowledge of thyroid anatomy and radiation sensitivity and the knowledge of the use of thyroid shield amongst final year students of the University of Benin.

1.5 Aim of the Study

The purpose of the research is to evaluate the level of knowledge of the use of thyroid shield among final-year radiology students of the University of Benin.

1.6 Objectives of the study

1. To assess the extent of final-year radiography students at the University of Benin in terms of their knowledge on the thyroid anatomy and thyroid radiation sensitivity.
2. To assess the understanding of final-year radiology students on how thyroid shields should be used when taking radiographs.

3. To assess the level of institutional practices and policies concerning radiation protection and use of thyroid shield among final-year radiography students.

1.7 Significance of the Study

This study is important as it emphasizes on the need to observe the appropriate radiation protective measures in future radiographers, especially in protection of sensitive organs like thyroid gland. Through the assessment of the knowledge and awareness of thyroid shield usage in final-year radiography students, the study sheds light on the important information that can be used to enhance training programs related to radiation safety by educators and clinical supervisors. The results can also be used to inform curriculum review and lead towards better adherence to radiation protection standards in clinical practice. Finally, this research provides an addition to the improvement of patient and practitioner safety, promoting the use of essential protective equipment on a regular and reasonable basis.

1.8 Scope of the Study

This research paper will be restricted to final-year radiography students in the University of Benin. It particularly targets their knowledge and awareness about the use of thyroid shield during radiographic procedures. Students in other departments have not been included in the research, neither have the radiography professionals who have already been in the clinical setting nor other types of radiation protection equipment than the thyroid shield.

1.9 Operational definition of terms

Thyroid Shield: A protective lead or lead-equivalent device worn by a person around the neck during radiographic procedures to minimize the exposure of the thyroid gland to the effects of radiation is called a thyroid shield.

Knowledge: The concept of knowledge used in this research is the degree of understanding, awareness, and proper use of thyroid shields as perceived by the final-year radiography students on the purpose, importance and proper utilization of the shield.

Radiography Students: The targeted group of radiography students is those in the final year of their degree course, the Bachelor of Science in Radiography degree at the University of Benin.

Radiation Protection: Radiation protection can be defined as the practices, principles, and equipments employed in reducing exposure to ionizing radiation in order to decrease radiation exposure on patients and medical workers during radiographic processes.

CHAPTER TWO

LITERATURE REVIEW

2.1 Conceptual review

2.1.1 Anatomy of Head, Neck and Thyroid

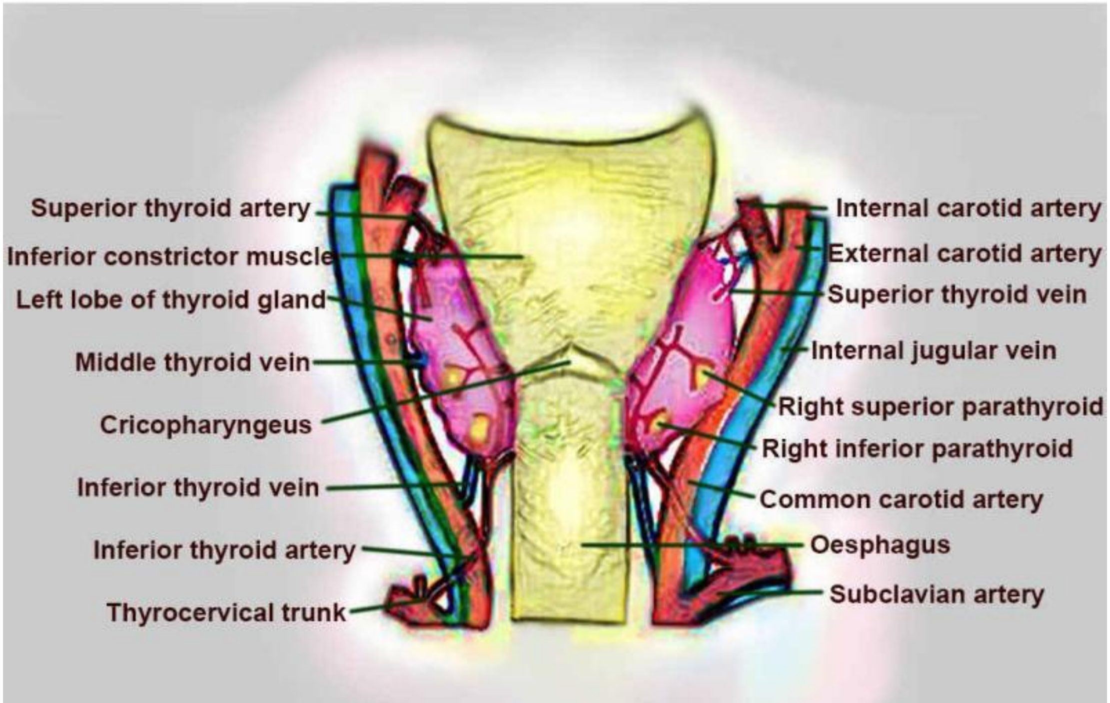

Figure 1: Schematic diagram of the posterior thyroid. (Lee & Pearce, 2023)

The thyroid gland is a midline gland in the anterior cervix position, which is located over the C5-T1 levels. The gland is an endocrine organ that secretes thyroid hormone and calcitonin, thus, controlling metabolism, growth and calcium levels in the serum. There are several disease processes which may involve the thyroid. The altered production of the hormones leads to either hypothyroidism or hyperthyroidism. The thyroid is also prone to inflammatory diseases like thyroiditis, autoimmune diseases like Graves disease and malignancies, which include papillary thyroid carcinoma, follicular carcinoma, and medullary thyroid carcinoma (Chaker et al., 2022).

Knowledge of thyroid anatomy and physiology would help clinicians in the identification and management of endocrine, inflammatory and neoplastic diseases of the gland. The knowledge of the anatomical relationships of this organ also helps in reducing the complications arising in the process of the surgery of the neck (Lee & Pearce, 2023).

Structure and Function

The thyroid gland has a weight of about 25 g in an adult and a mean mass of 6.6 ml in general (Turcios et al., 2015). The gland is situated in a hollow or space in the neck (mid-neck, or in the visceral or deep or middle compartment) that borders the esophagus, pharynx, and trachea (Norris & Anzai, 2022). This compartment is furthered over hyoid bone and downward to the aorta arch.

The thyroid is made up of 2 normally symmetrical lobes unified by the isthmus that traverses the upper trachea at the height of the 2nd and the 3 rd tracheal rings. Each lobe usually has a pyramidal extension which is known as the tube of Zuckerkandl. In spite of these usual characteristics, the thyroid has a high level of morphologic variation (Allen & Fingeret, 2017).

The organ is posterior to the sternothyroid and sternohyoid muscles, and wraps around the cricoid cartilage and rings of the trachea, and underneath the laryngeal thyroid cartilage. The thyroid usually measures between C5 and T1 levels of the spine (Kapral & Khot, 2022). This gland is attached to the trachea through a coagulation of the connective tissue referred to as the lateral suspensory ligament or Berry ligament that attaches each of the lobes to the trachea.(Mantalovas et al., 2022).

The thyroid is laterally covered by the sternaothyroid muscle. The organ lies against the larynx and the trachea medially. The gland is located behind and is adjacent to the carotid sheath, and partially covers the common carotid artery.

Embryology

Thyroid gland parenchyma is derived out of endoderm. The foramen cecum is the point of origin of development, which is a hole in the junction of the anterior 2/3 and posterior 1/3 of the tongue (Lesi et al., 2022). The thyroid is formed in the early stages of gestation and is in the form of a bilobed diverticulum which is descended in front of the pharynx. This structure proceeds on to descend in front of the hyoid bone and cartilages of the larynx. The thyroid gets its final location with the 7th week of development, it is midline and in front of the upper trachea. The thyroglossal duct has a temporary relation between the growing thyroid and the tongue base which further involutes and disappears subsequently.

The ultimobranchial body, which is a product of the 4th pharyngeal pouch, becomes integrated in the posterior part of the developing thyroid. Through this structure, there is the formation of the parafollicular cells (C cells) of the gland that helps in the production of calcitonin.

Blood Supply and Lymphatics

The superior and inferior thyroid arteries supply the thyroid gland with a rich blood supply and close the upper and lower parts of the thyroid gland respectively. The superior thyroid artery is the 1 st branch of the external carotid artery, usually at the same level as the superior horn of the thyroid cartilage. This is a nearly vertical blood vessel, which comes with its mate, the vein, behind the sternothyroid muscle, and to the superior pole of the thyroid lobe. At the distal end, this artery forms the infrahyoid, sterna cleavage, superior laryngeal arteries and cricothyroid arteries. The internal laryngeal nerve accompanies the superior laryngeal artery which passes through the thyrohyoid membrane. The cricothyroid artery joins its opposite one, at the midline (Tzortzis et al., 2023).

Inferior thyroid artery originates at the thyrocervical trunk which originates at the anterosuperior side of the subclavian artery. This vessel divides around the middle of the anterior scalene muscle and passes medially, towards the back of the thyroid gland (Bunea et al., 2023). At the junction of the lower 3rd of the outer border the artery usually reaches the lateral lobe. The greatest branch of the inferior thyroid artery is the ascending cervical artery which has to be differentiated with the main trunk of the inferior thyroid artery during excision surgery in an operation (Roman et al., 2019).

There is also an extra artery, the thyroid ima artery that exists in about 10% of the people. The source of this blood vessel is very diverse, as it can be branches off the brachiocephalic trunk, aortic arch, right common carotid, subclavian, pericardiacophrenic or thyrocervical trunk, transverse scapular or internal thoracic. This, however, is the thyroid ima artery that usually grows off the brachiocephalic trunk and serves the isthus and anterior surface of the thyroid gland (Bunea et al., 2024).

The thyroid has a venous drainage of superior, middle and inferior thyroid veins. The superior and middle veins have a twisting path to the internal jugular vein, which occurs bilaterally. The poor quality thyroid vein usually leads to the subclavian or brachiocephalic veins only slightly behind the manubrium (see Image). Inc. Thyroid Arteries, Veins, and Muscles) (Singh, 2023).

The prelaryngeal, the pretracheal, the paratracheal, and the lower deep cervical lymph nodes are the lymphatic drainage. Isthmus and inferior lateral lobes are the main drainers to the paratracheal and lower deep cervical nodes. The isocortical part of the gland empties into the isocortical pretracheal and cervical nodes.

Innervation of the thyroid gland

The thyroid gland is mainly innervated by the autonomic nervous system. Branches of the vagus nerve provide parasympathetic input and the sympathetic fibers are produced by the superior, middle, and inferior cervical ganglia of the sympathetic trunk (Saylam et al., 2009). The autonomic nervous system, though does not control hormone production and secretion, it controls the thyroidal vascular state.

Muscles of the neck and the thyroid area

The neck and the thyroid area have several muscles that create significant landmarks in the surgical anatomy. The deepest of these is known as the platysma, which is bounded by the superficial cervical fascia and runs along the lines of the superficial fascia of the deltoid clavicle to the face and the mandible. The anterior border of the posterior cervical triangle is the sternocleidomastoid that anterolaterally touches the thyroid gland and runs in an oblique direction along the mastoid process to the clavicle and sternum. The digastric muscle originates at the mandibular tubercle, and then goes deep behind the hyoid bone and inserts at the mastoid tip. The infrahyoid or strap muscles are being 4 pairs of muscles located on the anterior laterolateral part of the thyroid gland and help in gross laryngeal movement during swallowing and vocalization.

Omohyoid is placed deep behind the sternocleidomastoid, and runs along the hyoid bone to the lateral part of the clavicle. Sternohyoid is positioned in superficial location of the thyroid gland, running between the hyoid and the sternum. Sternothyroid extends between the oblique line of the thyroid cartilage to the sternum and is directly above the anterior thyroid surface. The thyrohyoid occurs between the oblique line of the thyroid cartilage and the hyoid. The poor pharyngeal constrictor is an insertion of the thyroid and cricoid cartilages which insert on the pharyngeal raphe and touch the superior medial side of thyroid lobe (Agcaoglu et al., 2024).

Physiologic Variants of the thyroid gland

The ecstatic thyroid tissue can be present anywhere along the embryologic migratory pathway with recorded sites lying between tongue and diaphragm (Ectopic Thyroid). The most common location is the lingual thyroid at the tongue base and its prevalence is between 1 in 100,000 and 1 in 300,000 people (Gao et al., 2023; Tsai et al., 2021). There can be a pyramidal lobe which extends superiorly in a superior position of the isthmus as vestigial remnant of the thyroglossal duct. This type is present in 28%-55% of people and is most frequently acquired on the left side (Ranade et al., 2008). pyramidal lobe It can be bilateral or independent of the primary gland.

Other morphologic discrepancies are commonplace (Al-Azzawi & Takahashi, 2021). The isthmus can either be eminent, or narrowed or even absent. Lateral lobes have asymmetry and size difference that is usually observed.

Clinical Significance

Thyroid diseases and abnormalities, as well as subsequent surgery, may cause numerous presentations and complications, which have clinical significance (Naytah et al., 2019). Comprehensive knowledge on thyroid anatomy and pathology will be used to identify and ensure proper treatment.

Hyperthyroidism: The overproduction of thyroid hormone can occur through the autoimmune or neoplastic mechanisms. Most of the cases are Graves disease and it is associated with the production of autoantibodies against the thyroid-stimulating hormone receptor (Davies et al., 2020). The most frequent are heat intolerance, excessive sweating, tachycardia, palpitations, anxiety, inadvertent weight loss, tremor, menstrual abnormalities and eye manifestation in form of exophthalmos and diplopia. The treatment is dependent on comorbidities, the severity of the disease, as well as patient preferences, and it may consist either of pharmacological or surgical treatment.

Hypothyroidism: The lack of sufficient levels of thyroid hormones can result in nonspecific or insidious symptoms. Typical symptoms are an increase in weight, coldness, constipation, dry skin, fatigue, menstrual disturbance and low mood. In most cases, it is brought about by autoimmune destruction of follicular cells, which may be common in women as many as 7 times more frequently than in men. The long-term management is effective due to hormone replacement and periodic monitoring (Klubo-Gwiezdzinska & Wartofsky, 2022).

Goiter: Goiter means swelling of thyroid gland that begins with mild asymmetry to large scale growth that results in obstruction of airways. Ordinary etiologies consist of iodine deficiency, hyperthyroidism and hypothyroidism (Knobel, 2016).

Consequences of Ectopic Thyroid Tissue: The appearance of an ectopic thyroid tissue causes location-specific symptoms. Lingual thyroid could result in dysphagia, bleeding or respiratory distress. Suprahyoid and infrahyoid thyroid tissue can be manifested as a midline neck mass and can be perceived as a thyroglossal duct cyst. The thyroid tissue present as an intraluminal Tracheal or Laryngeal intraluminal tissue may cause obstruction of the airways, and the esophagus may lead to dysphagia. The pyramidal lobes are usually asymptomatic as are ectopic tissue of thyroid in aorta, pericardium or myocardium.

2.1.2 Radiological examinations involving the use of Thyroid shield

During radiological examinations it is important to follow radiation protection principles both to the personnel and to the patient. The fundamental radiation protection principles are Distance, Time and Shielding, In this section we shall be discussing about the thyroid shield and the radiological examinations that utilize this type of shielding. One of the different examinations that requires the use of a thyroid shield is discussed below.

X-ray Imaging of the Proximal Humerus

The rotational movements of the proximal humerus or shoulder girdle are usually done to patients with non-trauma when gross fractures or humeral dislocations have been eliminated. These projections of the AP rotations clearly outline the scapulohumeral joint (shoulder joint), showing potential deposits of calcium or other pathology. By studying the position and relationships of the greater and lesser tubercles on a radiograph of the shoulder, you can determine the rotational position of the arm. This understanding enables you to know which rotational view is necessary for visualization of specific parts of the proximal humerus (Bontrager & Lampignano, 2013).

External Rotation

The external rotation position represents a true AP projection of the humerus in the anatomic position, as determined by the epicondyles of the distal humerus. Positioning requires supination of the hand and external rotation of the elbow so that the interepicondylar line is parallel to the image receptor.

On the external rotation, the greater tubercle is seen on the radiograph which is now tubercle , in a neutral position, anteriorly seen laterally in profile. The lesser tubercle is now found medially between the great tubercle and anteriorly (Bontrager & Lampignano, 2013).

Internal Rotation

In the case of internal rotation position, the hand and arm is rotated internally until the epicondyles of the distal humerus are orthogonal to the image receptor (IR), with the humerus in a true lateral orientation. The hand should be in the pronation posture and the arm also positioned in such a manner that the epicondyles are parallel to the IR. When the AP projection of the shoulder is taken in the internal rotation position, the proximal humerus will be in the lateral position. The larger tubercle is turned in this position to the anterior aspect and the medial aspect of proximal humerus, and the lesser one appears in the profile towards the center (Bontrager & Lampignano, 2013).

Neutral Rotation

In case of trauma patients, rotating the arm is not a good idea and hence neutral rotation is utilized. Here the distal humerus is positioned at about 45deg to the IR with the epicondyles visible. This is a downward facing palm of the hand against the thigh oblique position. The neutral rotation is halfway between the external and internal rotation, with the greater tubercle in the anterior position, but also slightly lateral to the lesser tubercle as seen in normal neutral-rotation shoulder radiographs (Bontrager & Lampignano, 2013).

Positioning and Exposure Factors.

General principles of positioning the humerus and shoulder girdle, which includes the clavicle and the scapula, follow the same principles as other imaging of the upper and lower limbs.

Technical Considerations

The humerus can be imaged either with or without a grid depending on the thickness of the anatomical part. The grid is normally applied when the examination is done in the erect position using a Bucky. The advice is that adults have shoulders that are between 10 and 15 cm across and therefore require the use of grids. Children and slim or asthenic adults can however be less than 10 cm where adjustment of exposure is necessary; a grid is not necessary (Bontrager & Lampignano, 2013).

The acromioclavcular (AC) joints are also usually less than 10 cm and need less kV (65-70 kV) without a grid in analog imaging but higher values are typical in digital systems. Department protocols can differ, and the grids can be used to support the IR and minimize the scattering although the dose to the patient is greater due to higher exposure factors.

Technical Rules for Humerus and Shoulder in average adults.

- Medium kV (70-80) on a grid with part sizes above 10 cm;
- 65-70 kV without a grid for parts <10 cm.
- Very often 5-10 kV additional is needed with digital systems.
- High exposure times and mA.
- Select a small focal spot.
- Shoulder imaging can be done using center AEC cell (manual exposure could be encouraged in case of humerus or AC joints).
- Adequate mAs is necessary to see soft tissues, cortical borders and trabecular pattern.
- Most projections should be made using a 40-44 inch (102-110 cm) SID;
- 183 cm (72 inches) of AC joints to reduce beam divergence.

Shielding Gonads:

The significance of gonadal shielding is due to the anatomy of the upper limb as it is close to the pelvic area in case the patient is in the supine position. Beam divergence can extend to the pelvis even when sitting and thus shielding is necessary to ensure that as little radiation enters radiosensitive parts as possible (Bontrager & Lampignano, 2013).

Thyroid, Lungs, and Breasts: Radiation may be of great amount to the thyroid gland, lungs, and breasts upon radiography of the shoulder. These are very radiosensitive organs. Close collimation and contact shielding of areas of the organs that are not being imaged are, therefore, important without interfering with the area of interest (Bontrager & Lampignano, 2013).

Pediatric Applications

Imaging of the pediatric humerus and shoulder use radiographic methods that are usually based on adult protocols, but use lower exposure rates based on lower tissue thickness and density. The issue of motion is rather widespread, and that is why immobilizing means, like sponges or tape, are necessary. The weight of the sandbags should be handled with a lot of care (Bontrager & Lampignano, 2013).

Parents can help in positioning where necessary but they should be given proper shielding. Understanding of the communication and its straightforwardness, as well as confirmation, contribute to the enhanced compliance among the pediatric patients.

Geriatric Applications

The elderly can lack motion or hurt someone, and thus they need altered positioning. It is necessary to be guided and patient. Radiographic technique might require modification due to the geriatric patients which they usually present with bone-destructive pathology which will demand fewer exposure factors (Bontrager & Lampignano, 2013).

Digital Imaging Solutions.

Collimation: Tight collimation is necessary to achieve the best quality of images and dose reduction.

Accurate Centering: Since the plate readers are digitized and, therefore, work on a systematical manner, the part and the CR are to be aligned to the IR properly to prevent errors in the processing.

Exposure Factors: Apply the ALARA principle, i.e., the maximum kV and the minimum mAs to obtain a diagnostic quality image.

Exposure Indicator Review: Once the processing is complete, the technologist should ensure that the exposure indicator is within the acceptable range, which will ensure that the proper exposure and ALARA standards were f

2.1.3 Importance of Thyroid shield

The thyroid gland is a butterfly-shaped gland that is located on the neck and aids in the metabolic and other crucial functions of the body by producing and supplying the thyroid hormones. This is one of the primary endocrine glands which is highly vulnerable to being easily affected by the diffused radiation (Trivitron Healthcare, 2022).

Medical professionals and physicians performing medical procedures, radiologists, patients, and others who are having medical procedures and are not adequately covered are exposed to scattered radiation. The more common or repeated exposure to the radiation emitted by medical procedures such as X-rays, CT scan, Fluoroscopy, and Dental X-rays may result in the heightened risk of thyroid cancer, hypothyroidism, and thyroid nodules. Therefore, one should take into account the applications of thyroid shields during therapeutics or diagnostics by the patients as well as the physicians, radiologists, or operators (Trivitron Healthcare, 2022).

Not every work or medical environment involves the need of using thyroid shield or collar and the choice to use it can be made based on the ALARA principle. It is based on three factors as such, the time/duration of contact with radiation, distance between the radiation source and the person exposed, and whether the shielding equipment that is used is sufficient to offer radiation protection (ALARA) (Trivitron Healthcare, 2022).

A thyroid shield is usually composed of lead or non-lead or the most recent non-lead thousand-year thyroid collars are latex-free and standard radiation shields of 0.5 mm Pb equivalency.

The thyroid gland which is in the form of butterfly on the neck assists our body in their metabolic and other important functions by secretions and regulation of the thyroid hormones. The given endocrine gland is a simple area that can be easily affected by the scattered radiation (Trivitron Healthcare, 2022).

Medical workers doing or receiving medical procedures without proper protection stand at risk of scattered radiations include doctors, patients, physicians, radiologists, and other medical professionals. Multiple or regular exposure to radiations used in medicine such as the X-rays, CT scan, Fluoroscopy and the dental X rays may cause the development of thyroid cancer, impaired thyroid and thyroid nodules. Therefore, one should think about the use of thyroid shields in the therapeutic or diagnostic process by the patients themselves and those of the doctors, radiologists, or operators.

Not every medical environment or employment involves the need to use a thyroid shield or collar and the choice to wear the shield can be determined based on three issues namely the time/duration of exposure to radiation, whether the radiation source and exposed individual were in close proximity, and is the shielding material used befitting to afford radiation protection (Trivitron Healthcare, 2022).

According to the design and comfortability, Thyroid Shields can be allocated loosely or tightly to the neck. When purchasing a shield, it is always preferable to make experiment and test the ease of movement of the neck and head.

All the human body must be maintained clean and healthy so that the life span can be prolonged. Radiation protective measures including the required gears, apparels, and equipments should be taken properly and taken (Trivitron Healthcare, 2022).

2.2 Empirical Review

The empirical research on radiation protection behaviour brings a constant gap between research findings and the actual practice of radiation protection in the clinical setting. Eze et al. (2013) conducted a study in Lagos and discovered that the radiographers had sound theoretical knowledge of radiation protection principles but failed to use them on a regular basis when exposed to radiation. The authors have noted that in the presence of the workplace habits and resource limits the knowledge alone is insufficient in order to ensure safe practice. Zervides et al. (2020) also report similar results, evaluating the diagnostic radiography staff in Cyprus and finding a large disparity in the conceptualization of particular radiation protection at the levels of dose limits and legislative regulations. They observed that there are institutional culture, access to protecting equipment, and oversight, which are important to form safe practice.

This pattern can be supported by student populations. Prajapati et al. (2022) explored the radiography students knowledge concerning the personnel monitoring device and indicated that despite the baseline awareness was satisfactory, certain significant gaps were observed regarding using the compliance, limitations, and interpretation of the monitoring outcomes. They came up with a conclusion that the designing of the curriculum and practical clinical exposure were the main factors in the development of strong and habitual practices of radiation protection among students. This is particularly applicable when the thyroid shielding is used requiring conceptual knowledge as well as disciplined procedure when posing patients.

A lot of the apprehension over the use of thyroid shield is due to the calculated thyroid radiation in standard radiographic and CT scans. Dosimetric assessments of head and neck CT in children observed by Mazonakis et al. (2007) revealed that the thyroid gland received significant doses of the radiation that are the cause of an increased risk of radiation-induced malignancy later in life especially due to the higher radiosensitivity of children. The clinical significance of thyroid protection is supported by the fact that Tipnis et al. (2015) estimate thyroid doses in areas with neck CT among adult populations and emphasize the importance of regular dose-reduction steps in the given cases.

Research comparing shielding technologies gives another connotation to systematic shielding. Experiments with phantom neck CT, Hoang et al. (2012) established that tube current modulation as well as in-plane thyroid shielding in an organ could sufficiently lower the dose to the thyroid, as much as 45 percent, without impairment of diagnostically relevant image quality. The recent studies confirm the use of protective thyroid shields still, even though they are more recent. As an example, Alkhateeb et al. (2023) also reported significant decreases in measured thyroid dose during chest radiography in the presence of thyroid collars in the correct position. Similarly, Gunathilaka et al. (2025) assessed thyroid shielding when conducting CT brain research and demonstrated significant changes in dose of thyroid to about the negative, which once again confirms shielding as an effective and good practice.

Drawing together these findings, one can outline various themes which are directly applicable towards the determination of knowledge levels among final-year radiography students at the University of Benin. To start with, this is because first, thyroid is a very radiosensitive organ and empirical dosimetry tests have always shown that the thyroid organ usually receives unnecessary radiation in case there is no shielding in case procedures are to be done. Second, shielding and dose-modulation technology is very reliable in lowering the thyroid dose which supports the argument of uniform knowledge and application among students. Third, radiographer and student studies show that despite the plausible level of theoretical knowledge, habitual shield use depends on the clinical supervision and workflow limitations and perceived inconvenience, as well as the access to protective equipment (Eze et al., 2013; Zervides et al., 2020; Prajapati et al., 2022).

These empirical results, combined, highlight the necessity to quantify and strengthen knowledge on the use of thyroid shield in radiography students, especially those in their final year who are about to start full clinical responsibility.

2.3 Theoretical framework

Two theory models are also used in anchoring this study; they are the Health Belief Model (HBM) and The Theory Planned Behavior (TPB). These theories are behavioural-science explanation as to how individuals including radiography students develop their knowledge, attitudes, and intentions regarding use of radiation protection equipment such as thyroid shield.

Health Belief Model (HBM)

Rosensstock (1974) formulated the Health Belief Model, which holds that perceived severity, perceived susceptibility, perceived barriers, self-efficacy, cues to action, and perceived benefits are all known to influence the health-related behaviors that an individual engages in. In radiation protection, the perceived susceptibility is the perceived degree to which the students think that they can be harmed by radiation-induced thyroid damage whereas the perceived severity relates to the perceptions of the impacts of long-term exposure of the neck. Perceived benefits represent a student belief that thyroid shields help greatly in reducing the radiation dose whereas perceived barriers could be that it is uncomfortable, not available or not enforced by the department. Action cues can be occasioned by lecturers, clinical instructors or institutional radiation safety policies. Lastly, self-efficacy is used to evaluate how the students believe that they always put thyroid shields during radiographic procedures. It has been shown that the introduction of the radiographers to tools that help in protection against radiation is largely associated with the perception of risk and benefit (Eze et al., 2013; Alreshidi et al., 2020). Thus, HBM can be used to give a rational explanation of why not all students use thyroid shields with sufficient knowledge but still do not use them on a consistent basis.

Theory of Planned Behavior (TPB)

According to Theory of Planned Behavior by Ajzen, a behaviour is determined by intention which is shaped by attitudes, subjective norms, and perceived behavioural control (Ajzen, 1991). Regarding the use of thyroid shield, attitudes imply the positive or negative judgement of using thyroid shields by the students; subjective norms involve the expectation that a student has regarding using thyroid shields as mentioned by the lecturers, clinical supervisor, and peer; perceived behavioural control issues are whether it is easy or difficult to access and use thyroid shields during the time of clinical rotations.

Empirical results have depicted that institutional norms and perception of behavioural control play a major role in influencing compliance with radiation protection practices among radiographers (Shungube & Khoza, 2024). Therefore, TPB justifies the elements of behaviour intention that should be used to explain the failures between knowledge and actual shield use on the thyroid.

Theoretical Framework application to the Study.

The HBM and TPB can be directly used to guide the process of assessing the knowledge and behaviour of final-year radiography students towards using thyroid shield during the University of Benin.

The study is able to understand the level of knowledge of the students in terms of perceived susceptibility and perceived severity on the allowance of risks of thyroid radiations through the HBM. Knowledge about their perceived advantages and inhibitors assists the research in determining the translation of the knowledge into motivation to change behaviour. As an example, when students are informed that the thyroid is very radiosensitive but fail to wear shields then the model can be used to determine whether the logistical obstacles, misconceptions or absence of hierarchy enforcement are behind the non-compliance.

The TPB is used to analyse the construction of the intention of the students based on the attitude and social pressures in the training environment. Final year students tend to follow the behavioural pattern of the clinical instructors; thus, poor institutional culture or weak subjective norms can lead to low usage of shields despite the possession of proper knowledge. The theory is also used to explain whether the actual usage of protective tools depends on the perceived behavioural control, including access to these tools.

When combined, the theories offer an all-reaching description of behaviour that explains the divergence between student knowledge and practice hence informing the interpretation of the study results and the recommendations on training, policy and clinical supervision in the radiography program.

CHAPTER THREE

METHODOLOGY

3.1 Research Settings

The research was undertaken within the department of radiography at the faculty of basic medical sciences at the university of Benin at Edo state in Nigeria. University of Benin is one of top institutions located in Nigeria and offers a complete course on Radiography as a Bachelor of Science (B.Sc.) programme. Radiographic students admitted in their final years in the University of Benin Teaching Hospital (UBTH) and other approved diagnostic centres are taken through lengthy clinical placements that expose them to different radiographic practices that demand use of radiation safety equipment like thyroid shields. The environment is fitting with regards to the current study given that students in this level have had sufficient theoretical training in radiation protection and their clinical experience is very high hence were the right ones to gauge knowledge on the use of thyroid shields.

3.2 Study Design

This study assumed a descriptive cross-sectional research design. This design is suitable since it enables the whole population to be approached at one point in the time, thus giving a clear picture of the current level of understanding about the use of thyroid shield among final-year radiography students. This design is appropriate to detect the lack of knowledge, patterns, and variations of variables without controlling variables.

3.3 Target Population

The population under study included students of the B.Sc. Radiography programme, and final-year (500-level) of the University of Benin, studying radiography in the 2024/2025 academic session. These students constitute the ideal population of the study since they have had the majority of their professional training, albeit based on inherent knowledge on radiation protection and since they have been on active clinical postings where they dealt with thyroid shields.

3.3.1 Inclusion Criteria:

- The registered students of the final-year (500-level) radiography students in the University of Benin.
- Graduates holding the basic courses in radiation protection and safety.
- Students that have been placed on clinical rotations or posts where they have the expectation of wearing thyroid shields.
- Students whose consent to take part in the study was informed.

3.3.2 Exclusion Criteria:

- Student of radiography not yet in final-year level (i.e. student in 100-400 level).
- Students still to receive clinical postings or radiation protection practice training.
- Students that refuse to be involved or they are unable to give informed consent.
- Students that are not available at the time when data is being collected

3.4 Sampling techniques/Sampling size

The participants were chosen with the help of a purposive sampling method, as only those final-year (500-level) students of radiography were included in the sample that have studied the core course in radiology protection and have had clinical postings. This approach was useful because the participants are supposed to be known specifically in terms of thyroid shield usage and thus was fit to take part in the study.

In order to estimate the necessary sample size, the formula of Yamane (1967) was used to calculate the formula to use in the finite populations:

Sample size calculation

500L: 127 students

Total Population (N) = 127 students

Use Yamane's Formula for Sample

n =

$$\frac{N}{1 + N\,(e)^2}$$

Where:

n = sample size

N= total population size

e= Margin of error

Let's use a margin of error e = 0.05 (for 95% confidence level):

n =

$$\frac{127}{1 + 127\,(0.05)2}$$

n =

$$\frac{127}{1 + 127\,(0.0025)}$$

n =

$$\frac{127}{1 + 0.3175}$$

=

$$\frac{127}{1.3175}$$

= 96.39

= 96 students

3.5 Instrument of Data Collection

The structured and self-administered questionnaire was used to gather the data, in which the researcher based/structured the questionnaire review on the outcome of the literature review on radiation protection and the use of thyroid shields. The questionnaire included four parts

Section A: Demographic information (age, gender, experience in clinical postings, etc.).

Section B: Knowledge on Thyroid anatomy and radiation sensitivity.

Section C: Knowledge on thyroid shield usage.

Section D: Knowledge of institutional practices.

The questionnaire was designed into close-ended questions in multiple-choice and Likert questions and scales so as to ascertain uniformity and ease of analysis and response to the questions.

3.6 Validity of Instrument

Three experts were involved in face and content validation of the instrument:

1. A radiographer lecturer at senior level with background experience in radiation protection field,
2. A clinical radiographer having a large experience in diagnostic radiology, and
3. An authority on research methodology, supervisor.

The the questionnaire was checked by the validators who checked accuracy, relevance, clarity and alignment of the questionnaire with the study objective. They were revised and refined to bring the instrument to capture the intended variables and this is achieved through their suggestions.

3.7 Reliability of Instrument

The reliability of the questionnaire is going to be tested using a pilot study with 10 final-year radiography students of a different institution (e.g., Ambrose Alli University). To measure the consistency of responses, Cronbach's alpha, which is a statistical technique of determining internal consistency, was used to analyse the responses. The reliability coefficient of 0.80 was derived, meaning that the questions in the questionnaire were always capable of measuring the intended constructs.

3.8 Method of Data Collection

The researcher sought the permission of the Head of Department with regard to administering the questionnaire. The instrument was handed over physically to the students during lecture hours or departmental meetings so as to have maximum participation. The reason of the study was made known to the respondents, and they were guaranteed of confidentiality. The process of data collection required about one week when all the completed questionnaires were obtained to analyze them.

3.9 Method of Data Analysis

1. Statistical analysis was done with the Statistical Package of Social Sciences (SPSS) version 27.0.
2. Frequency, percentage, mean, and standard deviation as examples of descriptive statistics were employed to summarize demographic information and the level of knowledge.
3. Descriptive statistics was used in analyzing the research question.
4. Pearson correlation was used to test the hypothesis to understand whether there is a strong correlation between the level of knowledge of students and the frequency of the thyroid shield usage that students reported.
5. Conclusions were made in tabs and charts where necessary..

3.10 Ethical Consideration

The University of Benin Research and Ethics Committee provided the ethical approval. The subjects were informed about the aim of the study and were given an assurance that participation in the study was voluntary. An informed consent was taken in written form prior to the administration of questionnaires. The process of Confidentiality was upheld by leaving no names or any other identifying information in the instrument. The participants were told about their right to drop out of the study at any point and that they will never be penalized.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 DATA PRESENTATION

4.1.1 Demographic characteristics of Respondents

This section describes the demographic information gathered from the participants of this study. A total of 96 questionnaires were distributed to the final year radiography students of the University of Benin. The data is illustrated in Table 4.1 and demonstrates that only 94 respondents took part in this study i.e gave their full consent and completely filled their questionnaires. Majority of the respondents were men, 56.4%, and the females were 43.6%. The age distribution showed that most (88.3%) of the participants fell within the age bracket of 21-25 with the others (11.7%) aged within the 26-30 years age bracket and none aged below 21 years or over 30 years. In terms of clinical experience, a considerable percentage (85.1%) had over 12 months of clinical posting with 14.9% of the respondents reporting to have undergone just 6-12 months of clinical posting. All the respondents were over 6 months of clinical posting. In general, the sample represents a rather young group with a high level of clinical exposure.

Table 4.1 Demographic Information of Respondents (N=94)

Variable	Category	Frequency	Percentage (%)
Gender	Male	53	56.4
	Female	41	43.6
Age	16-20	0	0.0
	21-25	83	88.3
	26-30	11	11.7
	Above 30	0	0.0
Duration of clinical posting	< 6 months	0	0.0
	6-12 months	14	14.9
	> 12 months	80	85.1

4.1.2 Analysis of section B: Knowledge on Thyroid Anatomy and Radiation Sensitivity

Research question 1: How much do final-year students of radiography know of thyroid anatomy and radiation sensitivity?

This section was designed to answer the above research question, it consisted of 5 question items and the responses to the questions and their proportions are presented in Table 4.2

Table 4.2 Responses on knowledge on Thyroid Anatomy and Radiation Sensitivity (N=94)

Table 4.2:

Questions	Responses (Frequency %)		
	Yes	No	Maybe
The thyroid gland is a radiosensitive organ.	86 (91.5%)	2 (2.1%)	6 (6.4%)
Exposure to X-rays can increase the risk of thyroid cancer.	77 (81.9%)	2 (2.1%)	15 (16.0%)
Children's thyroid glands are more sensitive to radiation than adults.	86 (91.5%)	2 (2.1%)	6 (6.4%)
The thyroid gland is located in the anterior neck region.	86 (91.5%)	2 (2.1%)	6 (6.4%)
Radiation exposure to the thyroid can be reduced using protective devices.	85 (90.4%)	2 (2.1%)	7 (7.5%)

The findings show that the level of knowledge on the respondence on thyroid anatomy and radiation sensitivity is generally high. The thyroid gland was identified correctly by a high percentage (91.5%) of the students and it was also found that majority (91.5 percent) of them knew that the thyroid glands of children are more sensitive to radiation compared to the one of an adult. There was also high awareness of the anatomical position of thyroid gland with 91.5% answering correctly.

Additionally, 81.9% of the respondents admitted that X-rays may lead to development of thyroid cancer especially when an individual is exposed to the radiation, but 16% of them were uncertain. The majority of the respondents (90.4%) pointed out that they had a positive view that thyroid radiation could be lessened by using protective devices. Altogether, the results of the research indicate a good level of knowledge in the given field, and only a few percent of the respondents made wrong or ambiguous answers.

4.1.3 Analysis of section C: Knowledge on Thyroid Shield Usage

Research question 2: What is the knowledge of the final-year radiography students regarding the correct usage of thyroid shields in radiographic processes?

This section was designed to answer the above research question, it consisted of 6 question items and the responses to the questions and their proportions are presented in Table 4.3

Table 4.3: Responses on Knowledge on Thyroid Shield Usage (N=94)

Questions	Responses (Frequency %)		
	Yes	No	Maybe
Have you ever used a thyroid shield during clinical practice?	24 (25.5%)	55 (58.5%)	15 (16.0%)
Thyroid shields should be worn during all procedures where the neck is exposed to radiation.	78 (83.0%)	5 (5.3%)	11 (11.7%)
It is acceptable to skip using a thyroid shield if the procedure is short.	51 (54.3%)	22 (23.4%)	21 (22.3%)
Thyroid shields should be positioned to fully cover the thyroid gland.	76 (80.8%)	6 (6.4%)	12 (12.8%)
Using a thyroid shield can significantly reduce absorbed radiation dose to the thyroid.	78 (83.0%)	5 (5.3%)	11 (11.7%)
Thyroid shields can be reused multiple times without inspection for damage.	52 (55.3%)	17 (18.1%)	25 (26.6%)

The results show varying degrees of awareness and practice on the use of thyroid shield among the respondents. Only a quarter of the respondents (25.5%) had ever used a thyroid shield in clinical practice, with most (58.5%) having never used a thyroid shield in clinical practice. Positively, majority (83.0%) of respondents were able to say that thyroid shields were to be put on every time there was need to expose the neck to radiations. There were however, misconceptions. Over half of the respondents (54.3%) were of the opinion that they are okay to forego using thyroid shields in short procedures and they have a misconception of cumulative radiation effects. Equally, 55.3% believed that thyroid shields could be reused on several occasions without inspecting them on the presence of damages, which indicated lapses in knowledge regarding equipment integrity and safety. Positively, 80.8% knew that thyroid shields should completely enclose the thyroid gland in order to protect it, and 83.0% accepted that they greatly minimize the radiation dose taken in. In general, the theoretical knowledge does not seem to be weak, but the practical application of the theory and some safety principles have not yet been depicted, and it is necessary to implement specific training and support.

4.1.4 Analysis of section D: Knowledge of Institutional Practices

Research question 2: What is the knowledge level of final year radiography students on institutional policy and practice regarding radiation and using thyroid shields?

This section was designed to answer the above research question, it consisted of 5 question items and the responses to the questions and their proportions are presented in Table 4.4

Table 4.4: Responses on Knowledge of Institutional Practices (N=94)

Questions	Responses (Frequency %)		
	Yes	No	Maybe
Your institution provides thyroid shields for patients during clinical postings.	1 (1.1%)	55 (58.5%)	38 (40.4%)
Students are trained on proper thyroid shield usage during clinical postings.	1 (1.1%)	64 (68.1%)	29 (30.8%)
Supervisors regularly ensure that students know how to use thyroid shields on patients.	11 (11.7%)	47 (50.0%)	36 (38.3%)
Are you aware of your institution's radiation safety policy.	1 (1.1%)	73 (77.7%)	20 (21.2%)
There is a written radiation protection policy available for patients.	1 (1.1%)	48 (51.0%)	45 (47.9%)

As can be seen in Table 4.4, the level of awareness and access to institutional support regarding the use of thyroid shield on patients appears to be rather low. The percentage of those who reported that their institution does and does not provide thyroid shields for patients while on clinical postings was only 1.1% and 58.5% respectively and the percentage of those who were uncertain was 40.4%. On the same note, training on how to use thyroid shield is likewise limited with only 1.1% confirming they received training as compared to 68.1% who had not and 30.8% who were not sure.

Supervisory guidance also appears to be insufficient with only 11.7% admitting that supervisors routinely make sure that students are aware of how to use thyroid shields, half of the respondents (50.0%) denied it, and 38.3% were uncertain. Institutional safety policies awareness was also rather low: only one point one percent knew about a radiation safety policy and 77.7% did not know. Similarly, only 1.1% reported the presence of a written radiation protection policy towards patients with 51.0% stating that it did not exist and 47.9% saying that they did not know.

Generally, the results represent the high level of institutional gaps in the area of radiation safety provision, training, supervision, and policy awareness that could be one of the factors causing the identified deficiencies in the use of thyroid shields on patients among students.

4.1.5 Hypothesis Testing

Null Hypothesis (H_0): There is no significant relationship between the knowledge of thyroid anatomy and radiation sensitivity and the knowledge of the use of thyroid shield amongst final year students of the University of Benin.

Alternative Hypothesis (H_1): There is a significant relationship between the knowledge of thyroid anatomy and radiation sensitivity and the knowledge of the use of thyroid shield amongst final year students of the University of Benin.

Variables used:

Knowledge of thyroid anatomy and radiation sensitivity: This variable was measured using all item of Section B in our well structured questionnaire.

Knowledge of the use of thyroid shield: This variable was measured using all item of Section C in our well structured questionnaire.

Test of Hypothesis using Spearman’s correlation test.

Null Hypothesis H_0: There is no significant relationship between Radiographers knowledge of resuscitation procedures during radiological emergencies and their practices of Resuscitation.

Table 4.5: Spearman's Correlation between Knowledge of thyroid anatomy and radiation sensitivity and Knowledge of the use of thyroid shield

Variable	ρ(Spearman's rho)	p-value	N	Decision
Knowledge of thyroid anatomy and radiation sensitivity vs Knowledge of the use of thyroid shield	0.465	0.000	94	Significant

Spearman's Correlation Result: ρ= 0.465 p = 0.000; Since p = 0.000 is lesser than 0.05, we reject the null hypothesis H_0 and accept the alternative hypothesis.

Conclusion: The correlation analysis demonstrated that there is a statistically significant and positive correlation between the students knowledge of thyroid anatomy and its radiation sensitivity and knowledge of the use of thyroid shield (r = 0.465, p = 0.000). This shows that the students that displayed greater knowledge of anatomical features of the thyroid gland as well as its vulnerability to radiation also displayed better knowledge in terms of proper use of thyroid shields. The moderate positive value of the spearman's rho indicates that the enhancement of the basic knowledge of anatomy and radiation-sensitivity can have a significant impact on the increase in practical knowledge and adherence to thyroid shielding in students. The finding, on the whole, implies the significance of combining theoretical and practical radiation-protection training to facilitate the spread of safer radiographic habits among final-year students.

4.2 Discussion

The demographic profile of this research, which was majorly young students with considerable experience in clinical postings aged 21-25, offers a significant background on which the knowledge and practice gaps were identified. Surveys of radiography students and entry-level staff have indicated that a good level of classroom exposure and clinical hours do not necessarily correlate to regular and stable protective behaviours; Prajapati et al. (2022) found that students may have good theoretical knowledge of radiation monitoring devices, but when it comes to their practical implementation, they might be deficient in skills during clinical placements. The observed pattern assists in understanding why in the current study, the excellent awareness of the thyroid radiosensitivity and accurate anatomy are present, whereas the use of thyroid shields in the practice is relatively low.

The moderate statistically significant positive association between knowledge of thyroid anatomy/radiation sensitivity and the knowledge of thyroid shield use ($r = 0.465$) is consistent with the growing evidence that knowledge is the basis of safer practice; however, it is not a sufficient condition. According to Fiagbedzi et al. (2022), knowledge scores of radiographers were associated with compliance with protection practices, but the institutional and resource constraints often inhibited the transition into the coherent action. That is, knowledge is a sufficient but not a necessary condition to use the shield regularly, a finding that best characterizes your mixed pattern in your findings, with high cognitive but low practical uptake among the participants.

Minimal supply of shields, little training on clinical postings, and limited knowledge of formal radiation safety policy, as institutional factors in the study, are the same as larger, more recent studies of compliance and institutional preparedness in the workplace. Similar compliance gaps in the field of public health were reported by Shungube et al. (2024), with the authors focusing on the fact that the absence of equipment, inconsistent enforcement of supervisors, and a lack of dissemination of policies are the main obstacles to regular radiation protection practice. Such systemic failures are probably the cause of the identified gap between theoretical and practical knowledge among the final-year students depending on clinical sites to ensure their practical reinforcement.

The practical efficacy of thyroid shields itself is good-grounded and this supports the necessity to promote their application. Alkhateeb et al. (2023) demonstrated significant dose reductions with appropriately used collars in chest radiography and Purdom (2023) in a recent phantom/patient studies indicated that a good fit and proper positioning has a large effect on dose saving. The said results give weight to the thesis that enhancing the availability of shield and the importance of placing shield correctly, instead of doubting its usefulness, should be the priority of training programs that will lessen the thyroid dose in regular imaging.

It is the convergence of such lines of evidence which leads to educational implications. According to Prajapati et al. (2022) and other more recent reports, supplementing didactic teaching with other clinical training and supervised learning and specific refresher courses could be recommended; the current findings indicate that they would be especially applicable at the University of Benin. Besides that, Fiagbedzi et al. (2022) and Shungube et al. (2024) reported that the clarity of the institutional policy, regular audits of the protective equipment availability, and active supervisor enforcement are useful drivers of compliance. These measures would probably help to convert more knowledge into the habitual protective behaviour in the students.

Lastly, the fact that, in your sample, good theoretical knowledge and low levels of practical application lead to an opportunity: since students already have the conceptual backgrounds, low-cost interventions based on forced demonstrations, quick competency assessments during clinical placements, and frequent equipment audits would be beneficial, without requiring substantial changes in the curriculum. Such practical, holistic methods are feasible and effective in enhancing radiation protection behaviours in students and young radiographers in the beginning of their careers due to the support offered by the literature.

CHAPTER FIVE

CONCLUSION, RECOMMENDATIONS, LIMITATIONS AND SUGGESTIONS

5.1 CONCLUSION

This study revealed that final year students of the department of radiography at the University of Benin have a solid theoretical knowledge on thyroid anatomy and radiation sensitivity as they had high scores in these aspects. Only a small percentage of students have reported to making use of thyroid shields during clinical practice. The institutional support such as accessibility of shields, formal training and implementing radiation safety policies was also seen to be low, which also served as a contributing factor to the knowledge and practice mismatch. The positive, moderate relationship between knowledge of thyroid anatomy/radiation sensitivity and knowledge of shield use demonstrates that underlining knowledge allows researchers to understand the awareness of protective practices but systemic and practical barriers hinder the continuity of the practice. Finally, the results obtained indicate the importance of the specific intervention that combines both theoretical knowledge and systematic clinical reinforcement to improve the radiation protection behaviours in students.

5.2 RECOMMENDATIONS

1. Improving Real-life Training and Supervision.

The University and the associated clinical sites would be required to institute formal, practical practice workshops directly on the application of thyroid shield. This may involve overseen demonstrations, practical skill evaluations and competency checklists in clinical postings. Constant checks and reports by the supervisors will aid in proper positioning, handling and constant use of shields so that what is learned in theory is applied in routine.

2. Supply and servicing of Radiation Protection Gear.

There should be enough thyroid shields which are in good condition and easily accessible to all the students in the clinical training centres. Regular checking of shields when they are worn or damaged, as well as definite instructions on how to replace he/she or to maintain the shield, will increase confidence and compliance. Having adequate protective gear as institutional investment will decrease obstacles to regular use of the equipment and facilitate safe radiographic procedures.

3. Design and Establishment of Institutional Radiation Safety Policies.

The University must ensure the establishment of an extensive radiation protection policy which clearly addresses the training of students, wearing of thyroid shields and other forms of protection. This policy is to be articulated to the students and supervisors and there should be a means of review and follow up. Besides that, the inclusion of refresher courses or radiation safety workshops in the curriculum will assist in sustaining the level of awareness and the safety culture in clinical practice..

5.3 LIMITATIONS

1. **Self-reported data bias**: For the study, it placed a lot of trust on self-administered questionnaires that are highly susceptible to social desirability and recall bias. The respondents could have exaggerated their knowledge or underreported bad practices to make them seem good and the results could be disjointed between the knowledge or behaviour they actually have and what they report.

2. **Institutional level**: The research was carried out solely among the final-year radiography students in the University of Benin. Such a geographical and institutional narrowness hinders the extent to which the findings can be generalized because the quality of training, the availability of resources and institutional policies can vary greatly in other universities where radiography programs are provided in Nigeria.
3. **Lack of observational validation**: The research evaluated the knowledge but did not observe the actual practice of the students of clinical procedures with thyroid shields. There is no observational information, so the study has not been able to establish whether or not enough knowledge can be converted to proper clinical practice, which is essential with regard to radiation protection.

5.4 SUGGESTIONS FOR FURTHER STUDIES

Based on the findings of this research the following are areas suggested for further studies:

1. **Extend to other institutions to enhance comparison**: Future studies should also involve radiography students in different geopolitical regions in Nigeria in various universities. This will allow us to compare, enhance external validity and also help to pinpoint institution-specific gaps or best practices in radiation protection training.
2. **Include observational or practical evaluations**: The research must culminate the use of questionnaire with actual observation of students through clinical rotations. Such a mixed-method will enable the researcher to measure not just the knowledge of students, but also how they can use their knowledge in practice in the actual clinical situations.

3. **Evaluate institutional resources and policy enactment**: Future research should include clinical training centre audits to evaluate the accessibility, condition, and availability of thyroid shields, policy enforcement against radiation protection policies. This will assist in determining systemic determinants that affect the use of shields.
4. **Test the effects of specific educational interventions**: Researchers might develop and apply structured educational interventions, i.e. workshops, skill demonstrations, or simulation-based learning, on thyroid protection. Pre- and post-intervention evaluation would aid in establishing the success of this type of training in enhancing knowledge as well as practical compliance.

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APPENDIX I

ASSESSMENT OF KNOWLEDGE OF THYROID SHIELD USAGE AMONG FINAL-YEAR RADIOGRAPHY STUDENTS AT THE UNIVERSITY OF BENIN

Instructions: Please answer all questions honestly by marking Yes or No. All responses will be kept confidential and used solely for research purposes.

SECTION A: Demographic Information

1. Age: ________years

2. Gender: ☐ Male ☐ Female

3. Duration of clinical postings: ☐ <6 months ☐ 6–12 months ☐ >12 months

SECTION B: Knowledge on Thyroid Anatomy and Radiation Sensitivity

1. The thyroid gland is a radiosensitive organ. ☐ Yes ☐ No

2. Exposure to X-rays can increase the risk of thyroid cancer. ☐ Yes ☐ No

3. Children's thyroid glands are more sensitive to radiation than adults. ☐ Yes ☐ No

4. The thyroid gland is located in the anterior neck region. ☐ Yes ☐ No

5. Radiation exposure to the thyroid can be reduced using protective devices. ☐ Yes ☐ No

SECTION C: Knowledge on Thyroid Shield Usage

4. Have you ever used a thyroid shield during clinical practice? ☐ Yes ☐ No

1. Thyroid shields should be worn during all procedures where the neck is exposed to radiation. ☐ Yes ☐ No

2. It is acceptable to skip using a thyroid shield if the procedure is short. ☐ Yes ☐ No

3. Thyroid shields should be positioned to fully cover the thyroid gland. ☐ Yes ☐ No

4. Using a thyroid shield can significantly reduce absorbed radiation dose to the thyroid. ☐ Yes ☐ No

5. Thyroid shields can be reused multiple times without inspection for damage. ☐ Yes ☐ No

SECTION D: Knowledge of Institutional Practices

1. Your institution provides thyroid shields for students during clinical postings. ☐ Yes ☐ No

2. Students are trained on proper thyroid shield usage during clinical instruction. ☐ Yes ☐ No

3. Supervisors regularly ensure that students use thyroid shields. ☐ Yes ☐ No

4. Are you aware of your institution’s radiation safety policy? ☐ Yes ☐ No

5. There is a written radiation protection policy available for students. ☐ Yes ☐ No

6. Non-compliance with thyroid shield usage is monitored or corrected by the institution. ☐ Yes ☐ No

RESEARCH ETHICS COMMITTEE

COLLEGE OF MEDICAL SCIENCES
UNIVERSITY OF BENIN, BENIN CITY, NIGERIA.

Chairman: Prof. F. A Imarhiagbe
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Our Ref: CMS/REC/01/VOL.2/903 **Date:** 7th February 2026

RE: ASSESSMENT OF THE KNOWLEDGE OF THYROID SHEILD USAGE AMONG FINAL YEAR RADIOGRAPHY STUDENTS AT THE UNIVERSITY OF BENIN

Name of Principal Investigator: **OMOZOYA FLOURISH**
Department of Radiography
School of Basic Medical Sciences
University of Benin

REC Approval No: **CMS/REC/2026/903**

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 **7th February 2026 to 6th February 2027.** 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