SONOGRAPHIC DETERMINATION OF PREVALENCE OF THYROID PATHOLOGY AMONG ASYMPTOMATIC HEALTH WORKERS OF VOLTA REGIONAL HOSPITAL, HO

BY

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DECLARATION

I **RICHARD KWAKU DELALI** do hereby declare that this dissertation which is being submitted in fulfillment of the requirements for the degree of MSc Medical Ultrasonography is the result of my own research performed under supervision, and that except where otherwise other sources are acknowledged and duly referenced, this work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree. I hereby give permission for the Department of Radiography to seek dissemination/publication of the dissertation in any appropriate format. Authorship in such circumstances to be jointly held between myself as first author and the project supervisors as subsequent authors.

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DEDICATION

The work is dedicated to God who granted me knowledge, understanding, wisdom, guidance and protection to do this work for purposes of preserving mankind. Consequently, dedication of this work is extended to the Community of believers who are patiently waiting for the glorious appearing of the Lord, Jesus Christ.

I also dedicate this work to my wife Eunice Ama Delali and my children John Kwaku McDelali and Gabriel Kwaku McDelali.

Finally, I dedicate it to my sister Confort Akuvi Quarcoo and my brothers Isaac Quarcoo, James Quarcoo, Emmanuel Danso, my mother Francisca Agbodogli, and my aunt Victoria Agbodogli.

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LIST OF ABBREVIATIONS

US:	Ultrasonography
FNA:	Fine needle aspiration
TSH:	Thyroid stimulating hormones
IDD:	Iodine deficiency disorders
WHO:	World health organization
HT:	Hashimoto's thyroiditis
DTC:	Differentiated thyroid cancer
PTC:	Papillary thyroid cancer
TI-RADS:	Thyroid imaging reporting and data system
ATA:	American thyroid association
AACE/AME:	American Association of Clinical Endocrinologists and Associazione medicine endocrinology
KSThR	Korean society of thyroid radiology
FNAB:	Fine needle aspiration biopsy
PS:	Planar scintigraphy
SPECT:	Single positron emission computed tomography
MRI:	Magnetic resonance imaging
MY:	Manufacturing year
SPSS:	Statistical Package for Social Sciences
AHP:	Allied Health Professionals
WHO/ICCIDD:	World health organization international council for the control of iodine deficiency disorders

NSIP:	National salt iodization program
HMHD:	Ho municipal health directorate

ABSTRACT

Background: Ultrasonography is now the preferred imaging modality in diagnosing thyroid pathology because it is widely available, affordable, and easy to use. Apart from detecting more nodules than palpation, it is able to classify the nodules and also measure thyroid volume. Thyroid pathology detection is up to 8% by palpation, 13 to 65% by ultrasound, and up to 50% by autopsy studies,

Aim: The aim of this study was to sonographically determine the prevalence of thyroid pathology among the asyptomatic health workers of the hospital.

Methods: In a cross-sectional study, 100 asymptomatic health workers at the Volta Regional Hospital, Ho, were enrolled by convenient sampling method in May 2014. Thyroid volumes were measured and nodules detected were characterized and classified into benign, undeterminate and suspicious pathologies using Toshiba Aplio 300 ultrasound scanner with a linear transducer of frequency 7.5 Mhz, 2012 make. The data was analyzed using SPSS version 20.

Results: The result showed prevalence rate of 41%. Although 41% prevalence is on the high side, it falls within the continental rate of up to 90%. More females than males had pathology. The prevalence rate among males and females were 44.6% and 23.5% respectively. The results also showed that out of the 41% prevalence of thyroid pathology, the majority, 28%, were benign, 4% were suspicious thyroid pathology. The study showed that 23.5% of the males and 44.6% of females presented with pathology and 9% undeterminates. The mean thyroid volume of the study was 12.46 ± 6.47mls, a volume which was lower than WHO/ICCIDD reference level.

Conclusion: It can be concluded that a stand-alone application of ultrasonography for diagnosing malignancy is comparable to cytology results as 4% obtained in this study is within the range reported from cytology results. The study further revealed higher prevalence of thyroid pathology in women (44.6%) than in men (23.5%). This finding agreeable with most published literature which indicated female: male prevalence ratio of almost 2:1. This study is thus conclusive that women living in iodine deficient area are about 50% more likely to suffer from thyroid pathology than men living in the same locality. The study is also conclusive that majority, (28%) of thyroid pathologies were benign and hence the affected participants could be counseled.

Key words: Thyroid pathology, Thyroid nodules, Ultrasonography and iodine deficiency disorders.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

Thyroid ultrasonography (US) is an imaging modality of choice to assess thyroid size, shape and pathology. Ultrasonography is widely used in thyroid pathology detection because of its ability to depict and characterize wide range of thyroid pathologies in the form of solid, cystic and partially cystic nodules and in diffusedly enlarged thyroids (Koike et al., 2001, Papini et al., 2002). According to American Association of Clinical Endocrinologists, and European Thyroid Association Medical guidelines, thyroid pathology includes benign and malignant medical conditions such as benign nodular goiter, chronic lymphocytic thyroiditis, simple or haemorrhagic cysts, follicular adenomas, anaplastic and subacute thyroiditis. It also includes papillar, follicular, hürthle- cell, medullary and poorly differentiated carcinomas. Others include Primary thyroid lymphoma, sarcoma, teratoma, and miscellaneous tumors (Gharib et al., 2010). These pathologies can be detected using several diagnostic imaging modalities including ultrasonography. Certainly, fine needle aspiration (FNA) remains the ultimate diagnostic tool. However, many recent reports suggest that diagnostic accuracy of FNA is enhanced with ultrasound guidance Carmeci et al., (1998).

Physiologically, thyroid pathology is as result of hormonal imbalance. Iodine is very important for normal thyroid function. In particular, iodine is the form of inorganic iodide when it enters the follicular cells and through a series of metabolic mechanisms it is converted into thyroid hormones, thyroxine (T4) and triiodothyronine (T3). This process include; active iodine transport, iodination of tyrosyl residue of thyroglobuline (Tg), coupling of iodotyrosine molecules to form T3 and T4, proteolysis of Tg, with the release of free iodotyrosines and iodothyronines, deiodination of iodotyrosines and reuse of liberated iodide, and deiodination T4 to T3 (Solter et al., 1991). Thyroid function is hampered when there is chronic inadequate iodine in the blood streams, a condition which leads to elevated thyroid stimulating hormones (TSH) secretion. Prolonged TSH elevation leads to hypertrophy and hyperplasia of the thyroid cells causing increase in thyroid volumes.

In the past thyroid nodules were detected by endocrinologists with palpation. However, in recent times there has been increased use of diagnostic ultrasound imaging equipment and hence increase detection rates of thyroid pathologies. In particular, detection rates as high as 67% among adult population (Wang and Crapo, 1997). Therefore thyroid sonography is capable of finding out whether the thyroid is of normal size or enlarged. It can also show whether the pathology present invades adjacent structures or it is confined to the gland. It further tells whether the pathology is benign, probably benign or suspicious sonographic features (Berghout et al., 1987).

1.2 PROBLEM STATEMENT

Globally, iodine deficiency disorders (IDDs) is a public health challenge. Although a study has been done by Amoah et al., (2004) on the feasibility of thyroid ultrasonography in Ghana, it was limited to children aged 10-15 years from two districts in Greater Accra region and data on adult population was missing. This study was therefore intended to fill that age gap of information on thyroid pathology in Ghana. Anecdotal evidence suggests that clinical diagnosis of thyroid pathologies at the study site had been limited to palpation which is only preliminary and inconclusive. No evidence regarding the application or use of radiodiagnostic (CT) and other non-ionizing radiation (MRI) and non-invasive (US) imaging modalities for diagnosis of thyroid pathologies had also been recorded in Ho distrct. This work is arguably the first of its kind in the utilization of ultrasonography in detecting thyroid pathology.

Anecdotal report suggests that the Ho district of the Volta region of Ghana is an iodine deficient area and thus is prone to presenting the above-mentioned diseases and health challenges to persons residing in the district. Available data at Ho Municipal Health Directorate, Nutrition Division showed that only 42% of the people consume iodated salt of counts within acceptable limit (HMHD, 2014).

Radiographically, thyroid pathology or nodules of various patterns can be detected via imaging modalities including computed tomography (CT), magnetic resonance imaging (MRI), nuclear medicine, and medical ultrasonography. Ultrasound was chosen because it was relatively cheaper and easy to use. This study was therefore established to employ the use medical ultrasonography imaging modality to detect the presence of thyroid pathology in health workers at the district using Volta Regional Hospital staff as a reference study site and consequently determine the prevalence of the medical conditions. The hospital was chosen for convenience. It is the largest hospital in the region with a modern ultrasound imaging equipment.

1.3 SIGNIFICANCE OF STUDY

According to Hetzel and Dunn et al., (1989), such persons living in iodine deficiency areas may suffer diseases such as goiter, mental defects, still births, miscarriages and muscle paralysis. Diagnostically, thyroid pathology is commonly missed by endocrinologists by the use of palpation and this has resulted in the majority of them being detected only at autopsy. According to (Dean and Gharib, 2008) 8% to 35% was recorded in autopsy studies

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The study is therefore significant in providing sonographic diagnosis of thyroid pathology at the study site. It will further enhance understanding and application of ultrasonography which is more conclusive in detection of thyroid pathology than palpation. The inclusion of ultrasonography in detection of thyroid pathology will further broaden the awareness of prevalence of thyroid pathology among health workers at the Volta Regional Hospital. Significantly, the expected increase in awareness and access to a more conclusive and reliable diagnostic method of detecting thyroid pathology could be enhanced.

It was expected that the outcome of the study could provide professional and technical advice to the stakeholders for purposes of implementing technical decisions and policies to mitigate the prevalence and incidence of thyroid pathology. This will be significant in alleviating the suffering of the people.

Finally, this research work is significant as its outcomes will help in public education on the prevalence of thyroid pathology among asymptomatic humans.

1.4 HYPOTHESIS

There is no thyroid pathology among asymptomatic health workers.

1.5 AIM

The aim of this study was to sonographically determine the prevalence of thyroid pathology among the asyptomatic health workers of the hospital.

1.6 SPECIFIC OBJECTIVES

The specific objectives identified in achieving the aim of this study include:

1. determination of the proportion or the percentage of the asymptomatic health workers presenting with thyroid pathologies unaware.
2. Classification of the detected pathologies into benign, undeterminate and suspicious thyroid pathologies based on their sonographic features.
3. determination of the mean thyroid volume among the asymptomatic health workers in order to compare it with World Health Organization/International Council for the control of Iodine Deficiency Disorders (WHO)/ICCIDD adult reference level.

1.7 RESEARCH QUESTIONS

The research questions posed for this study were as follows:

- What proportion of the study population could be presenting with thyroid nodules?
- What kinds of nodules were detected?
- Were the thyroid volumes measured below or above the normal thyroid volume?
- What was the gender-based distribution of pathology?

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This Chapter reviews relevant literature related to this research study. The key areas include thyroid gland anatomy, epidemiology of thyroid pathology, prevalence of thyroid pathology, benignity and malignancy of thyroid pathology.

2.2 THYROID GLAND ANATOMY

The thyroid gland consists of the right lobe, the right lobe and a connecting isthmus as shown in Fig 2.1 below.

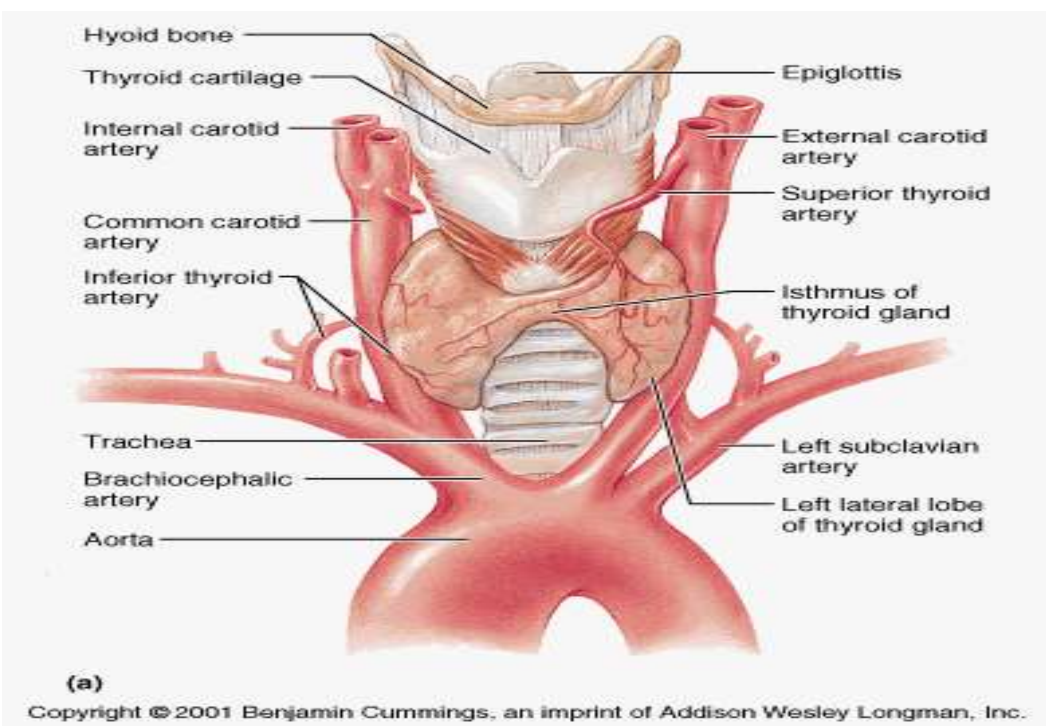

Fig. 2.1: Thyroid gland Anatomy. Source: Study Blue.

According to Bliss et al., (2000), both lateromedial and anteroposterial dimensions of the lobes range between 20-30mm and the craniocaudal is about 50mm. Bliss et al.,(2000) further stated that both the transverse and vertical dimensions are about 1.25mm. A B-mode sonogram showing the sonographic anatomy of the thyroid gland is presented in Fig. 1.2.

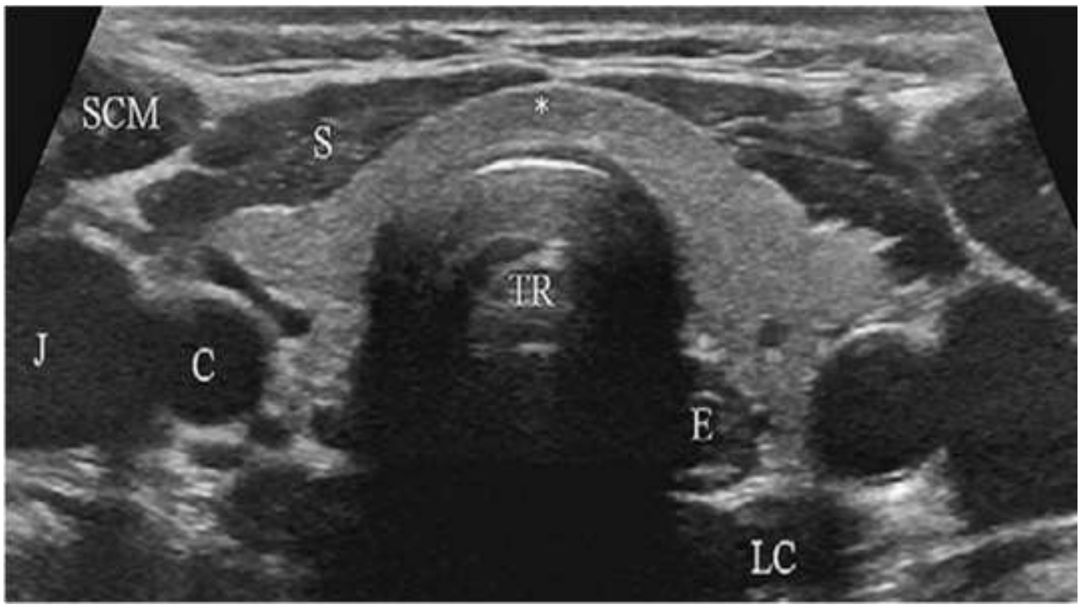

Fig. 2.2: Sonographic Anatomy of the thyroid gland showing adjacent structures

Source: Study Blue

KEY: *= Thyroid gland, C= Commom carotic artery, TR= Trachea, E= Oesophagus,

J= Jugular vein, SCM= Sternocledomastoid muscle, S= Sternothyroid muscle

LC= Longus colli muscle,

2.3 EPIDEMIOLOGY OF THYROID PATHOLOGY

Thyroid pathology is any abnormality that results in thyroid disorders. In general, the term thyroid disorder represents several different diseases involving thyroid hormones and the thyroid gland. Thyroid disorders are usually categorized as hyperthyroidism and hypothyroidism, according to the increase or decrease of the serum thyroid hormone levels (T_4 and T_3) respectively. Thyroid pathology includes benign and malignant medical conditions. The benign conditions include benign nodular goiter, chronic lymphocytic thyroiditis, simple or haemorrhagic cysts, follicular adenomas, anaplastic and subacute thyroiditis. The malignant thyroid pathologies consist of papillar, follicular, hürthle-cell, medullary and poorly differentiated carcinomas. Others include primary thyroid lymphoma, sarcoma, teratoma, and miscellaneous tumors (Gharib et al., 2010).

Iodine is very important for normal thyroid function. In particular, upon entry into the follicular cells in the form of inorganic iodide, and via a series of metabolic mechanisms, it is converted into thyroid hormones, thyroxine (T_4) and triiodothyronine (T_3). This process includes active iodine transport, iodination of tyrosyl residue of thyroglobuline (Tg), coupling of iodotyrosine molecules to form T_3 and T_4, proteolysis of Tg, with the release of free iodotyrosines and iodothyronines, deiodination of iodotyrosines and reuse of liberated iodide, and deiodination T_4 to T_3 (Solter et al., 1991). Chronic inadequacy of iodine in the blood streams is a condition that hampers thyroid function, leading to elevated thyroid stimulating hormones (TSH) secretion. Prolonged TSH elevation leads to hypertrophy and hyperplasia of the thyroid cells causing increase in thyroid volumes. Physiologically, thyroid pathology therefore results from hormonal imbalance.

Thyroid pathologies are common findings in recent years due to increasing use of modern ultrasound equipment (Yeung and Serpell, 2008). Family history has been known to account for thyroid neoplasm which has a well- documented association for medullary thyroid cancer (Halac and Zimmerman, 2005). Hashimoto's thyroiditis (HT) is frequently and especially diagnosed in females and is the most common cause of hypothyroidism in iodine-sufficient areas of the world, with an increasing prevalence in older patients (Hollowell et al., 2002).

It is known that apart from iodine deficiency which causes thyroid pathology, consumption of cyanogenic plants such as cassava leaves accounts for persistence of goiter in Ghana after many years of salt iodization (Marwaha, 2003, Opoku-Nkoom, 2013).

2.3.1 Prevalence of Thyroid Pathology

Prevalence studies that measure the morbodity based on existing pathology or a condition in a given population, estimated either at a particular time, (point prevalence) or over a stated period (period prevalence). Prevalence studies can be viewed as a snap shot at the population at a point in time (Gordis, 2000).

Prevalence of thyroid abnormalities reported by Knudsen et al., (2000) in Denmark was 30%. According to Knudsen et al., (2000) thyroid pathology increases with age within the age group of 40-45years. Thyroid enlargement was 15% in the region of mild iodine deficiency and 22.6% in a moderate iodine deficient region. Prevalence of thyroid nodules in United State of America was 30 to 50% (Mazzaferri, 1993). According to Davies and Welch, (2002) while reported cases of head and neck cancers were on decline, thyroid cancer in particular was on the increase due to increase detection rates, majority of which were papillary carcinpomas. The rate increased from 3.6 per 100,000 in 1973 to 8.7 per 100,000 in 2002. However, mortality from thyroid cancer remained constant from 1973 to 2002 was about 0.5 deaths per 100,000.

Thyroid pathology could be 4% to 8% in adult population by palpation and was from 13% to 67% by ultrasonography (Wang and Crapo, 1997). Also in Dean and Gharib, (2008) as high as

8% to 65% has been reported. It has also been recorded that prevalence of thyroid nodules increases with age (Mazzaferi, 1992, Kuma et al., 1992). Thyroid pathology is of higher prevalence rate in females than in males (Ojule et al., 1998). In particular, as high as 72% in women and 41% in men among asymptomatic North American subjects (Ezzat et al., 1994). Prevalence of cancer was recorded as high as 7.7% in a study conducted by (Papini et al., 2002). With emergence of high resolution modern ultrasound equipment the detection rates of thyroid nodules is on the increase, 76% prevalence recorded by (Ferraz et al.,2011).

Iodine deficiency disorders (IDD) which top the list of thyroid disorders and remain the commonest cause of thyroid disorders in the continent is often affected not only by the iodine status in the region but sometimes also by selenium deficiency and thiocyanate toxicity (Ogbera and Kuku 2011) . There exist on the continent prevalence rates of endemic goiter ranging from 1% to 90% depending on the area of study. Although Ghana started iodine supplementation on large scales in 1996, well over a decade now, cannot be considered the end of thyroid pathology in Ghana (Dakubo et al., (2013). They further stated that Ghana is yet to have its fullest impact on thyroid diseases. Large goiters which caused pressure effects were still reported. A study conducted by Pearce et al., (2013) on effects of long-term use of iodine water filters among American Peace Corps volunteers in Niger, West Africa in 1998 revealed 44% rates of goiter.

According to Dailey et al., (1955) it has been established that there is association between Hashimoto's thyroiditis a benign condition, and differentiated thyroid cancer (DTC). Several studies have confirmed the co-existence of Hashimoto's thyroiditis. In particular, Mazokopakis et al., (2010) analysed 140 patients retrospectively and found significant association between the presence of HT and papillary thyroid cancer (PTC). Similarly, results of Fiore et al., (2011) also found a significant association between Hashimoto's thyroiditis and papillary thyroid carcinoma. Risk for malignancy predictive sonogragraphic features associated with Hashimoto thyroiditis include all-solid consistency, hypoechogenicity and microcalcifications (Zosin and Balas, 2013). Zosin and Balas et al, (2013) further established that features of the margins, the shape of the nodule and the type of vascularity shown on colour Doppler are all not useful in identifying malignancy in Hashimoto's thyroiditis. Nodule prevalence in adult population is about 2% to 6% by means of palpation, 19% to 35% by ultrasound (US) and from 8% to 35% in postmortem (Dean and Gharib, 2008).

Prevalence rates of endemic goiter in africa range from 1% to 90% depending on the area of study with myxedematous cretinism still a prominent feature of IDD in only a few regions of the continent (Ogbera and Kuku 2011).

2.4 THYROID NODULES

According to Vandermeer and Wong-You-Cheong, (2007), a thyroid nodule is a distinct focal lesion having different echogenicity from the thyroid parenchyma. The lesion is sonographically distinct from the surrounding thyroid parenchyma, and are manifestations of a gamut of thyroid diseases appearing as a nodule, other than being a solitary or single disease (Papini et al., 2004; Bonavita et al., 2009). Published articles of several studies have showed that thyroid nodules are common findings in recent years due to increasing use of modern ultrasound equipment (Yeung and Serpell, 2008). Most of the thyroid nodules are benign and only 3% to 7% are malignant (Brander et al., 2000, Jemal et al., 2005). The findings from Oertel et al., (2007) also support the fact that majority of thyroid nodules are benign.

According to Mu et al., (1987), increased serum thyrotropin hormone (TSH) was associated with increasing thyroid volume. By World Health Organization (WHO) standards, a geographical region is considered endemic of iodine deficiency if more than 5% the population have goitre or thyroid enlargement, as expressed by Abd El Naser Yamamah et al., (2013).

2.4.1 Thyroid Nodule Size

There is a debate on the size of thyroid nodules which need to be suspected for biopsy. The controversy regarding asymptomatic thyroid nodules and the subjection of biopsy study or not is on-going Mazzaferri et al., (1988). In particular, while some reports suggest that nodules less than 10mm should be left alone. Giuffrida and Gharib (1995) reported that malignancy occurs at nodules of all sizes. According to Leenhardt et al., (1999), about 5.4% of prevalence of malignancy has been recorded.

2.4.2 Benign Thyroid Nodules

In an attempt to accurately identify benign thyroid nodules, Bonavita et al, (2009) studied all the benign features of thyroid nodules and grouped them into four with specific morphologies indicative of benignity, namely,

i. Spongiform configuration without hypervascularity,

ii. Cyst with colloid clot,

iii. Giraffe pattern,

iv. Diffused hyperechogenicity

All of these had a100% benignity out of 10 discrete recognizable morphologic patterns. In a research conducted by Reading et al., (2005). Samples of sonograms of benign sonographic features, thyroid nodule predominantly cystic with eccentric colloid features, B-mode sonogram of a thyroid nodule with a giraffe pattern typical of Hashimoto's thyroiditis, and nodular goiter with benign features as shown are illustrated in Figs. 2.3- 2.7.

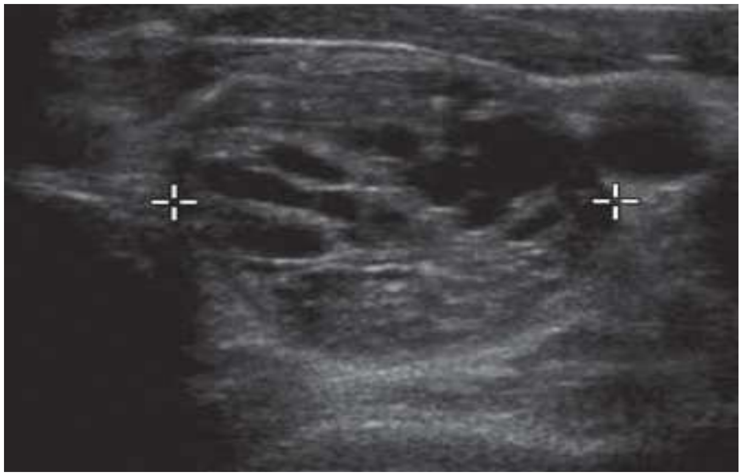

Fig. 2.3: Sonogram of colloid nodule with spongiform configuration suggestive of benignity

Fig. 2.4: Sonogram of predominatly cystic colloid nodule with benign features

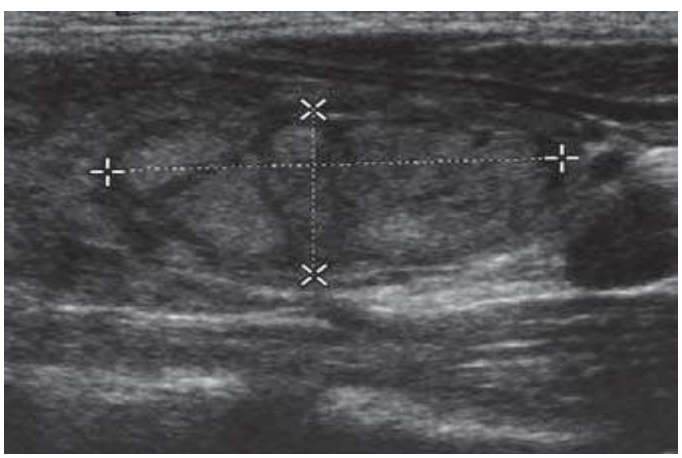

Fig. 2.5: Benign features of heterogeneous echogenicity like giraffe hide, wider-than-tall

Fig. 2.6: A hyperechoic solid thyroid nodule suggestive of benignity

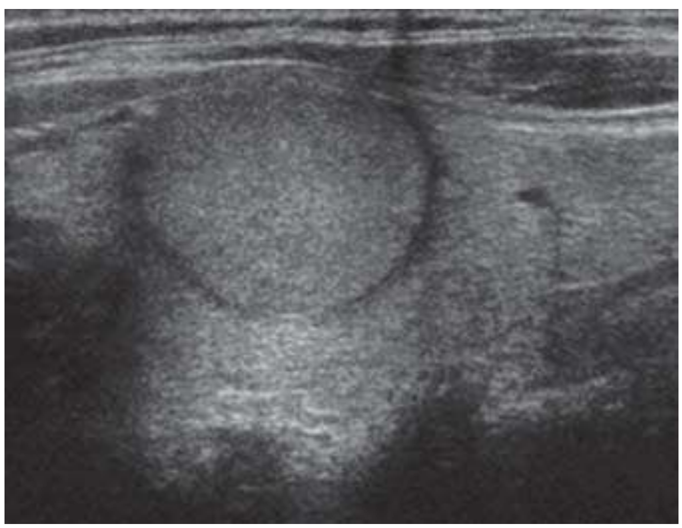

Fig. 2.7: A nodular goiter, showing isoechogenicity with a well-defined halo

2.4.3 Malignant Thyroid Nodules

In attempting to correlate sonographic features with cytologic results in detection of malignancy among thyroid pathologies, it was observed that 9.2% occurred in solitary nodules, 6.3% occurred in multinodular goiter and a total prevalence of 7.7% malignancy was recorded (Papini et al., 2002), while Kamran et al., (2013) reported 13% malignancy in their studies. Further to that, Kamran et al., (2013) noted that nodule size influenced cancer risk in a nonlinear fashion. Also in Frates et al., (2005), it was reported that solidity of nodules in itself is not a suspicious sonographic feature. However, FNA is recommended whenever a solid nodule size exceeds 10mm or whenever a partly cystic and partly solid nodule exceeds 15 mm.

Belfiore et al., (1992) evaluated the frequency of cancer among patients with cold thyroid nodules and reported 4.6% overall cancer rate. They further indicated thyroid cancer prevalence among multiple nodules was not significantly different from solitary nodules. According to Davies and Welch (2006), at the time USA was recording a decline in head and neck cancers, thyroid cancer was on the increase. Although incidence rate of thyroid malignancy is low, according to Mazzaferri et al., (1992), as high as 8% to 17% malignancy was recorded among surgically excised thyroid nodules and 6.6% out of 300 recorded by Bisi et al., (1989).

According to Adedapo et al., (2012) the commonest type of thyroid malignancy in Africa was papillary thyroid cancer (51.8%), while follicular cancer accounted for 41.1%. Medullary and Anaplastic thyroid cancers were the least common.

2.5 CHARACTERIZATION OF THYROID PATHOLOGY

In the past thyroid nodules were detected by endocrinologists with palpation. However, in recent times there has been increased use of several diagnostic imaging modalities including ultrasonography, although FNA remains the ultimate diagnostic tool. The literature suggest that diagnostic accuracy of FNA is enhanced with ultrasound guidance (Carmeci et al., 1998). The inclusion of ultrasonography has resulted in increased detection rates of thyroid pathologies. In particular, detection rates as high as 67% among adult population (Wang and Crapo, 1997). Therefore thyroid sonography is capable of identifying whether the thyroid is of normal size or enlarged. It can also show whether the pathology present invades adjacent structures or it is confined to the gland. It further tells whether the pathology is benign, probably benign or suspicious sonographic features (Berghout et al., 1987). According to the American Institute of Ultrasound in Medicine, an indication of thyroid ultrasound is evaluation of the thyroid gland for suspicious thyroid nodules before neck surgery for non-thyroid diseases (Arciero et al., 2012).

Thyroid nodules are characterized using sonographic features of their shapes, size, margins, echogenicity, calcifications and vascularity and then classified into benign, probably benign, probably malignant and malignant using TI-RADS (Russ et al., 2013).

2.5.1 Malignant Sonographic Features of Thyroid Pathology

There are several sonographic features that suggest malignancy some with higher specificity than others. According to Kim et al., (2002) the following patterns strongly suggest malignancy:

i. a hypoechoic nodule with microcalcifications
ii. coarse calcifications in a hypoechoic nodules, without comet tail effect
iii. well-marginated, ovoid, solid nodules with a thin hypoechoic halo
iv. a solid mass with refractive shadowing from edges.

while the presence of any of the following sonographic features in a thyroid pathology justifies it to be suspected for malignancy;

1. microcalcifications
2. irregular or microlobulated margins
3. taller than wide

In a study conducted by Corrias and Mussa, (2013) although sonographic features are not absolute in determining malignancy and benignity, features such as hypoechogenicity, microcalcifications and intranodular hypervascularity strongly suggest malignancy and hence FNA cytology must be done as early as possible. Also in Moon et al., (2008) malignant sonographic features include

1. taller-than-wide shape, having sensitivity of 40% and specificity of 91.4%
2. jagged or speculated margins having 48.3% sensitivity and 91.8% specificity
3. marked hypoechogenicity (41.4% sensitivity, 92.2% specificity)
4. microcalcifications having 44.2% sensitivity and 90.8% specificity
5. macrocalcifications 9.7% sensitivity and 96.1% specificity

Further to that, they also observed that ultrasound findings suggestive of benignity were isoechogenicity and spongiform configuration. By this, 49 cases of malignancy out of 155 non-palpable nodules in 132 patients were detected. In order to establish sonographic features suggestive of malignancy Papini et al, (2002) confirmed specificities of 95% for microcalcifications, 85% for irregular margins and 80.8% for intranodular vascularity. Papini et al., (2002) further established that an appearance or the presence of a solitary lesion were not independent risk factors for malignancy in non-palpable thyroid nodules. In order to come out with common sonographic features associated with papillary thyroid carcinoma, Chan et al., (2003) established that sonographic features common to all the known papillary carcinomas are predominantly cystic, poorly defined margins. According to Corrias and Mussa, (2013) hypoechogenicity, midfcrocalcifications, specific lymph node adenopathy and increased internal nodular vascularity are all indicative of malignancy. Papini et al, (2002), reported that a treatment strategy of selecting nodules for FNA based only on a size threshold of 1cm is not as efficient as one taking the most common sonographic features of thyroid carcinoma into account. However, some report suggest that nodules with sizes from 2cm and above needs to be suspected for malignancy (Kamran et al., 2013). In Frates et al., (2005), the value of Colour Doppler flow patterns in predicting malignancy is an important indicator. They found that solid hypervascular thyroid nodules were more likely to be malignant than partially cystic or non-hypervascular nodules.

However, in accordance with studies conducted by Moon et al., (2010) vascularity was not as useful as the use of suspicious grey-scale sonographic features alone for determining thyroid malignancy sonographically. Also Moifo et al., (2013) noted while determining the reliability of Russ' modified TI-RADS, that sonographic features associated with high risk of malignancy were irregular contour, taller-than-wide shape, microcalcifications, and marked hypoechogenicity. Examples of sonograms showing features of malignant thyroid nodules are shown in Fig. 2.8. Both sonograms are hypoechoic nodules, taller-than-wide, irregular margins and with microcalcifications.

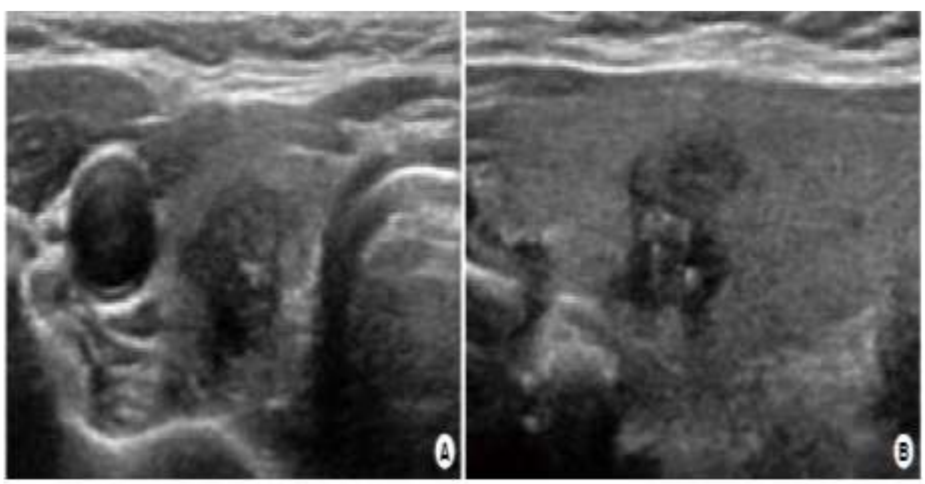

Fig. 2.8: Sonographic features of thyroid malignancy. Source: (Kwak et al., 2011)

Hypoechogenicity is a well known sonographic feature of thyroid malignancy (Kim et al., 2002, Kim et al., 2013, Brauer et al., 2005). Hypoechogenicity has 41.4% sensitivity, 92.2% specificity (Moon et al., 2008), and is considered as a suspicious sonographic feature (Gharib et al.) American Thyroid Association (ATA), American Association of Clinical Endocrinologists and Associazione Medici Endocrinology (AACE/AME) and Korean Society of Thyroid Radiology (KSThR) all accept hypoechogenicity as a suspicious sonographic feature (Kwak et al., 2013, Cooper et al., 2009).

According to Kwak et al., (2013) both microcalcifications and macrocalcifications are indicative of malignancy. However, American Thyroid Association considers microcalcifications defined as a prominent echogenic focus with or without comet-tail effect as very suspicious of thyroid malignancy (Frates et al., 2005, Cooper, 2006, Kwak et al., 2011, Kwak et al., 2013).

Hypervascularity otherwise known as chaotic vascularity was reported in some studies as indicative of malignancy (Cooper et al., 2009, Gharib et al., Frates et al., 2005). However, other studies such as Moon et al., (2010), and Kwak et al., (2013) reported that vascularity is not to be considered a definite sign for malignancy.

Spiculated or jagged margin is most sensitive and most specific for malignancy (Moon et al., 2008, Park et al., 2012, Park et al., 2010, Choi et al., 2010). Others such as ill-defined and microlobulated margins are also suspicious sonographic features of malignancy (Park et al., 2009b). According to Moon et al., (2011), Kim et al., (2002) and Gharib et al., (2010) a taller-than-wide shape has been reported as being a suspicious sonographic feature of thyroid nodules indicative of malignancy. However, contrary to earlier held notion that taller-than-wide shape should on either transverse or longitudinal scan is indicative of malignancy.

2.6 CLASSIFICATION OF PATHOLOGIES USING SONOGRAPHIC FEATURES

According to Kim et al., (2012) classification of pathologies with partially cystic nodules into benignancy and malignancy, must be considered differently from those which are entirely solid. Accordingly, partially cystic nodules which have more than three ultrasound features of benignancy and no feature of malignancy should be classified as benign pathology while those with one or two malignant sonographic features should be classified as probably benign. Partially cystic nodules having one malignant sonographic feature was considered probably malignant regardless of the presence of other benign features. Any nodule with two or more malignant features could be considered malignant irrespective of the presence of any benign sonographic features. Similar criteria were used to classify solid nodules into same groups (Kim et al., 2012).

A sonogram showing the characterization and classification thyroid nodules is shown in Fig. 2.2. Figure 2.9(A) is a benign nodule partly cystic and partly solid whose characteristic sonographic features include oval shape, isoechogenicity, smooth marginated solid component, and centrally and eccentrally located cystic component. Figure 2.9(B) is a probably benign thyroid nodule with characteristic sonographic features of eccentric configuration, blunt angle between the solid and cystic component (arrows) and the isoechoic component being smooth marginated. Figure 2.9(C) is a probably malignant nodule with suspicious malignant features such as eccentric configuration having acute angles between solid and cystic component, with microlobulated margin. Figure 2.9(D) is a malignant nodule showing eccentric configuration with acute angle between cystic and solid part components (arrows) and some microcalcifications in the solid component typical sonographic feature of papillary thyroid carcinoma (Kim et al., 2012).

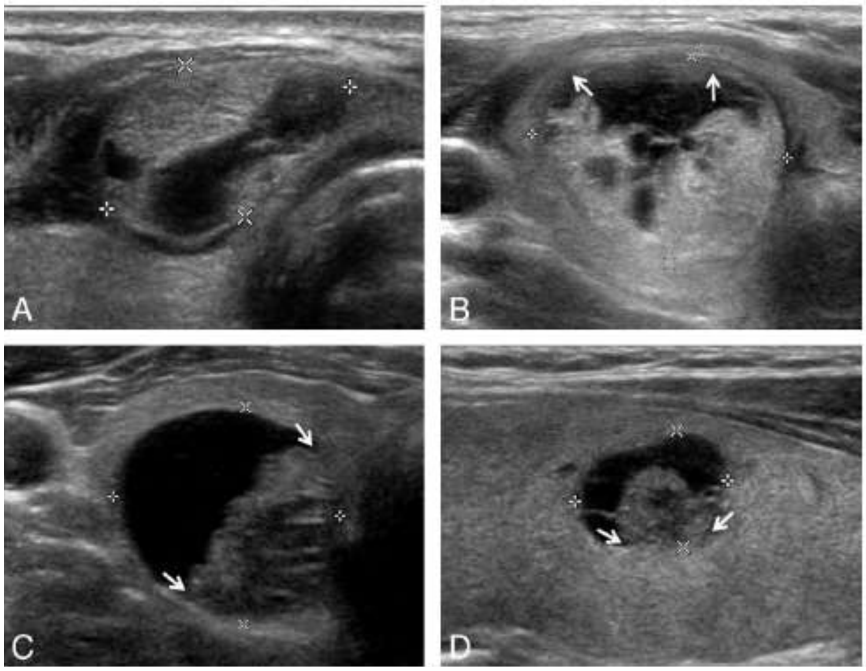

Fig. 2.9: Characterization and classification thyroid nodules

Illustrated below are sonographs of solid thyroid nodules showing various degrees of benignity and malignancy Fig : 2.10.

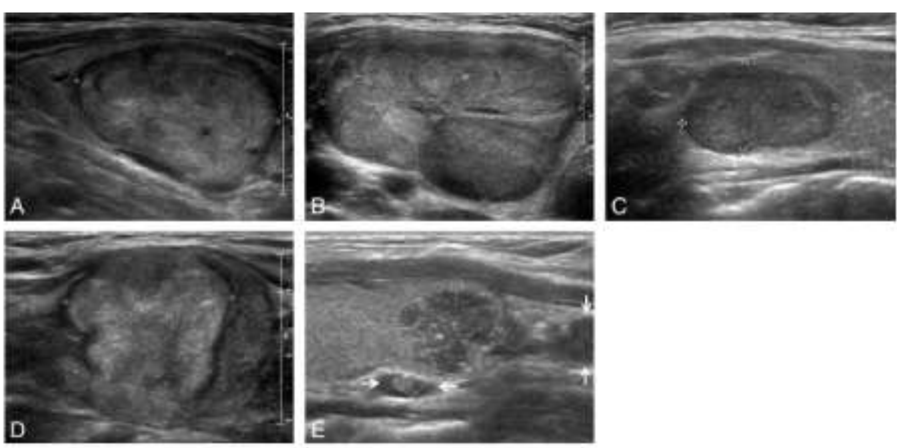

Fig. 2.10:Sonographic patterns of various degrees of benignity and malignancy in solid thyroid nodules

A. Benign solid nodules; ovoid shape, wider-than-tall, isoechogenic and smooth margins, typical of nodular hyperplasia. **B.** Probably benign nodules; ovoid shape, inhomogenously isoechoic, and macrolobulated margins (trabecular variant of follicular adenoma). **C.** Indeterminate nodules; hypoechogenicity, smooth margin, and an ovoid shape, (oncocytic variant of follicular adenoma). **D.** Possibly Malignant nodule; isoechogenicity, macrolobulated margins, and taller-than-wide shape (follicular variant of papillary thyroid carcinoma. **E.** Malignant nodules; rounded shape, marked hypoechogenicity, microlobulated margins, microcalcifications (classical features of papillary thyroid carcinoma) (Kim et al, 2012)

2.6.1 Thyroid Imaging Reporting and Data System (TI-RADS)

Thyroid imaging reporting and data system (TI-RADS) started with the works of Horvath et al., (2009) and Park et al., (2009a) with the concern for standardizing thyroid ultrasound reports. Park et al., (2009a) derived an equation for predicting malignancy among thyroid nodules on the basis of 12 sonographic features. Horvath et al, (2009) intended to standardize ultrasound nodules characterization and reporting system and concluded that TI-RADS allowed for improved patient management and avoided unnecessary fine needle aspiration biopsy (FNAB). Their study also established standard codes to be used by sonographers, radiologists and endocrinologists in the course of their work. To evaluate the TI-RADS proposed by Horvath et al, Russ et al., (2013) studied a total of 4550 nodules with both grey scale and elastography ultrasound, out of which 3658 nodules were analyzed with gray-scale ultrasound score only, and 991 nodules analyzed with ultrasound elastography only, and compared the results with histology reports. The sensitivity of the TIRADS gray-scale score were 93.2% and 95.1% compared to histopathological reports and the total number of carcinomas respectively, whereas the sensitivity of elastography alone was 41.9%. The TIRADS reliability was proved by Moifo et al., (2013) in a cross-sectional study on risk of malignancy in focal thyroid nodules (Table 2.1) and concluded that Russ' modified TIRADS classification was reliable in predicting thyroid malignancy.

Table 2.1: TI-RADS classification

Classification	Indications
TI-RADS-1	Normal thyroids having no nodules
TI-RADS-2	Benign nodules with simple cysts, spongiform nodules, "white night" aspect, isolated macrocalcifications, and a typical sabacute thyroiditis
TI-RADS-3	Probably benign nodules such as isoechogenicity and hyperechogenicity
TI-RADS-4A	Low suspicious thyroid nodules of moderately hypoechogenicity (where moderately hypoechogenicity is defined as echogenicity higher than the surrounding thyroid parenchyma but less than strap muscles)
TI-RADS-4B	High suspicious nodules, taller-than-wide shape, irregular or microlobulated margins, microcalcifitions, and marked hypoechogenicity
TIRADS-5	Presence of three or more of the malignat sonographic features of TI-RADS-4B

2.7 THYROID VOLUME

Thyroid volume detection by palpation is inaccurate (Zimmermann et al., 2004). Sonographic measurement of the thyroid volume is widely used in radioiodine therapy dosing because it is widely available, affordable and easy to operate (Lyshchik et al., 2004). Clinically, this is done by the ellipsoid formula of Brunn et al., (1981) by which the accuracy of the thyroid volume determined using measurement of the anteropostrial, mediolateral and the craniocaudal dimensions. A summary of previous thyroid volume studies covered in the literature review are shown in Table 2.2 below.

Table 2.2: Mean thyroid volumes reported by previous studies.

Study	Mean Thyroid Volume	Country
Yousef et al., 2011	6.44 ± 2.44	Sudan
Adibi et al., 2008	9.53 ± 3.68	Iran
Ahidjo et al., 2006	8.55 ± 1.83	Nigeria
Ivanac et al., 2004	10.68 ± 2.83	Croatia
Chanoine et al., 1991	11.60 ± 4.40	Belgiun
Gutekunst et al., (1988)	18.00 (females), 25.00 (males)	WHO/ICCIDD

Most studies agree that right thyroid volume is larger than the left lobe volume and Ahidjo et al., (2006) in particular reported values of right lobe volume significantly larger than the left lobes. The study further stated that thyroid volumes are generally larger in males than in females. This finding was consistent with the report of Yousef et al.,(2011), that right thyroid lobes were generally larger than the left for both gender. Yousef et al., (2011) also reported that total thyroid volumes were generally larger in males than in females. Ivanac et al., (2004) included the isthmus in their measurement of the thyroid volume using 2D-ultrasound and reported a minimum value of 0.45mls and the maximum value of 2.34mls for thyroid volume, 1.01 ± 0.31mls as mean isthmus volume.

In attempting to compare the accuracy of planar scintigraphy (PS), single positron emission computed tomography (SPECT), and ultrasonography with MRI as the gold standard, van Isselt et al., (2003) concluded that ultrasonography is the most accurate modality if correction is made for bias. However, a study conducted by Trimboli et al., (2008) showed that ultrasonography underestimates thyroid volumes. Ng et al., (2004) stated that 3-D ultrasonographic measurements of thyroid volume are accurate and reliable with mean 12.78 ± 2.483 mls. Sheikh et al., (2004) showed that thyroid volumes could be calculated by measuring the volumes of each lobe. The volume (*V*) of each lobe was calculated as follows:

$$V = \frac{\pi}{6} CLA = 0.523 CLA \qquad 2.1$$

where *C*= craniocaudal dimension (length), *L*= lateromedial dimension (width)

A= anteroposterior dimension (thickness), (Brunn et al., 1981)

0.523=π/6 (established by Vitti et al., (1994)).

In particular, only the lateromedial dimension of the thyroid correlates with the thyroid volume. They further established that thyroid volume can be predicted by simply measuring the lateromedial dimension and substituting the value in Eqn. (2.2)

$$VOL = 13 \times LM - 15 \qquad 2.2$$

where *LM* = lateromedial dimension.

According to Bisi et al., (1989) the mean normal thyroid weight was 18.84g and ranged from 8g to 48g.

CHAPTER THREE

METHODOLOGY

3.1 INTRODUCTION

This Chapter deals with the measures, procedures and actions taken in order to comply with protocols and ethical issues regarded in ethical clearance. It also deals with techniques used in the actual ultrasound scanning such as sonographic positioning, scanning techniques, and equipment used.

3.2 PHILOSOPHY OF THE STUDY

The study was descriptive and sought to collect information on thyroid pathology among the asymptomatic health staff without manipulating the environment. Therefore, it was one time interaction with the study population.

3.3 STUDY DESIGN

A cross-sectional study was conducted in the month of May, 2014. Cross-sectional study was chosen because it was a prevalence study which was observational. The investigator observed prevalence of thyroid pathology without altering any condition of the individuals in the population. Case study was not used because there was no control group for the study population and would not be any follow up on the study population in this current study.

3.4 STUDY SITE

The study was conducted at Radiology Department of the Volta Regional Hospital, Ho. Volta Regional hospital was chosen for convenience. It a center of excellence away from the national capital equipped with modern ultrasound equipment having all categories of health workers. The center is located in a region which has mild to severe iodine deficiency.

3.5 STUDY POPULATION

Participants of the study were the permanent staff of the Hospital. This includes medical officers, nurses, allied health professionals, orderlies, pharmacists and accountants, health services administrators, mortuary - attendants and securities men, who were classified as others.

3.6 SAMPLING TECHNIQUE

Convenient sampling method was used as the investigator was sitting in the sonography room and accepted any participant who voluntarily presented for the study.

3.6.1 Sample Size

The sample size (*N*) was determined via the equation

$$N = \frac{Z^2 pq}{E^2} \qquad 3.1$$

where p = population proportion (=0.5 for unknown prevalence)

q= sample proportion (=0.5 for unknown prevalence)

Z= 1.96 (for two-tail test)

E= allowable error

Assuming a 10% allowable error, and unknown prevalence, Eq. (3.1) yields a sample size of

$$N = \frac{Z^2 pq}{E^2} = \frac{(1.96)^2 (0.5)(0.5)}{(0.1)^2} = 96 \approx 100$$

For purposes of better statistics the sample size was increased to 100

3.7 INCLUSION AND EXCLUSION CRITERIA

3.7.1 Inclusion Criteria

Permanent staff of the Volta Regional Hospital contacted who had no known clinical history of thyroid disorders are qualified to participate in the study.

3.7.2 Exclusion Criteria

Students undergoing clinical rotation and internship were excluded. Staff who were pregnant and those who were in their menstrual cycle were excluded because thyroid volumes are affected by menstrual cycle and pregnancy. According to Nelson et al., (1987) and Rasmussen et al., (1989) thyroid volume in women increase during pregnancy and become normal about a year after delivery.

3.8 MATERIALS

Materials used included ultrasound equipment, bed, linens and towels, ultrasound gel, pillows, ultrasound thermal paper, data-sheets and pens.

3.8.1 Ultrasound Equipment Used

The equipment used in this study was Toshiba Medical Systems, ultrasound scanner, Applio 300, made in Japan, in 2012.The model number was TUS-A 300 with 7.5 MHz linear probe. The equipment was equipped with colour and power Doppler functions. Among the types of examinations the equipment was designed to perform is thyroid examination.

3.9 PROCEDURE FOR DATA COLLECTION

After the examination procedure was clearly explained to each participant, their consent to participate in the study, were then sought. Procedorally, each participant was positioned supine on a comfortable couch, with a pillow under the chest and shoulders, was the neck hyperflexed with head comfortably supported on a pad. A moderate a acoustic gel was spread on the anterior part of the neck in order to remove air- interphase. Each lobe was scanned by the investigator using ultrasound beam, first in the transverse plain to obtain the anteroposterior and then lateromedial dimensions. Longitudinal scans to obtain the craniocaudal dimensions were also made. Sonograms of the transverse, longitudinal and craniocaudal dimensions of the thyroid lobes and the isthmus in B-mode are illustrated in Figures 3.1 to 3.3.

A sonogram showing the method of taking anteroposterial and lateromedial measurements of thyroid lobes as in Fig. 3.1.

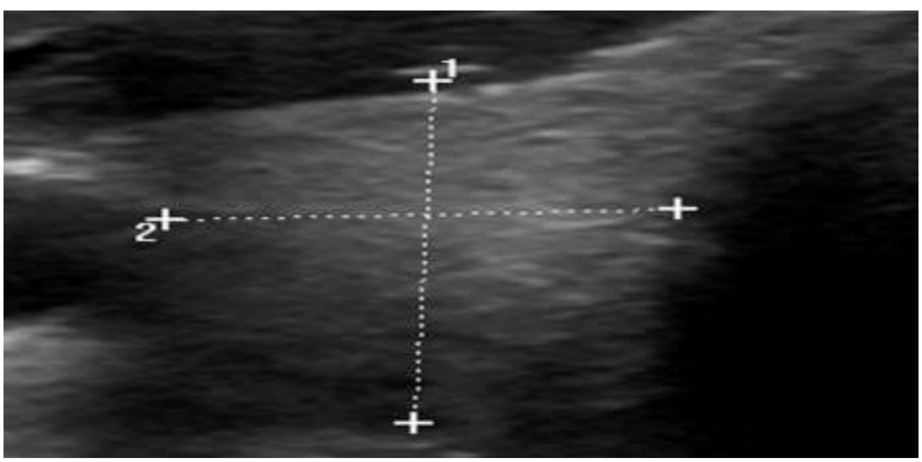

Fig. 3.1: Anteroposterial (caliper 1) and mediolateral (caliper 2) dimensions of the right lobe of a thyroid gland (Malago et al., 2008).

Below is a B-mode sonogram indicating placement of calipers for measuring craniocaudal dimension of the thyroid lobe.

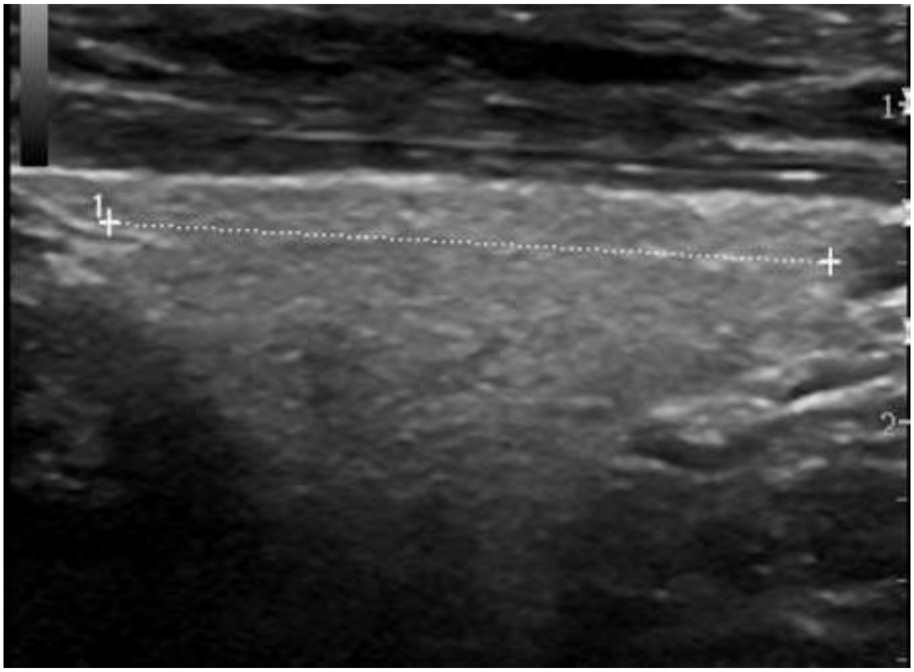

Figure 3.2: Longitudinal Scan sonogram showing measurement of the craniocaudal dimension (caliper 1) of the right lobe of a thyroid gland (Malago et al., 2008).

A B-mode sonogram showing anteroposterial and transverse measurement of the isthmus of the thyroid is shown in Fig. 3.3 below.

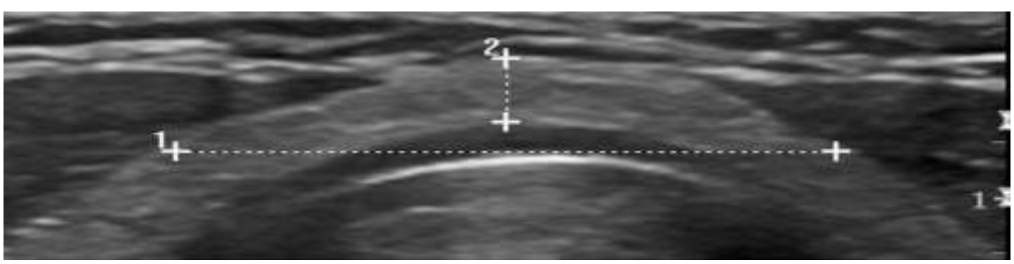

Fig.3.3:Transverse Scan, B-mode sonogram showing measurement of the transverse (calliper1) and anteroposterior (caliper 2) dimensions of the thyroid isthmus (Malago et al., 2008)

The total thyroid volume was calculated as the algebriac sum of right lobe, left lobe and the isthmus volumes. The lobe volumes were calculated using the lellipsoid model formula

$$V_l = V_l^R + V_l^L = \frac{\pi}{6}\left(d_l^R w_l^R l_l^R\right) + \frac{\pi}{6}\left(d_l^L w_l^L l_l^L\right) \qquad 3.2$$

where V_l^R, and V_l^L are the right and left lobe volumes, and d_l^R, d_l^L, w_l^R, w_l^L, and l_l^R l_l^L are the depths, widths and lengths of the right and left lobes respectively.

Similarly, the isthmus volume was also calculated using the following formula:

$$V_{isth} = \frac{\pi}{6}\left(d_{isth} w_{isth} l_{isth}\right) \qquad 3.3$$

Hence combing eqns. 3.2 and 3.3, the total thyroid volume can be expressed as

$$\begin{aligned} V_{th} &= V_l^R + V_l^L + V_{isth} = \frac{\pi}{6}\left(d_l^R w_l^R l_l^R\right) + \frac{\pi}{6}\left(d_l^L w_l^L l_l^L\right) + \frac{\pi}{6}\left(d_{isth} w_{isth} l_{isth}\right) \\ &= \frac{\pi}{6}\left\{\left(d_l^R w_l^R l_l^R\right) + \left(d_l^R w_l^L l_l^L\right) + \left(d_{isth} w_{isth} l_{isth}\right)\right\} \end{aligned} \qquad 3.4$$

Colour Doppler imaging was performed with a 5cm, 7.5MHz linear transducer with Toshiba ultrasound system, Aplio 300, (2012 MY) to obtain the data as in the Appendix III, the data collection sheet, validated by a practicing consultant radiologist. The volumes (*V*) of each lobe could also be calculated via Eqn.2.1.

3.10 DATA MANAGEMENT PLAN

All procedures were conducted with strict adherence to standard protocols. Cross checking of data entries to ensure accurate data capture for accurate analysis adhered to. Research participants were given codes for identification. Data collecting sheets were stored in safe cabinet. Electronic data is stored in a password protected database. Seminars were held at the

School of Allied Health Sciences. The outcome of the research will be disseminated to the University of Ghana, College of Health Sciences, Department of Radiography of the School of Allied Health Sciences. Presentation of this study was made at the College of Health Sciences Annual Scientific Conference and Department of Radiography. Articles of this study will be published in Scientific Journals. The study reports shall also be presented in various seminars and conferences

3.11 DATA ANALYSIS

Data obtained from the study was entered into the Statistical Package for Social Sciences (SPSS version 20.0). Data was summarized as frequencies, percentages, means and standard deviations. The independent t-test was used to compare means of thyroid volume at the left, right, and isthmus after checking for normality. The Pearsons correlation test was also used to determine the level of correlation among the various thyroid parts (left lobe, right lobe, and isthmus). The chi-square test was used for association between demographic characteristics (independent variables) and that of thyroid pathology (dependent variables). All tests were two-tail and a p-value less than 0.05 was interpreted as significant.

3.11.1 Reliability of Data

In order to ensure accuracy and reliability of data, the student took each measurement twice and recorded the average value for each data entry.

3.12 ETHICS

The study conformed to the guidelines for human experimentation in the Helsinki Declaration "Ethical Principles for Medical Research Involving Human Subjects" of 1964, revised in 2008. Ethical approval was obtained from the School of Allied Health Sciences Ethical and Protocol Review Committee before the commencement of the study, and permission was sought from the management of Volta Regional Hospital (study site) to perform the study there. Participation was strictly voluntary and participants were free to withdraw at any time from the study. All data were handled anonymously and all information kept confidential.

3.12.1 Standard Protocol Adopted for the Study

To prevent the re-occurrence of the history of medical abuse of human subjects, the study was carried out with the strict adherence to the following protocol guidelines:

1. Voluntary participation was read to each participant, explanation given and their consent obtained.
2. The researcher showed respect for participants and treated each of them as autonomous agents
3. Participants were given the right to choose to end participation in the research at any stage.
4. Their privacy was respected and their well-being protected.
5. Their integrity was safe guarded.
6. Participants were protected from mental, physical and emotional harm.

CHAPTER FOUR

RESULTS

4.1 INTRODUCTION

This Chapter presents the findings of the study in accordance with the stated objectives. The results were presented in the form of tables and graphs and summarized using frequencies, counts, means and standard deviation. Independent t-test was also used to compare the means of selected variables.

4.2 DEMOGRAPHICS

4.2.1 Professional Classification of participants

Several demographic indices were employed to describe the demographics of the participants. The age distribution and professional classification is presented in Table 4.1.

Table 4.1: Age and professional classification of participants

Age range	AHPs		Nurses		Pharmacists		Others		Total	
(yrs)	No.	%	No.	%	No.	%	No.	%	No.	%
21-25	0	0.000	1	1.000	0	0.000	2	2.000	3	3.000
26-30	3	2.000	9	9.000	0	0.000	1	1.000	13	13.000
31-35	0	0.000	2	2.000	0	0.000	6	6.000	8	8.000
36-40	3	3.000	8	8.000	0	0.000	12	12.000	23	23.000
41-45	1	1.000	3	3.000	0	0.000	7	7.000	11	11.000
46-50	0	0.000	4	4.000	0	0.000	10	10.000	14	14.000
51-55	0	0.000	3	3.000	2	2.000	12	12.000	17	17.000
56-60	0	0.000	7	7.000	1	1.000	3	3.000	11	11.000
∑	7	6.000	37	37.000	3	3.000	53	53.000	100	100.000

AHP = Allied Health Professionals

4.2.2 Age Distribution of Participants

The age range of the participants was 23-59 years with a mean of 42.07±10.02 (Table 4.2).

Table 4.2: Age distribution of participants

Age range	Frequency	Percentage
21-25	3	3
26-30	13	13
31-35	8	8
36-40	22	22
41-45	12	12
46-50	14	14
51-55	17	17
56-60	11	11
Total	100	100

The 25th and 75th percentiles were 35.3 years and of 51 years respectively.

4.2.3 Gender Distribution of Participants

The gender of participants was shown in Table 4.3 below.

Table 4.3 Gender Distribution of participants

	Gender	
Male	**Female**	**Total**
17 (17.0)	83 (83.0)	100 (100.0)

The study population included more females (*n*=83, 83%) than males (*n*=17, 17%).

4.3 THYROID PATHOLOGY

4.3.1 Prevalence of thyroid pathology

The prevalence of pathology was investigated using ultrasonography on the participants. The results as indicated in Table 4.4 showed a prevalence of 41% (*n*=41) while pathology was absent in 59% of them. The study showed that only 23.5% of the males and 44.6% of the females presented with pathology. Per the estimated *p*-value (p=0.108>0.05), the statistics established no association between gender and the presence of pathology.

Table 4.4: Distribution of Thyroid pathology among gender

Gender	Prevalence of Pathology							
	Present		Absent		Total		χ^2	*p*-value
	No.	%	No.	%	No.	%		
Males	4	23.500	13	76.600	17	100.000		
Females	37	44.600	46	55.400	83	100.000	2.564	0.108
Total	41	41.000	59	50.000	100	100.000		

4.3.2 Characterization and Classification of Thyroid Pathologies among Participants

The thyroid pathologies diagnosed with ultrasonography were characterized and classified based on thyroid imaging reporting and data system (TIRADS) into benign, undeterminate and suspicious pathologies (Table 4.4). More than half of the participants (*n*=59, 59%) were normal while 49% presented with pathology of which the most prevalent were benign (28%) as shown in Table 4.5.

Table 4.5: Characterization and classification of thyroid pathologies

TI-RADS	Sonographic features	Interpretation	No.	Percent
TI-RADS-1	Normal thyroid, no nodule seen	Normal	59	59
TI-RADS-2	Entirely cystic nodules, Calcifications with comet-tail effect Colour Doppler shows no vascularity, spongiform configuration without vascularity, wider-than-tall shape, smooth margins, Isoechogenicity	Benign	28	28
TI-RADS-3	All solid consistency, homogenously hyperechoic, well-defined halo	Undeterminate	9	9
TI-RADS-4	Hypoechogenicity with microcalcifications Calcifications without comet-tail effect Solid mass with refractive edge shadowing Taller-than-wide shape	Suspicious	4	4
Total			100	100

4.3.3 Comparison of thyroid volumes among gender

The volumes of the left, right and isthmus of the thyroid were estimated to determine the net thyroid volumes of the participants. The statistical difference is shown in Table 4.6. The mean total thyroid volume of the study was 12.46mls±6.47mls. The mean volume of female 12.57mls ± 6.89mls was higher than the males 11.94±3.91. The study did not show significant difference between the mean levels of thyroid volume for male and female participants for the right lobe (p=0.801). However, the mean thyroid volume of females 6.42ml was higher than that of males 6.24. Similarly, the mean thyroid volume of left lobe of females 5.53ml was higher than males 5.12ml. However, this difference was not statistically significant (0.474).

Table 4.6: Distribution for mean thyroid volume among gender of participants

	Gender	*N*	Mean	s.d	t-value	*p*-value	95% C.I.	
Right Vol/ml	Male	17	6.24	2.278				
	Female	83	6.42	4.404	-0.254	0.801	-1.665	1.293
Left Vol/ml	Male	17	5.12	1.867				
	Female	83	5.53	3.160	-0.723	0.474	-1.567	0.742
Isthmus Vol/ml	Male	17	0.76	0.437				
	Female	83	0.58	0.701	1.423	0.164	-0.079	0.452
Total Vol/ml	Male	17	11.94	3.913				
	Female	83	12.57	6.893	-0.515	0.609	-3.079	1.828

The total thyroid volume for males 11.94ml was lower than that for the females 12.57ml. However, this difference was not statistically significant (p=0.609). The mean total thyroid volume obtained for this study was 12.46 ± 6.47 was much lower than that of the recommended world health organization international council for the control of iodine deficiency disorders (WHO/ICCIDD) mean value of 18.6ml for female and 25mls for male adults.

4.3.4 Comparison of thyroid volume with prevalence of pathologies

In Table 4.7, the results of the thyroid volumes estimated among the participants presenting with pathology are indicated. The study showed significant difference (p=0.004) in the mean thyroid volume (8.02mls) of the right lobe for participants with presence of pathologies compare to those without pathologies (5.25ml).

Table 4.7: Distribution for mean thyroid volume among prevalence of pathologies

	Prev.	*N*	Mean	s.d.	t-value	*p*-value	95% C.I.	
Right Vol/ml	Present	41	8.020	5.681				
	Absent	59	5.250	1.844	3.014	0.004*	0.920	4.620
Left Vol/ml	Present	41	6.950	3.633				
	Absent	59	4.420	1.831	4.107	0.001*	1.294	3.761
Isthmus Vol/ml	Present	41	0.800	0.813				
	Absent	59	0.470	0.504	2.311	0.024*	0.045	0.616
Total Vol/ml	Present	41	15.660	8.365				
	Absent	59	10.240	3.313	3.94	0.001*	2.656	8.186

***Significant at 5%**

Statistically, the left thyroid lobe volume (6.95mls) for those with pathologies was significantly different from that those without pathologies (4.42mls) (p=0.001). The mean thyroid isthmus volume for those with pathologies 0.80ml was significantly different from that of those without pathologies (0.47ml) (p=0.024). The mean total thyroid volume 15.66ml for presence of pathologies was significantly different from that of those without pathologies (10.24ml) (p=0.001).

4.3.5 Comparison of thyroid volume among classes of the pathologies

With respect to characterization of the pathology (normal, benign, undefined and suspicious) The study showed significant mean difference between the mean thyroid volumes among grading for the right lobe (p=0.001); left lobe (p=0.001); isthmus (p=0.015) and total volume (p=0.001) (Table 4.8).

Table 4.8: Distribution for mean thyroid volume among various classes of pathologies

	Grading	N	Mean	s.d.	*f*-value	*p*-value
Right Vol/ml	Normal	59	5.260	1.860		
	Benign	28	6.680	3.267		
	Undeterminate	9	12.330	9.747	9.975	0.001*
	Suspicious	4	7.200	2.775		
	Total	100	6.390	4.112		
Left Vol/ml	Normal	59	4.470	1.818		
	Benign	28	6.460	3.825		
	Undeterminate	9	8.440	3.395	7.541	0.001*
	Suspicious	4	6.000	2.915		
	Total	100	5.460	2.976		
Isthmus Vol/ml	Normal	59	0.480	0.504		
	Benign	28	0.640	0.678		
	Undeterminate	9	1.220	1.202	3.686	0.015*
	Suspicious	4	0.800	0.447		
	Total	100	0.610	0.665		
Total Vol/ml	Normal	59	10.280	3.329		
	Benign	28	13.750	6.530		
	Undeterminate	9	21.780	11.987	11.749	0.001*
	Suspicious	4	13.800	5.020		
	Total	100	12.460	6.472		

***Significant at 5%**

4.3.6 Dimensions of Thyroid Lobes and Thyroid Isthmus

The study showed that, anteroposterial dimension of the thyroid lobes ranges from 7mm-32mm with the mean ± s.d of 14.67±4.18mls for the right lobe and 13.79 ± 4.57 mls for the left lobe (table 4.8). The lateromedial dimension of the thyroid lobe ranges from 8mm-38mm with the mean values of 17.68 ± 4.54 for the right lobe and 17.13 ± 4.66 for the left lobe (Table 4.9). The transverse dimensions was highest for isthmus 20.3±4.11 and craniocaudal was highest for left lobe 43.81±6.89mls (Table 4.9).

Table 4.9: Descriptive summary of thyroid lobe dimensions

Dimensions	*N*	Minimum	Maximum	Mean	s.d.
Right Lobe Anteroposterial/mm	100	7	32	14.670	4.180
Right Lobe Lateromedial/mm	100	10	38	17.680	4.540
Right Lobe Craniocaudal/mm	100	9	59	36.140	16.530
Left Lobe Anteroposterior/mm	100	7	25	13.790	4.570
Left Lobe Latermedial/mm	100	8	29	17.130	4.660
Left Lobe Craniocaudal/mm	100	28	60	43.810	6.890
Isthmus Anteroposterial/mm	100	2	13	3.140	1.430
Isthmus Transverse/mm	100	3	30	20.320	4.110
Isthmus Craniocaudal/mm	100	9	36	18.540	3.990

4.3.7 Pot Hoc Analysis

Post Hoc analysis shows specific areas of significant differences as indicated in Table 4.10. The Table compared paired means of various classes of pathology with the normal thyroids in this study.For the right thyroid lobe, it first shows the comparison of the means of normal thyroids with the means of benign pathologies observed and there was no significant difference between them ($p > 0.05$). However, comparing the means of normal thyroids with the undeterminate group of pathologies, there was a great significant difference ($p < 0.05$).

Similar comparisons were made for left thyroid lobes and clearly undeterminate pathologies showed significant differences in all the pairing except for benign pathologies of left thyroid lobe.

Table 4.10: Post Hoc Analysis of mean thyroid volumes across graded pathologies

LSD Dependent Variable	Grading (I)	Grading (J)	Mean Difference (I-J)	*p*-value	95% C.I.	
Right Vol/ml	Normal	Benign	-1.420	0.094	-3.090	0.250
	Normal	Undeterminate	-7.075*	0.000	-9.670	-4.480
	Normal	Suspicious	-1.940	0.256	-5.310	1.430
	Benign	Undeterminate	-5.655*	0.000	-8.430	-2.880
	Benign	Suspicious	-0.520	0.769	-4.030	2.990
	Undeterminate	Suspicious	5.133*	0.013	1.100	9.170
Left Vol/ml	Normal	Benign	-1.999*	0.002	-3.240	-0.760
	Normal	Undeterminate	-3.979*	0.000	-5.910	-2.050
	Normal	Suspicious	-1.530	0.229	-4.050	0.980
	Benign	Undeterminate	-1.980	0.060	-4.050	0.090
	Benign	Suspicious	0.460	0.726	-2.160	3.080
	Undeterminate	Suspicious	2.440	0.110	-0.570	5.450
Isthmus Vol/ml	Normal	Benign	-0.160	0.279	-0.450	0.130
	Normal	Undeterminate	-0.739*	0.002	-1.190	-0.280
	Normal	Suspicious	-0.320	0.290	-0.910	0.270
	Benign	Undeterminate	-0.579*	0.020	-1.070	-0.090
	Benign	Suspicious	-0.160	0.614	-0.770	0.460
	Undeterminate	Suspicious	0.420	0.239	-0.290	1.130
Total Vol/ml	Normal	Benign	-3.474*	0.009	-6.040	-0.910
	Normal	Undeterminate	-11.502*	0.000	-15.500	-7.500
	Normal	Suspicious	-3.520	0.182	-8.720	1.680
	Benign	Undeterminate	-8.028*	0.000	-12.300	-3.750
	Benign	Suspicious	-0.050	0.985	-5.470	5.370
	Undeterminate	Suspicious	7.978*	0.013	1.750	14.200

* The mean difference is significant at the 0.05 level.

4.4 CORRELATION OF THYROID LOBE DIMENSIONS WITH TOTAL VOLUME

The Pearsons correlation analysis was used to establish the existence of any correlation between the various thyroid volume dimensions and the total thyroid volume.

4.4.1 Anteroposterior Dimension

In this study, a significantly positive correlation was found between total thyroid volume and all three thyroid volume dimensions of participants (*p*=0.001) as shown in Table 4.11.

Table 4.11: Correlation between anteroposterior dimensions and the total thyroid volume

	Anteroposterior Dimension				
	Correlations	**Right Lobe/mm**	**Left Lobe/mm**	**Isthmus/mm**	**Total Vol/ml**
Right Lobe/mm	Pearson Correlation	1	0.496**	0.630**	0.690**
	p-value		0.001	0.001	0.001
	N	100	100	100	100
Left Lobe/mm	Pearson Correlation	0.496**	1	0.381**	0.475**
	p-value	0.001		0.001	0.001
	N	100	100	100	100
Isthmus/mm	Pearson Correlation	0.630**	0.381**	1	0.800**
	p-value	0	0.001		0.001
	N	100	100	100	100
Total Vol/ml	Pearson Correlation	0.690**	0.475**	0.800**	1
	p-value	0.001	0.001	0.001	
	N	100	100	100	100

4.4.2 Lateromedial and Craniocaudal Dimensions

In this study, a significantly positive correlation was found between total thyroid volume and that of the right and left thyroid volume dimensions (*p*=0.001). However, there was no significant correlation between total thyroid volume and that of Isthmus (*p*>0.05) (Table 4.12). Similarly, significantly positive correlation was found between total thyroid volume and the dimensions of participants (*p*=0.001). However, there was no significant correlation between total thyroid volume and Isthmus (*p*>0.05) (Table 4.13)

Table 4.12: Correlation Between lateromedial dimensions and the total thyroid volume

		Lateromedial Dimension			
	Correlations	Right Lobe/mm	Left Lobe/mm	Isthmus/mm	Total Vol/ml
Right Lobe/mm	Pearson Correlation	1	0.589**	0.054	0.656**
	p-value		0.001	0.595	0.001
	N	100	100	99	100
Left Lobe/mm	Pearson Correlation	0.589**	1	-0.164	0.463**
	p-value	0.001		0.105	0.001
	N	100	100	99	100
Isthmus/mm	Pearson Correlation	0.054	-0.164	1	0.069
	p-value	0.595	0.105		0.498
	N	99	99	99	99
Total Vol/ml	Pearson Correlation	0.656**	0.463**	0.069	1
	p-value	0.001	0.001	0.498	
	N	100	100	99	100

Table 4.13 Correlation between Craniocaudal dimensions and the total thyroid volume

		Craniocaudal Dimensions			
	Correlations	**Right Lobe/mm**	**Left Lobe/mm**	**Isthmus/mm**	**Total Vol/ml**
Right Lobe/mm	Pearson Correlation	1	0.325**	0.088	0.207*
	p-value		0.001	0.384	0.039
	N	100	100	99	100
Left Lobe/mm	Pearson Correlation	0.325**	1	0.067	0.693**
	p-value	0.001		0.511	0.001
	N	100	100	99	100
Isthmus/mm	Pearson Correlation	0.088	0.067	1	0.162
	p-value	0.384	0.511		0.109
	N	99	99	99	99
Total Vol/ml	Pearson Correlation	0.207*	0.693**	0.162	1
	p-value	0.039	0.001	0.109	
	N	100	100	99	100

CHAPTER FIVE

DISCUSSION

5.1 INTRODUCTION

This Chapter discusses the findings of the study in conjunction with reviewed literature. The findings were presented in relation to the stated objectives of the study.

5.2 DEMOGRAPHICS

In this study participation was opened to all categories of health workers at the Volta Regional hospital. In particular, (*n*=6, 6%) Allied Health Professionals (AHPs), (*n*=37, 37%) nurses, (*n*=3, 3%) Pharmacists, and (*n*=54. 54%) other workers participated in the study. No medical doctor participated in this study probably because they were few at hospital and hence too much busy to avail themselves for the study or they did not hear of the study as they are group of health workers who are not easily accessible. The majority of the participants were others, (which included other health workers such as health aides, orderlies, clerical staff, mortuary attendants, security staff and artisans).The study also showed a varied age distribution (23–59 years) among the 100 participants. The estimated mean of 42.07±10.02 years was comparable with a mean age of 37.27 ± 11.80 years reported by Adibi et al. (2008), in a thyroid gland study conducted on a population of healthy adults in Iran. Comparatively, a higher tally of more females (83) than males (17) was observed contrary to the statistics (77 females and 123 males) reported by Adibi et al. (2008). In particular, the relatively higher female population in this current study could be attributed to the literature reports of higher prevalence of thyroid disorders in females than in males (Ojule et al, 1998). The skewed gender distribution in favour of females in Ghana (GSS, 2011) could also account for this observation

5.3 PREVALENCE OF THYROID PATHOLOGY

5.3.1 Thyroid Pathology

Prevalence of thyroid pathology recorded in this study was 41%. They were all nodular diseases. No non-nodular thyroid in this study had a thyroid volume larger than the WHO/ICCIDD reference level of 18ml for females and 25mls for males. Therefore, there could not have been a defused thyroid goiter among the pathologies recorded. All goiters (enlarged thyroids) detected were thyroid nodular goiters. However, this value of 41% prevalence was within the range of 13%-67 % published by Wang and Crapo (1997), in adult populations, agrees with the reported findings of 8%-67% by Dean and Gharib (2008) and the continental range of 1%-90% published (Dakubo et al., 2013).

On the basis of gender, this study revealed pathology in 44.6% of females and 23.5% in males. This observation is consistent with Ojule et al. (1998) and supported by other published literature Papini et al., (2002) that prevalence of thyroid pathology was higher in females than in males. In particular, Ezzat et al. (1994) earlier established this finding and estimated 72% prevalence of thyroid nodules in women compared with 41% in men among asymptomatic North American subjects. Out of the 41% thyroid pathology, 28%, being majority were benign. This agrees with published literature that majority of thyroid pathologies were benign (Brander et al., 2000, Jemal et al., 2005).

5.3.2 Characterization and Classification of Thyroid pathologies

In this study, thyroid pathologies (nodules) were characterized and classified based on margins, echogenicity, shape, configuration, calcifications and posterior acoustic shadowing.

With regards to margins, nodules were classified based on whether they were well-defined, ill-defined or spiculated. Also considered for margin was presence or absence a halo around the nodules. Spiculated margins were classified as suspicious for malignancy while well-defined margins were characterized and classified as benign pathology. This was consistent with published literature (Moon et al., (2008). Absence or absence of a halo was considered undeterminate.

Nodules echogenicity formed another basis for the classifications done. Nodules were either classified as hypoechoic, hyperechoic, and isoechoic. Hypoechoic nodules were considered highly specific for suspicious thyroid nodules (Moon et al., 2008) whereas hyperechogenic nodules were considered undeterminate thyroid pathology(Reading et al., 2005). Undeterminate means that there could be a probability it being either malignant or benign. However, hyperechoic nodules may sometime be benign (Bonavita et al., 2009). There may be both benign and suspicious features present in a nodule as a nodule may not be a manifestation of a single disease but a gamut of thyroid diseases (Bonavita et al., 2009). Hence a nodule may be partly benign and partly malignant. That is why Kim et al., (2012) may be right in suggesting that any nodule with two or more malignant features could be considered suspicious or malignant irrespective of the presence of any benign sonographic features. Therefore, in this study the presence any single sonographic feature qualified that particular nodule to be classified as a suspicious thyroid nodule.

Another basis for the classification was shape. Nodule measurement in horizontal and vertical planes should tell whether it was wider-than-tall or taller-than wide. Wider-than-tall shape was considered a benign characteristic whereas taller-than-wide shape was considered a suspicious nodule or pathology (Kwak et al., 2011).

Hypervascularity was not considered a strong basis for classifying nodules in this study as suspicious finding contary to the views held by Frates et al., (2005). This was because it was confusing as the thyroid vessels may also appear hypervascular. Apart from that the term hypervascular in itself is misleading as it requires comparing it with normal vascularity which may be subjective. Therefore, Moon et al., (2010), and Kwak et al., (2013) may be right in indicating that vascularity is not a strong indicator for classifying thyroid nodules as suspicious thyroid nodules.

Microcalcification is another sonographic feature with a high specificity for suspecting malignancy. Almost all the published literatures support this fact especially when present with hypoechogenicity (Moifo et al., 2013, Corrias and Mussa, (2013), Kwak et al., 2011).

The next basis for the classification used was presence or absence of acoustic posterior shadowing of the calcifications within the thyroid nodules also known as comet-tail effect as shown in the (Appendix III, section: d).

Based on the ultrasonographic features, the study established that 4% of the pathologies showed malignant features and were thus classified as suspicious. This outcome agrees favourably with the 5.4% prevalence of malignancy recorded by Leenhardt et al., (1999) who used ultrasound fine needle aspiration (FNA) cytology results. Consequently, this work affirms that a stand-alone application of ultrasonography for purposes of diagnosing thyroid malignancy is comparable to using cytology results provided sound characterization of pathologies is done using ultrasound features. Majority of the pathology (n=28, 28%) were benign. This was in consistence with the reports of (Brander et al., 2000, Jemal et al., 2005)

5.4 MEAN THYROID GLAND VOLUME

The volumes of the right lobe, left lobe and the isthmus of the thyroid were estimated to determine the mean thyroid gland volumes of the participants. The mean thyroid gland volume of 12 ± 6.52 mls estimated in this study,was much lower than the WHO/ ICCIDD reported reference level of 18.00mls for females and 25.00 mls for males (Gutekunst et al., 1988). Yousef et al. (2011) reported 6.44±2.44 in Sudan, Adibi et al. (2008) 9.53±3.68 in Iran, Ahidjo et al. (2006), 8.55±1.82 in Nigeria, Ivanac et al, (2004) 0.68±2.83 in Croatia and Chanoine et al, (1991) 11.6±4.4 in Belgium. Obviously, the mean thyroid volume varies from country to country and it appears that the WHO/ICCIDD reference level is too high for most countries. Therefore every country must have their local reference value. According to Langer (1989) the thyroid volume volume obtained in Iceland, Sweden, Netherlands and USA was 8ml-15ml which is comparable to this study.

One thing which could account for the higher mean thyroid volume in this study compared with those of Yousef et al., (2011), Adibi et al., (2008), and Ahidjo et al., (2006), was that the isthmus volume was not considered in their studies. It may be argued that the mean thyroid volume in Ivanac et al., (2004) was also low although isthmus volume measurement was included. However, it shows clearly that Ivanac et al., (2004) was not very current and that its geographical location is quite different from the rest, (Middle East and Africa). Yousef et al., (2011) studied Sudanes population, Adibi et al., (2008) studied Iranians, Ahidjo et al., studied Nigerians.

5.4.1 Comparison of Thyroid Volume among Gender

Mean thyroid volume of females in this study was 12.57mls ± 6.89mls which was higher than the mean thyroid volume among the males 11.9 ± 3.91. This was contrary to what has been reported elsewhere and this may need a follow-up study. Perhaps this is perculiar to the geographical location. It may either be due to a prevailing condition among the female population in the locality which has increased thyroid volume of females or a condition that has reduced sizes of male thyroid volumes. In studies done by Yousef et al., (2011) and Adibi et al., (2008), all recorded higher thyroid volumes for males than for females.

5.4.2 Mean Right and Left Thyroid Lobe Volumes

For both gender in this study, right thyroid lobes were larger in volume than that of the left lobes. This is consistent with the findings of Yousef et al., (2011) and Ahijo et al., (2006). Yousef et al., (2011) recorded mean right lobe volume for males of 3.51mls ± 1.46mls as against 3.21mls ± 1.28mls for left lobe volume. Similarlly, the right thyroid lobe volumes for the female participants in this study were also larger than that of their left lobes.

5.4.3 Comparison of Thyroid Gland Volume with Presence of Pathology

The presence or absence of pathology was also investigated in this study and the findings suggest that the presence of pathology causes increased levels of thyroid volumes. In all three sides (right lobe, left lobe and the isthmus) the mean volumes levels were higher for those with pathology compared to those without pathology. The total thyroid volumes of the participants with pathology were also significantly higher than those without pathology. This could be attributed to hypertrophy and hyperplasia occurring in follicular cells. According to Solter et al., (1991), chronic inadequacy of iodine in the blood streams is a condition that hampers thyroid function, leading to elevated thyroid stimulating hormones (TSH) secretion. Prolonged TSH elevation leads to hypertrophy and hyperplasia of the thyroid cells causing increase in thyroid volumes. Physiologically, thyroid pathology therefore results from hormonal imbalance. Also according to Mu et al., (1987), increased serum thyrotropin hormone (TSH) was associated with increasing thyroid volume.

5.4.4 Comparison of Thyroid Volume among Various Classes of Pathology

The thyroid volumes in all classes of pathology were significantly different. Among all the various classes; benign, undeterminate and suspicious, the mean thyroid volumes were highest in the undeterminate class of thyroid pathology.

5.5 ANTEROPOSTERIAL, LATEROMEDIAL AND CRANIOCAUDAL DIMENSIONS

The three main dimensions used in measuring thyroid lobe volumes sonographically (anteroposterial, lateromedial and craniocaudal dimensions) were compared in this study. Generally the mean levels of the craniocaudal dimensions were highest followed by anteroposterial and the lateromedial was the lowest. The right lobes recorded the highest anteroposterial, lateromedial, and craniocaudal dimensions. This agrees with the literature (Bliss et al., (2000), which reported 50mm for craniocaudal and between 20-30mm for both anteroposterial and lateromedial dimensions. However, for anteroposterial dimension, the current study recorded the mean value of (14.67 ± 4.18) mm for the right lobes and (13.79 ± 4.57)mm and the ranges from 7-32mm . Similarly, for lateromedial dimensions, the mean value of value of (17.68 ± 4.57)mm for the right lobes and (17.13 ± 4.66)mm and the ranged between 8-38mm for the left lobe. It was evidently clear that comparing the range recorded in this study was wider than that recorded by Bliss et al., (2000). This could be due to differences in geographical locations.

The craniocaudal dimension had mean value of (36.14 ± 16.63) mm for the right lobe and (43.81 ± 6.89) mm and ranges from 9-60 mm. The anteroposterial dimension of the isthmus ranged from 2-13mm, while trasverse diamension ranged from ranged from 3-30 mm and craniocaudal dimension range from 9-36mm whereas Bliss et al., (2000) reported a range of 10-25mm for both transverse and anteroposterial dimensions.

5.6 CORRELATION OF DIMENSIONS WITH TOTAL THYROID VOLUME

The Pearsons correlation analysis was used to establish the existence of any correlation between the various thyroid volume dimensions and the total thyroid volume. In this study, total thyroid volume significantly correlated with all three dimensions (anteroposterial, lateromedial and craniocaudal) dimensions. Increase in the volume of any of these three dimensions leads to significant increase in the total thyroid volumes. This finding is contrary to that reported by (Sheikh et al., 2004) that among all the three dimensions only the lateromedial dimension of the thyroid correlates significantly with the thyroid volume.

CHAPTER SIX

CONCLUSION, RECOMMENDATIONS AND LIMITATTIONS

6.1 INTRODUCTION

A cross-sectional study on sonographic determination of prevalence of thyroid pathology among asymptomatic health workers of the Volta Regional Hospital, Ho, has been done and this Chapter presents the conclusion drawn from the discussion, the recommendations to mitigate the challenges and the limitations of the study.

6.2 CONCLUSION

The published literature has indicated prevalence rates of 1% to 65% of thyroid pathology among adults Dean and Gharib (2008). This study established a 41% prevalence of thyroid pathology among asymptomatic health workers at the Volta Regional Hospital, which is consistent with the literature, howbeit in the higher range. This finding is however contrary to the stated hypothesis that there is no thyroid pathology among asymptomatic health workers. On the basis of the findings as well as the contradiction, it can be concluded that thyroid pathology cannot be ruled out in any asymptomatic human, and hence the hypothesis is rejectable.

The study further revealed higher prevalence of thyroid pathology in women (44.6%) than in men (23.5%). This finding agreeable with most published literature which indicated female: male prevalence ratio of almost 2:1. This study is thus conclusive that women living in iodine deficient area are about 50% more likely to suffer from thyroid pathology than men living in the same locality. The study is also conclusive that majority, (28%) of thyroid pathologies were benign and hence the affected participants could be counseled. The few (4%) were suspicious for malignancy. From the results, the study strongly inferred that a stand-alone application of ultrasonography for purposes of diagnosing thyroid malignancy is somehow comparable to clinical cytology provided a very good thyroid nodule characterizations is made as done in this study, and that the rate of suspicious pathology was within the rates of cytology reports for malignancy. Significantly, the study established lower thyroid volumes compared with the recommended levels by WHO/ICCIDD.

In conclusion, the study firmly established that the presence of thyroid pathology was associated with thyroid volume. Participants with thyroid pathology showed higher thyroid volumes compared to those without thyroid pathology in this study.

6.3 RECOMMENDATIONS

Following the results of this study and the conclusions drawn, the following recommendations are made for future studies and public policy formulation:

1. In respect of the high prevalence rate of 41%, a need for specialist endocrinological diagnosis and treatment of thyroid pathologies as well as other endocrine disorders in the district is advocated,
2. The high prevalence of thyroid pathology in the district could suspect some challenges in the National Salt Iodization program (NSIP). Therefore it is recommended that the authorities of NSIP assess the success or otherwise of the program in the district.
3. This study has established the local reference level of mean thyroid volume of 12.46mls ± 6.47mls for Ho district. A further study with a larger sample size is needed to establish

national reference level. An extension of the work on a nationwide scale is recommended.

4. Further studies in cytology should be done to confirm the suspicious findings made in this study.

6.4 LIMITATION

The research topic was changed a couple of times due to administrative problems in granting permission from earlier study sites. This final topic was agreed upon a few months to the official submission deadlines. Time was a therefore a major limiting factor in this study. The work was thus limited in scope as it could not be extended to include FNA biopsy for cytology reports to confirm ultrasonography results.

Financial resources could not permit for larger sample size which could be representative to establish national reference level of thyroid volume for adult population of Ghana. There were also delay in securing permissiom from the authorities of the from the study site.

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APPENDIX I

PARTICIPANTS INFORMATION SHEET

You are being asked to participate in this study in order to determine the rate of thyroid pathology among the staff of this hospital. Autopsies are reporting high prevalence of thyroid pathology 2 to 3 times more common among females than among men. Detecting these thyroid pathologies early may help receive early attention.

General Information

If you agree to be part of this study, ultrasound scanning will be performed on your thyroid gland.

Possible Benefits

There is no direct benefit to you from this study. However, your participation may help to establish data on the rate of thyroid pathology which will eventually benefit all mankind.

Possible Risks

Ultrasound scan is generally safe and has no known bio-effect on human beings.

Withdrawal from Study

This study is strictly voluntary. Should you decide not to participate it will have no consequences for you. If you decide at any point during the study that you do not wish to participate any further, you are free to terminate your participation, effective immediately. Any such decision will be respected without any further discussion.

APPENDIX II

INFORMED CONSENT FORM

Department of Radiography

School of Allied Health Sciences

College of Health Sciences

University of Ghana

Title of Project: prevalence of thyroid pathology among staff of Volta Regional Hospital

Purpose of Research: IN PARTIAL FULFILMENT OF MSc. DEGREE

Name of Researcher: RICHARD KWAKU DELALI

Name of Supervisors: DR. S. ANIM-SAMPONG, Mr. K. BAMFO- QUAICOE

CONFIDENTIALITY All data will be anonymously and confidentially handled.

I…………………………………………………………………………… agree to take part in the above research and I consent to my participation. I understand that my participation is entirely voluntary and that there is no personal benefit that I will derive by participating in this study.

If you have any concern about this study and wish to contact someone independently, you may contact supervisors below.

SIGNATURE…………………………………………………………

Dr. S. ANIM-SAMPONG
Dept. of Radiography
School of Health Allied Health Sciences
University of Ghana
P. O. Box KB 143
Korle-Bu.

Mr. K. BAMFO- QUAICOE
Dept. of Radiography
School of Health Allied Health Sciences
University of Ghana
P. O. Box KB 143
Korle-Bu.

APPENDIX III

DATA COLLECTION SHEET

THYROID SCAN

SERIAL NO: Age ……….. Gender……….. Date…………………..

1. Thyroid Volume:

Right Lobe (CxLxA)……………………………………………………..

Left Lobe (CxLxA)……………………………………………………..

Ishmus …………………………………………………………….

2. Nodule(s):

Present……………………. Not Present………...........

3. **SONOGRAPHIC FEATURES**:

Single……………………. Multiples…………………………………

Size…………………………………Taller than wide ……..Wider than tall…….

a. **Configuration**

All Solid consistency….......Solid with Cystic parts…….. Purely Cystic…………

Cyst with Colloid………….. Spongiform Configuration/honeycomb……………

.b.**Echogenicity**

Diffused Hyperechoic………Hypoechoic……………….Heterogenous…………

c. **Margin**

Well-defined………. Ill- defined………… Halo………Spiculated……………

d. **Calcifications**

Complete Eggshell……Eggshell with interruption…..Coarse with comet tail.............

Coarse without comet tail effect…………….. Microcalcifications…………………

e.**Vascularity**

Normal vascularity……….. Hypervascularity…… No vascularity………

Scanned By……………………………… Signature………………

APPENDIX IV
ETHICAL CLEARANCE

SCHOOL OF ALLIED HEALTH SCIENCES
COLLEGE OF HEALTH SCIENCES
UNIVERSITY OF GHANA
ACADEMIC AFFAIRS

Phone: +233-0302-687974/5
Fax: +233-0302-688291

My Ref. No. SAHS/ 10434063
Your Ref. No.

P. O .Box KB 143
Korle Bu
Accra
Ghana

2nd April, 2014.

Mr. Richard Kwaku Delali,
Dept. of Radiography,
SAHS,
Korle Bu.

Dear Mr. Delali,

ETHICS CLEARANCE

Ethics Identification Number: SAHS – ET. /10436063/AA/3A/2013-2014.

Following a meeting of the Ethics and Protocol Review Committee of the School of Allied Health Sciences held on Monday 24th March, 2014, I write on behalf of the Committee to approve your research proposal as follows:

TITLE OF RESEARCH PROPOSAL: **"Prevalence of Thyroid Pathology among Staff of Volta Regional Hospital, Ho"**

This approval requires that you submit six-monthly review reports of the protocol to the Committee and a final full review to the Committee on completion of the research. The Committee may observe the procedures and records of the research during and after implementation.

Please note that any significant modification of the research must be submitted to the Committee for review and approval before its implementation.

You are required to report all serious adverse events related to this research to the Committee within seven (7) days verbally and fourteen (14) days in writing.

As part of the review process, it is the Committee's duty to review the ethical aspects of any manuscript that may be produced from this research. You will therefore, be required to furnish the Committee with any manuscript for publication.

Please always quote the ethical identification number in all future correspondence in relation to this protocol.

Thank you.

Yours sincerely,

Dr. Michael Mark Addae
(Chairman, Ethics and Protocol Review Committee)

cc Dean
Co-ordinator/HoD Dept. of Dietetics
Senior Assistant Registrar

APPENDIX V

APPROVAL TO CARRY OUT RESEARCH WORK

MEMO

From	:	HEALTH SERVICES ADMINISTRATOR
To	:	ALL STAFF/UNIT HEADS/NOTICE BOARD
CC:	:	ALL DOCTORS
Date	:	2nd May, 2014
SUBJECT	:	APPROVAL TO CARRY ON RESEARCH WORK

Mr Richard Kwaku Delali, Department of Radiology, Volta Regional Hospital, Ho has been granted approval to conduct a research on Staff of the Volta Regional Hospital, Ho on the Topic: **Prevalence of Thyroid Pathology among staff of the Volta Regional Hospital-Ho.**

In view of that all staff are encouraged to avail themselves at the X-ray department, Volta Regional Hospital on Mondays and Fridays between the hours of 10:00am to 5:00pm.

You are all encourage to accord him the needed assistance.

Thank you