

2026-01-18

Diagnostic Accuracy Of Ultrasound In Characterization Of Thyroid Nodule Compared To Fnac Results And Associated Factors In Predicting Malignancy In Patients Visiting Tibebe Ghion Specialized Hospital For Thyroid Nodule Scanning

Yenew, Getnet

<http://ir.bdu.edu.et/handle/123456789/17084>

Downloaded from DSpace Repository, DSpace Institution's institutional repository



COLLEGE OF MEDICINE AND HEALTH SCIENCES
SCHOOL OF MEDICINE
DEPARTMENT OF CLINICAL RADIOLOGY

DIAGNOSTIC ACCURACY OF ULTRASOUND IN
CHARACTERIZATION OF THYROID NODULE COMPARED
TO FNAC RESULTS AND ASSOCIATED FACTORS IN
PREDICTING MALIGNANCY IN PATIENTS VISITING TIBEBE
GHION SPECIALIZED HOSPITAL FOR THYROID NODULE
SCANNING

A RESEARCH THESIS TO BE SUBMITTED TO THE DEPARTMENT OF
CLINICAL RADIOLOGY, COLLEGE OF MEDICINE AND HEALTH
SCIENCE, BAHIR DAR UNIVERSITY, IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR SPECIALITY IN CLINICAL RADIOLOGY.

BY, Simegnew (MD, FINAL YEAR RADIOLOGY RESIDENT)

JANUARY 2026

BAHIR DAR,

ETHIOPIA 2026 G.C.

PRINCIPAL INVESTIGATOR	SIMEGNEW GETAHUN (MD,RADIOLOGY RESIDENT,BDU PHONE NUMBER 0912806032 EMAIL ADRESS anleymom143@gmail.com
ADVISORS	WODAJE GIETANEH EMAIL ADRESS ,wodajegietaneh@gmail.com Dr.Getnet Yenew EMAIL ADRESS ynwgetnet@yahoo.com
TITLE	DIAGNOSTIC ACCURACY OF ULTRASOUND IN CHARACTERIZATION OF THYROID NODULE COMPARED TO FNAC RESULTS AND ASSOCIATED FACTORS IN PREDICTING MALIGNANCY IN PATIENTS VISITING TIBEBE GHION SPECIALIZED HOSPITAL FOR THYROID NODULE SCANNING
STUDY PERIOD	December to January 30,2026
TOTAL BUDGET	30,000

Declaration

I undersigned, declared that this is my original work, has never been presented in this university, and that all the resources and materials used for the research, have been fully acknowledged.

Principal investigator

Name Dr.Simegnew Getahun (final year resident)

Signature ... Date 1/18

Advisors

Name Dr Getnet Yenew

Signature ... Date 1/18/17/17

Name wodaje Gietaneh

Signature Date 1/18



ACKNOWLEDGMENT

I would like to express my deepest gratitude to Bahir Dar University, School of Medicine and Health Science, for providing the resources, academic environment, and support necessary to undertake this research.

I would also like to express my heartfelt gratitude to my advisors, whose support and guidance were essential to the completion of this research.

First, I would like to thank Wodaje Gietaneh (MPH, PHD candidate), my principal advisor, for his invaluable mentorship throughout this entire journey. His expert knowledge in research and his constant encouragement pushed me to expand my ideas and to improve my work. I am deeply appreciative of the time and care he dedicated to the thesis.

I would also like to express my sincere appreciation to Dr Getnet Yenew (MD, Radiologist), my second advisor, for his insightful feedback and constructive criticism.

Finally, I would also like to express my sincere appreciation to resident physicians who helped me in data collection.

ABBREVIATIONS AND ACRONYMS

Acronyms and Abbreviation

long form

E.C

Ethiopian calendar

ETB.....

Ethiopian Birr

FNA.....

FINE NEEDLE ASPIRATION

G.C:

Gregorian calendar

TIRAD: THYROID IMAGING REPORTING AND DATA SYSTEM

TGSH... ..

Tibebe Ghion Specialised Hospital

RR.....

Radiology resident

SRU.....

.the Society of Radiologists in Ultrasound

TNS:

THYROID NODULES

US.....

ULTRASOUND

ABSTRACT

Background: Thyroid nodules are a common problem in clinical practice, caused by congenital anomalies, inflammatory pathologies, and tumors. Thyroid nodules are a common endocrine problem, and while most are benign, differentiating between benign and malignant nodules is crucial for appropriate patient management. Ultrasonography (US) is the primary imaging modality for evaluating thyroid nodules and has high sensitivity of detecting benign nodules but its accuracy in definitively diagnosing malignancy can vary. Even though Final diagnosis relies on FNAC and histopathology of surgical specimens, every patient with thyroid nodules are not candidate for FNAC and histopathology diagnosis. This study aims to assess the accuracy of ultrasound characterisation of thyroid nodules compared with FNAC to reduce non-eligible patients from the invasive FNAC and histopathology procedure and avoid unnecessary surgery.

Objective: The objective of this study is to assess the diagnostic accuracy of ultrasound in the characterisation of thyroid nodules compared to the fine needle aspiration results in patients visiting Tibebe Ghion hospital for thyroid scanning from December to January 2026

Methods: This study was conducted at Tibebe Ghion specialised hospital in an institution-based cross-sectional study in patients visiting Tibebe Ghion specialized hospital scanned for thyroid disease and nodules detected with ultrasound and FNAC results. From December,1 to January 30,2026. The data was collected by trained radiology residents from December 1 to January 30, 2025. In this study, all patients who full fill the inclusion criteria in the study period were included .The questioners included questions on patient demography, duration of the symptoms, ultrasound and FNAC findings. Data were che ckd for completeness and consistency and the data was collected by kobo software and then analyzed by SPSS compute software based on specific and general objectives.

The two by two tables used to calculate the dependent variables. The sensitivity, specificity, diagnostic accuracy, positive predictive value and negative predictive value was calculated from the two by two table. Binary regression using bivariate and multivariate factors used to show the association of each independent variable with the dependent variable.

The total cost of this study estimated was 30,000 ETB.

RESULT.

Among 131 nodules 26(19.8%) were malignant and 105 (80.2%) were benign by FNAC. ultrasound demonstrated a sensitivity of 80.8 % and specificity of 81%.the overall diagnostic accuracy was 80.9%.the positive predictive value was 51.2% while the negative predictive value was 94.4%.the positive likelihood ratio was 4.25 and the negative likely hood ratio is 0.24.a statistically significant association was observed between ultrasound diagnosis and FNAC results ($\chi^2=36.92, p=0.001$)

Conclusion,

This study show ultrasound has high accuracy to detect and characterize benign thyroid nodules and can be used as a sensitive screening tool and avoid unnecessary surgical interventions but ultrasound has limitation to diagnosis malignant nodules accurately so that FNAC and histopathologic examination is mandatory to confirm ultrasound malignant looking lesions.

Keywords: ultrasound, Fine Needle Aspiration, thyroid nodule

Table of Contents

ACKNOWLEDGMENT.....	iii
ABBREVIATIONS AND ACRONYMS	v
ABSTRACT.....	6
Table of Contents.....	7
List of tables:	9
Introduction	10
1.1 back ground	10
1.2 Statement of the problem	11
1.3 Significance of the Study	12
2 Literature review:.....	13
2.1 Overview of thyroid nodules	13
2.2 role of ultrasound in evaluation of thyroid nodules	14
2.3 ACR TI-TIRADS classification.....	14
2.4 Fine Needle Aspiration Cytology (FNAC)	16
2.5 Diagnostic Accuracy of ultrasound compared to FNAC	16
2.6 Research gap	17
3 Conceptual framework	18
4. Objectives.....	19
4.1 General objective	19
4.2 specific objective.....	19
5 Method and material:	19
5.1 Study design & study period.....	19
5.2 Study area	19
5.3 Source population.....	20
5.4 Study population	20
5.5 Study unit.....	20
5.6 Inclusion & exclusion criteria.....	20

5.6.1 Inclusion criteria	20
5.6.2 Exclusion criteria	20
5.7 Sampling technique and sample size	20
5.9 Variables of the study	21
5.9.1 Dependent variables:	21
5.9.2 Independent variables:	21
5.10 operational definitions.....	21
5.11 Data collection procedure.....	22
5.12. Data quality control	22
5.13. Data processing and analysis	22
5.14 Ethical clearance	23
6. Results	23
6.1 sociodemographic characteristics	23
6.2 clinical data	24
6.3 ultrasound image findings	24
6.4 FNAC RESULT	26
6.5 diagnostic accuracy, sensitivity and specificity of ultrasound compared to FNAC.....	27
6.6 Factors that affect the final FNAC diagnosis	28
7. DISCUSSION.....	31
8 Limitations of the Study:.....	32
9. CONCLUSION:.....	33
10. Recommendation:.....	33
11.Reference	34
ANNEX	38

List of tables:

Table 1 SOCIO-DEMOGRAPHICCHARATERSTICS OF PATIENTS WHO HAD THYROID NODULE ON ULTRASOUNDAND FNAC FROMDECEMBER TO JANUARY ,2026 (N-131).....	24
Table 2 Ultrasound findings in patients having thyroid nodule in TGSH from december2025-january 2026 (N-131)	25
Table 3 ASSOCIATION BETWEEN ULTRASOUND DIAGNOSIS AND FNAC RESULTS IN PATIENTS HAVING THYROID NODULE IN TGSH FROM DECEMBER 2025 TO JANUARY 2026 (N-131)	27
Table 4 the validity of thyroid ultrasound diagnosis of thyroid carcinoma in TGSH from December 2025-January 2026 (N=131)	27
Table 5 showing the diagnostic accuracy of ultrasound in differentiating malignant and benign nodules based on ROC	28
Table 6 Bivariate and multivariate regression analysis to identify factors associated with thyroid malignancy patients with thyroid nodules in TGSH, from December 2025 to January 2026 (N=131)	30

LIST OF figures

Figure 1 conceptual framework of dependent and independent variables	18
Figure 2 show distribution of FNAC results in TGSH from December to January 2026 (N=131)	26
Figure 3 showing the diagnostic accuracy of ultrasound in differentiating malignant and benign nodules in TGSH from December to January 2026 (N=131).....	28

Introduction

1.1 back ground

Thyroid nodules are a common problem in clinical practice, caused by congenital anomalies, inflammatory pathologies, and tumors(1). These nodules (TNs) are solid or fluid-filled lumps that form within the thyroid gland. The estimated prevalence by palpation is 3%-7% in some countries (2). The prevalence is higher among randomly selected individuals by high-resolution ultrasonography where it may increase to 67% according to one study (2). Thyroid nodules are always examined due to the fear of it being thyroid malignancy.

Thyroid nodule incidence is increasing due to the widespread application of ultrasonography. Fine-needle aspiration cytology is widely applied for the detection of malignancies .(3)The incidence of thyroid cancer is on the rise and is now the fifth most common cancer diagnosed in adult women worldwide and the second most common in women over 50 years of age (2). The advancements in diagnostic technologies may be contributing to the increasing prevalence of TNs, but it may be explained by other traditional risk factors such as increasing age, insufficient iodine intake, exposure to radiation, and unhealthy lifestyles. This in turn increases the risk of obesity and metabolic syndrome, which are regarded as risk factors for TNs (2).Several conditions can cause nodules to develop in the thyroid gland, including overgrowth of normal thyroid tissue, thyroid cysts, Hashimoto's disease, multinodular goiter and thyroid cancer (2). Most TNs aren't serious and don't cause symptoms(3, 4). However, a small percentage of TNs are caused by thyroid malignancy. This percentage is variable in different countries.

One of the important diagnostic tools in the assessment of TNs is ultrasound (US)(5). It is currently the most accurate imaging modality for detecting TNs. It provides the best information about the shape and structure of nodules. Furthermore, it is useful as a guide in performing fine-needle aspiration (FNA) if required (2, 6).

1.2 Statement of the problem

The incidence of thyroid nodules has been on the rise in the world population, with women more likely to develop thyroid cancer than men (7, 8). In fact, thyroid cancer is the second most common malignancy among world women.(7).Similarly, in the Gulf countries, thyroid cancer is the fifth Most common cancer among women, and the rates of thyroid malignancies are significantly higher in women from these countries than in those from the United States(7).There are limited studies on thyroid disease in Africa. The prevalence of thyroid disease was reported from few countries. For instance, the prevalence was 7.3% in Zambia, and 3.6% in Uganda(9). Although there is no population-based study regarding the prevalence of thyroid disease, it appears to be not uncommon in Ethiopia. Studies have shown that goiters are very prevalent in Ethiopia; many hospitals are burdened with the disease. According to the UNICEF report in 1993, 78% of the total population of Ethiopia was exposed to iodine deficiency, 62% were iodine deficient and 26% had goiter(9). The rate of goiter was 59% (study done in Jimma, Southwest Ethiopia)(10).the other study done in 2025 in Addis Ababa private setting show 93% of patients with hyperthyroidism presented with goiter and 91% has toxic nodular goiter(11).a study done in Gondar northern Ethiopia show the incidental finding of thyroid nodules in patients visiting outpatient department for other complaint was 33.4% (95% CI: 27.9, 38.9)(12). International studies show about 5-10% of all thyroid nodules are malignant (13). the above mentioned studies try to show the burden of thyroid disease worldwide and also in Ethiopia, but none of these studies mentioned the significance of ultrasound to detect either clinically suspected thyroid nodules or incidental findings for those patients having neck ultrasound for other reasons .ultrasound is vital investigative modality not only to detect thyroid nodules but also to characterize the nodules by identifying malignancy predictive sonographic findings .Therefore, it is crucial to differentiate between benign and malignant thyroid nodules in this population. 'thyroid nodule are also commonly detected in patients scanned for other reasons.(14).Ultrasonography (US) is considered as the primary method for evaluating thyroid nodules because of its acceptability, cost- effectiveness and safety. (7) **B**ecause of the superficial location of the thyroid gland, high-resolution real-time gray-scale and color Doppler sonography can demonstrate normal thyroid anatomy and pathologic conditions with remarkable clarity (15). As a result, ultrasound plays an increasingly important role in the diagnostic evaluation of thyroid disease, although it is only one of several diagnostic methods currently available. To use ultrasound effectively and economically, it is important to understand its current capabilities and limitations.' However, being an operator- dependent method, its use is limited by the technical skill of the operator''.

In evaluating of thyroid nodule using ultrasound there is a system called thyroid imaging and reporting system (TIRAD)(8, 15). To facilitate interpretation and standardization among specialists, recently a standardized system for analyzing and reporting thyroid ultrasound and for risk stratification thyroid imaging reporting and Data System TIRAD was proposed,, following the BIRAD system widely used for mammography. According to this system, thyroid nodules can be categorized in six different risk groups according to their ultrasonographic characteristics(4)

- TIRAD I normal thyroid gland.

- TIRAD II benign conditions 0 % malignancy, including simple cysts, spongiform nodules, and isolated macrocalcifications.
- TIRAD III probably benign nodules < 5% malignancy.
- TIRAD IV suspicious nodules (5-80% malignancy rate). Nodules in this group can be further categorized as 4a (5 to 10% malignancy) and 4b (10-80% malignancy)
- TIRAD V probably malignant nodules malignancy > 80%.
- TIRAD VI biopsy-proven malignant nodules

In contrast, fine-needle aspiration cytology (FNAC) is considered the gold standard diagnostic test for evaluating thyroid nodules. (7) (16). As clearly mentioned in the TI-RAD system thyroid nodules grouped as TIRAD I-III has low chance of being malignant and no need of further invasive work up like FNAC and histopathologic exam but practical in our institution clinicians send neck ultrasound and FNAC at the same time after physical examination regardless of nodule condition, even sometimes there may be no nodule detected. Sometimes there is also bleeding of the nodule iatrogenically when they come to ultrasound after FNAC. These are procedures that should be improved. This study aimed to assess the diagnostic accuracy of ultrasound in characterization of thyroid nodules compared to FNAC and also identify the predictive ultrasound finding that associate with thyroid malignancy to decrease the burden of invasive procedures and unnecessary surgery for benign conditions.

1.3 Significance of the Study

This research aims to evaluate the diagnostic accuracy of ultrasonography (US) in differentiating between benign, and malignant thyroid nodules compared to FNAC. By determining whether the US can serve as a viable alternative to FNAC, which saves non-candidate patients from invasive procedures and seeks to establish effective diagnostic protocols that could enhance patient management and reduce unnecessary invasive procedures. The Society of Radiologists in Ultrasound (SRU) recommends avoiding unnecessary tests and surgeries in patients with benign nodules. "Therefore, to diagnose clinically significant thyroid cancers, the SRU recommends the use of FNAC only when the nodules are

1. ≥ 10 mm in size and with micro calcifications; ≥ 15 mm

2. Solid or with coarse calcifications; ≥ 20 mm

3. Mixed solid and cystic nodules or nodules that significantly increased in size since the last US.

Therefore, an accurate characterization of thyroid nodules by ultrasound may enhance clinical decision-making and patient management. This study will reduce the number of unnecessary biopsies and surgeries by determining the role of ultrasound in predicting benignity or malignancy of thyroid nodules, taking FNAC as a reference. Conducting this study in Tibebe Ghion Specialized Hospital, Bahir Dar, Ethiopia, addresses a gap in the existing literature regarding the use of ultrasound in this specific geographical and cultural context. It contributes to local healthcare knowledge and practices. The findings of this study may also help in the training of junior practitioners of ultrasound characterization of thyroid nodules.

The findings from this study can serve as a basis for further research on thyroid nodule characterization and management in Ethiopia and similar settings. It may pave the way for

larger-scale studies or investigations into other imaging modalities. Thyroid disorders to be a significant public health issue. This study can inform policy decisions regarding screening and management practices for thyroid nodules, ultimately improving health outcomes for the population

To the best of my knowledge, despite the high rates of thyroid nodules and malignancies in the region, there is a lack of studies analyzing the diagnostic accuracy of US for this purpose. Therefore, this research is crucial for clinical practice, patient care, and future research, particularly within the context of thyroid nodule management in Ethiopia

2 Literature review:

2.1 Overview of thyroid nodules

The American Thyroid Association (ATA) defines thyroid nodule as a discrete lesion within the thyroid gland(17). Thyroid nodules are common and are estimated to occur in at least 33% of the population and present a common clinical problem(18) Other Epidemiologic studies estimate that 4% to 7% of adults in the United States have palpable thyroid nodules, with women affected more frequently than men.(15). Thyroid nodules are any discrete lesion that can be delineated on imaging studies from adjacent parenchyma.(19)

Many thyroid diseases can present clinically with one or more thyroid nodules. These nodules represent common and controversial clinical problems. For instance, a study in the United States found that only one out of every 20 clinically identifiable nodules turns out malignant (2), while another reported that the proportion of thyroid cancer from TNs might reach up to 15% (2). Additionally, exposure to ionizing radiation increases the incidence of both benign and malignant nodules, with 20% to 30% of a radiation-exposed population having palpable thyroid disease (15)

Although nodular thyroid disease is relatively common, **thyroid cancer** is rare and accounts for less than 1% of all malignant neoplasms. (15) The overwhelming majority of thyroid nodules are benign (18, 20). The clinical challenge is to distinguish the few clinically significant malignant nodules from the many benign nodules and thus identify patients who need surgical excision. This task is complicated because nodular disease of the thyroid gland often is clinically occult (<10-15 mm), although it can be readily detected by high-resolution sonography (21). Differentiated thyroid cancer, the most frequent subtype of thyroid cancer, is increasing in prevalence (18, 22). Studies suggest that approximately 95% of thyroid nodules are benign and will not progress to malignant disease (20). However, the rate of malignancy within thyroid nodules may be higher in low-resource settings, specifically since nodules are more frequently detected when clinically apparent rather than incidentally (18)

Approximately 80% of nodular thyroid disease is caused by **hyperplasia** of the gland and occurs in up to 5% of the population. (15) The aetiology of hyperplasia includes **iodine deficiency** (endemic), **disorders of hormonogenesis** (hereditary familial forms), and **poor utilization of**

iodine as a result of medication (3). When hyperplasia leads to an overall increase in size or volume of the gland, the term **goiter** is used. Notably, the peak age of patients with goiter is 35 to 50 years, and women are affected three times more often than men (20). Supporting this trend, another study in India also states that there were significantly more women than men presenting with thyroid nodules (21). Furthermore, within that study, 171 (=85.5%) cases had only one thyroid nodule, while 29 (14.5%) had two or more nodules (21).

.

2.2 role of ultrasound in evaluation of thyroid nodules

Neck ultrasound is the diagnostic modality of choice, and it is widely used in thyroid conditions (20, 21). It is estimated that its use could show the existence of thyroid nodules in up to 67 per cent of the population, of which approximately 5 % would be malignant (20). Ultrasound plays an essential role in thyroid evaluation, since it allows us to calculate its size, distinguishing between (single and multiple) nodules and diffuse affection with or without nodules (22).

USG has many advantages as it is noninvasive, lacks radiation, cheap and easily accessible modality, and helps classify categorizing the nodules due to its superior resolution (22). Further, it also detects clinically apparent nodules and can guide FNAC of thyroid nodules. It can detect suspicious thyroid nodules that may require subsequent thorough examination and adequate treatment on time. The ultrasound predictors of thyroid malignancy include the presence of rim or punctate calcification, hypoechoic consistency, irregular margin, solid composition, and taller than wider in shape (23).

2.3 ACR TI-TIRADS classification

ACR TI-RADS is a reporting system for thyroid nodules on ultrasound proposed by the American College of Radiology (ACR)(20). Ultrasound scoring is determined from five categories of ultrasound findings; the higher the cumulative score, the higher the TI-RADS and the likelihood of malignancy (20).

One score is assigned from each of the following categories.

Composition: (choose one)

- o cystic or completely cystic *: 0 points
- o spongiform *: 0 points
- o mixed cystic and solid: 1 point
- o solid or almost completely solid: 2 points

Echogenicity: (choose one)

- o anechoic: 0 points
- o hyper- or isoechoic: 1 point
- o hypoechoic: 2 points
 - very hypoechoic: 3 points

Shape: (choose one) (assessed on the transverse plane)

- o wider than tall: 0 points

- o taller than wide: 3 points
- **Margin:** (choose one)
 - o smooth: 0 points
 - o ill-defined: 0 points
 - o lobulated/irregular: 2 points
 - o extra-thyroidal extension: 3 points

All findings in the final category are also added to the other four scores.

- **Echogenic foci:** (choose one or more)
 - o none: 0 points
 - o large comet-tail artifact: 0 points
 - o macrocalcifications: 1 point
 - o peripheral/rim calcifications: 2 points
 - o punctate echogenic foci: 3 points

Classification

- **TR1:** 0 points
- o benign
 - **TR2:** 2 points
- o not suspicious
 - **TR3:** 3 points
- o mildly suspicious
 - **TR4:** 4-6 points
- o moderately suspicious
 - **TR5:** ≥ 7 points
- o highly suspicious

Recommendations

- **TR1:** no FNA required
- **TR2:** no FNA required
- **TR3:** ≥ 1.5 cm follow up, ≥ 2.5 cm FNA
- o follow up: 1, 3, and 5 years
 - **TR4:** ≥ 1.0 cm follow up, ≥ 1.5 cm FNA
- o follow up: 1, 2, 3, and 5 years
 - **TR5:** ≥ 0.5 cm follow up, ≥ 1.0 cm FNA
- o annual follow-up for up to 5 years

FNA biopsy is recommended for suspicious lesions (TR3-TR5) with the above size criteria(20). If there are multiple nodules, the two with the highest ACR TI-RADS scores should be sampled (rather than the two largest), with the largest size being used as a tie-breaker if there are multiple nodules of the same classification.

Interval enlargement on follow-up is significant if there is an increase of >20% and >2 mm in two dimensions or a >50% increase in volume. If the ACR TI-RADS level increases between scans, an interval scan the following year is again recommended.

Despite this clear guideline, clinicians send every patient for ultrasound and FNAC at the same time in daily clinical practices.

2.4 Fine Needle Aspiration Cytology (FNAC)

Fine needle aspiration cytology (FNAC) is safe, easy to perform(21). Economic and an accurate procedure used in the diagnosis of thyroid Lesions, particularly in the presence of cold nodule(22). It is a well-established outpatient procedure used in the primary diagnosis of palpable thyroid swellings. Currently this technique is practiced world-wide and it is the investigation of choice in thyroid, breast, and lymph node swellings (21) The technique has been shown to be simple, the limitations include false negative results, false positive results and a proportion of FNA results that are not obviously benign or malignant and fall into the indeterminate or suspicious group(22, 23). Published data suggest FNA has an overall accuracy rate around 75% in the detection of thyroid malignancy (24).the other study shows Overall accuracy of FNAC as 85%, with sensitivity of 98% and specificity of 82%(22). Overall, the majority (94%) of nodules were benign, predominated by colloid nodules(25). Malignant nodules accounted for 6% of cases, out of which papillary carcinoma was most common (26). So the overall accuracy of Fine needle Aspiration can be affected by specimen inadequacy and sampling techniques .so managing clinicians should be aware of these potential limitations and pitfalls of FNAC interpretation(22).

2.5 Diagnostic Accuracy of ultrasound compared to FNAC

So, before jumping to the invasive FNAC, scholars recommend the use of high-frequency ultrasound. The question is how sensitive the US is in detecting thyroid nodules and predicting the malignant potential. A study done in India shows sensitivity, specificity, and accuracy of 66.7%, 87.8%, and 82.9%, respectively(27). Many studies have been done worldwide in correlation of US with the most sensitive test, FNAC(28).

a study done in Canada show Sixty-six nodules (8.1%) has a spongiform pattern and all were benign; 28 nodules (3.5%) showed the pattern described as “cyst with colloid clot” and all were benign; 14 nodules (1.7%) showed a “giraffe” pattern and all were proven to be Hashimoto thyroiditis; and eight nodules (1%) showed the “white knight” pattern and all were Hashimoto thyroiditis(29).

A study done in India; Combination of all imaging features on USG has a high sensitivity of 85.71 % and specificity of 90.91%, with 95% CI for diagnosing malignancy, with a significant correlation between USG and FNAC in evaluation of thyroid nodules(19).. So, in experienced hands, the combination of USG features can predict the presence of malignancy in the thyroid

nodule. The accuracy of this simple, safe and cost-effective investigation can be compared with FNAC, which can be reserved for ambiguous lesions.

. A study done in Yemen shows the association between USG and FNAC diagnoses showed a significant relationship ($\chi^2= 34.914$, $P < 0.001$), with a high proportion of benign cases in both USG and FNAC results. Validity analysis demonstrated a sensitivity of 88.68% and a specificity of 70.73% for USG in diagnosing thyroid carcinoma. The positive predictive value was 79.66%, and the negative predictive value was 82.86%. The overall accuracy of USG compared to FNAC was 80.85% (25). There was also a study done in South Africa; there is a high agreement between the ATA classification and Cytopathology or histology when nodule features are grouped into clusters. Agreement between the American Thyroid Association classification and cytopathology/histology was 86.7% with a kappa of 0.714. The agreement between the cytopathology FNA results and lobectomy histopathology was 98.8% with a kappa of 0.973.(30). Another study done at Uganda in patients clinically diagnosed with different benign and malignant thyroid nodules like graves' disease ,hashimoto thyroiditis and thyroid cancer and has both thyroid ultrasound and FNAC show percent of agreement of 90% accuracy ultrasound in predicting thyroid nodule benignity or malignancy.(31) USG-guided FNAC gives an added advantage of providing a more accurate diagnosis of the lesion or the lesions in thyroid. Study USG-guided FNAC better tissue yield and better quality of smears in comparison to conventional FNAC and improved the sensitivity and diagnostic accuracy(32).

Study done at Addis Ababa Ethiopia show over all agreement of ultrasound result and FNAC result of 65.2% (23)

Almost all the above studies in different parts of the world shows ultrasound is a significant noninvasive investigative modality to predict the benignity and malignancy of thyroid nodule before the invasive FNAC. despite the above fact it is common that clinicians send thyroid nodule case to the invasive FNAC before having ultrasound. so this study will show the accuracy of ultrasound compared to FNAC that will minimize the invasive procedures.

2.6 Research gap

Many studies on ultrasound thyroid nodule diagnostic accuracy are conducted in united states, India, Canada and Uganda and show over all high accuracy of ultrasound in diagnosis of thyroid nodules compared with FNAC (33-35), however there is limited evidence in Ethiopia regarding the diagnostic performance of ultrasound features compared to FNAC results.

3 Conceptual framework

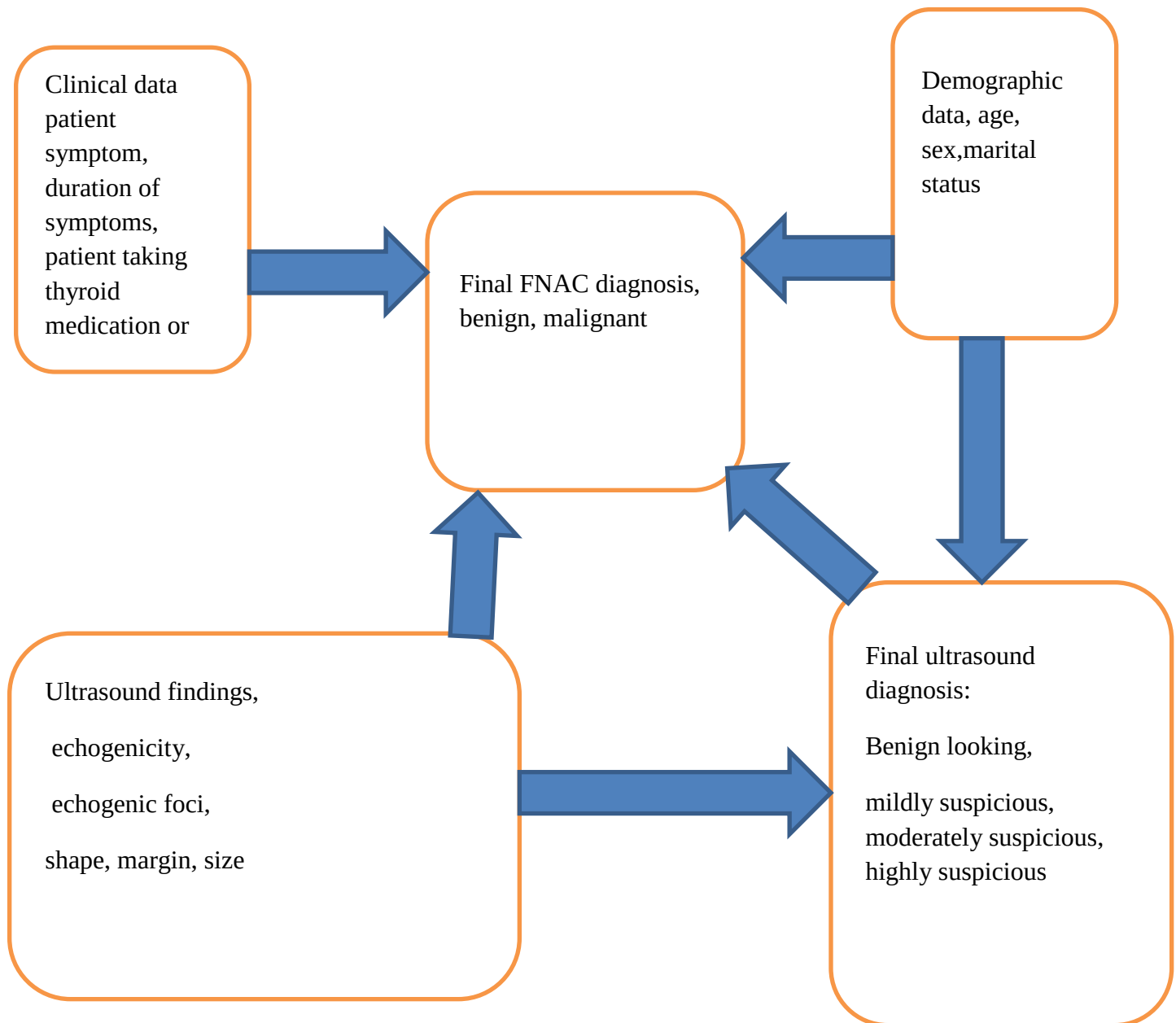


Figure 1 conceptual framework of dependent and independent variables

4. Objectives

4.1 General objective

The general objective of this study is to assess the diagnostic accuracy of ultrasound in the characterisation of thyroid nodule compared to the fine needle aspiration results in patients visiting Tibebe GHION hospital for thyroid scanning from December, 2025 to January 2026

4.2 specific objective

1. To describe ultrasound features of thyroid nodules
2. To determine the diagnostic accuracy, sensitivity and specificity of ultrasound in characterization of thyroid nodules compared to FNA findings in predicting of the benignity or malignancy of thyroid nodules.
- 3 To determine associated factors affecting the benignity and malignancy of thyroid nodules.

5 Method and material:

5.1 Study design & study period

Institution-based cross-sectional study design was used & study was conducted from December to January 2026 GC.

5.2 Study area

The study was conducted at Tibebe Ghion Comprehensive Specialized Hospital located in Bahir Dar city, Amhara Regional State, Ethiopia. Tibebe Ghion Specialized Hospital is situated in Sebatamit, en route to Adet town, approximately 570 kilometers to northwest of the capital city of Ethiopia, Addis Ababa and with 1840 meters (6036 feet above sea level) on the southern coast of Lake Tana. TGSH is a referral hospital serving as a teaching hospital for college of Medicine and Health science of Bahir Dar University and patients with a catchment population of more than five million people who are referred from the region and abuttal regions. The hospital offered a wide range of medical services, including Internal Medicine, Pediatrics, Gynecology/Obstetrics, Surgery, Dentistry, Otolaryngology, Psychiatry, Ophthalmology, Radiology, Dermatology, and Head and Neck Surgery. Each department comprised emergency, inpatient, and outpatient units. The department of radiology is pillar of the hospital with almost fully equipped with modern MRI, CT, Digital X RAY and ultrasound. Radiology department is organized into five subunits. These includes neurology unite, body unite, chest and

cardiovascular unite, musculoskeletal unite and ultrasound unite. This department is among the top reason for patient referral to TGSH different parts of the region and from the surrounding regions, the hospital also pathology department with fully functioning FNAC service.

5.3 Source population

The source population was all patients who visited the radiology department for thyroid nodule scanning.

5.4 Study population

The study population was all patients who visited the radiology department for thyroid nodule scanning from December 1, 2025 to January 30, 2026 G.C.

5.5 Study unit

All patients that were referred to the Radiology Department – TGSH to do neck ultrasound with clinical diagnoses of goiter and have thyroid nodule and FNAC result from December to January 2026 EC and selected by nonprobability consecutive sampling.

5.6 Inclusion & exclusion criteria

5.6.1 Inclusion criteria

all patients referred for thyroid ultrasound imaging with a clinically suspected thyroid nodule

5.6.2 Exclusion criteria

- Patients who has normal thyroid scan
- Patients who had known thyroid malignancy,
- Patients who had bleeding diathesis
- Pediatrics clients who cannot consent.

5.7 Sampling technique and sample size

The sample size was determined based on the objectives.using the following assumptions:

$n = Z^2 \cdot p \cdot (1 - p) / E^2$ where

Z is Confidence Level: 95% (Z = 1.96

p is Proportion which is 65% from previous study

E is Margin of Error .05

N is Population Size.

$N = 1.96 \times 1.96 \times 0.65 (1 - 0.65) / 0.05 \times 0.05$

N=350 and adding 10% it become 385

The time schedule for this research data collection was 2 months making the total working day for ultrasound 40 days, from the hospital registration for neck ultrasound for patients with thyroid nodule is 4 cases maximum daily based, assuming the maximum daily number of 4 cases the expected number of cases in the study period is 160.

now apply the finite population correction since $N = 160$:

$$n_{\text{(corrected)}} = n / 1 + (n - 1)/N\}$$

Substituting the values:

$$n_{\text{(corrected)}} = 385 / 1 + (385 - 1)/160\} = 385 / 1 + 349/160\} = 385 / 1 + 2.1825 = 385 / 3.18125 \approx 121$$

Since the sample size using finite population corrected formula is less than expected case, this study use non-probability consecutive sampling technique and all patients for whom ultrasound and FNAC was done and full fill the inclusion criteria in the study period have been included in our study. 140 cases were identified, from these nine cases had no FNAC result during the study period.

A total of 131 patients with thyroid ultrasound and FNAC were included in the study

5.9 Variables of the study

5.9.1 Dependent variables:

FNAC result (benign thyroid nodules, malignant thyroid nodules)

5.9.2 Independent variables:

Ultrasound findings, size, echogenicity, margin, echogenic, foci, shape, composition

Demographic data, age sex, marital status, educational level

Symptom duration,

5.10 operational definitions

Thyroid nodule: thyroid is defined as any discrete lesion with in the thyroid gland identified by ultrasound

Benign nodule: Thyroid nodule identified as benign by FNAC

Malignant nodule: thyroid nodule identified as malignant by FNAC

Hypoechoogenicity: thyroid nodules with lower echogenicity compared to surrounding strap muscles (darker).

Taller than wider: nodules anteroposterior dimension is larger than transverse dimension

Abnormal calcification: presence of microcalcification (<1mm), macrocalcification (>1mm),

Rim calcification is echogenic calcified rim surrounding the periphery thyroid nodule

Punctate calcification: tiny, punctate echogenic foci usually <1mm inside the nodule with no posterior shadowing.

Smooth margin: well defined nodule border with no irregularity or spiculation

5.11 Data collection procedure

Prepared questionnaires in English language that contain measurable language were utilized. Two radiology residents were trained how to collect data and the questionnaire was explained. Using kobo collect software through smartphone by 2 trained data collectors (residents) from December, 2025 to January 2026 include those patients who has thyroid nodules on ultrasound and signed the consent were included and some of the patients has FNAC at their hand or on their chart was filled at the same day and for patients with no FNAC result at the same day of ultrasound, the medical record number were traced and the result was collected at the card room.

5.12. Data quality control

Trained data collectors (2 resident physicians) collected the data. Training was given for data collectors for one day on method of extracting the needed information, how to fill the information to the **kobo collect** software. Pretest was done using 10% of sample size to asses' understandability of the questioners. The data was collected with close supervision by the principal investigator (PI) to check its consistency and for any ambiguousness of the questionnaire.

5.13. Data processing and analysis

The data was checked for its completeness every day by principal investigator and then it was exported to Statistical Package for Social Science version 27 (SPSS-27) for analysis. Descriptive statistics (mean, standard deviation, median, frequency & percentages) was computed depending on the nature of the variable and results were presented as graphs & tables. Two by two crosstab was used to assess the sensitivity, specificity, positive predictive value and negative predictive

value. Chi-square test, Cohen's kappa and p value were used to assess the association of thyroid ultrasound result with FNAC result and also each ultrasound finding with p value greater than 0.05. Bivariate assessment was used to assess their association with final FNAC diagnosis. Binary logistic regression analysis was performed to identify ultrasound features independently associated with malignancy. Odds ratio with 95% confidence interval were reported. Sensitivity, specificity, positive predictive value and negative predictive value were calculated using FNAC as the reference standard. Receiver operating curve analysis was performed to assess diagnostic performance. Before performing multivariable analysis, multicollinearity among independent variables was assessed using the variance inflation factor (VIF) and a Spearman correlation matrix. Results showed a low risk of collinearity with VIF values less than 5 and correlation coefficient less than 0.6, and Hosmer-Lemeshow test and variables that are not significant are considered for analysis. Finally, variables with P-value <0.05 at confidence interval (CI) of 95% in multi-variate analysis with a corresponding odds ratio was used to declare the variable as having strong association with thyroid malignancy.

5.14 Ethical clearance

Ethical clearance was obtained before data collection from the institutional review board of BDU College of Health Science and Medical Faculty after receiving support letter from the radiology department. In order to respect patient's bill of rights, regulation of the Tibebe Ghion hospital where the study was conducted, permission was obtained from the officials. Any piece of information was kept confidential by keeping anonymity of the study subjects.

6. Results

6.1 Sociodemographic characteristics

The study included 131 patients with thyroid nodules; the majority were females, 85.5% (N = 112) and the rest 14.5% were males. The mean age was 41 years and the age range was 20, with minimum 20 years and maximum 70 years. The average duration of symptom is 7 years.

Table 1 SOCIO-DEMOGRAPHICCHARATERSTICS OF PATIENTS WHO HAD THYROID NODULE ON
ULTRASOUNDAND FNAC FROMDECEMBER TO JANUARY ,2026 (N-131)

Variables	Category	Frequency	Percentage (%)
Sex	Female	112	85.5
	Male	19	14.5
Age	20-30 years	38	29
	30- 40years	40	30.5
	40-50 years	27	20.6
	50-60 years	18	13.7
	60-70	8	6.1
Marital status	Married	97	74
	Single	25	19.1
	Widowed	7	5.3
	Divorced	2	1.5

6.2 clinical data

The most common symptom was anterior neck swelling (81.7%,N=107),has no previous thyroid surgery (93.1%,N=122),has no family history of thyroid disease (96.2%,N=126) ,do not take thyroid medication (67.9%,N=89).

The average duration of symptoms was 7 yrs.

6.3 ultrasound image findings

The average size of the thyroid nodules were 3 cm, Most thyroid nodules were solid in composition (58% (N =77)) ,iso/hyperechoic in echogenicity ((.66.4% N =67),wider than taller in shape 92.4 % (N= 112 ,smooth in margin (72.5 % ,N= 95) and has no or large comet tail artifact (56.4 % (N = 74)). Most of the thyroid nodules were benign looking in the final ultrasound diagnosis 46.6% (N =61_) (Table 2)

Table 2 Ultrasound findings in patients having thyroid nodule in TGS from december2025-january 2026 (N-131)

Ultrasound finding		frequency	percent
Composition	Solid	77	58.8
	Cystic	18	13.7
	Mixed cystic and solid	26	19.8
	Spongiform	10	7.6
Echogenicity	Anechoic	22	16.8
	Hyperechoic or isoechoic	87	66.4
	Hypoechoic	22	16.8
	Very hypoechoic		
Echogenic foci	No or large comet tail artifact	74	56.8
	Macro calcification	37	26.7
	Peripheral or rim calcification	18	13.7
	Punctate	4	3.1
Margin	Smooth	95	72.5
	Ill-defined	22	16.8
	Lobulated or irregular	12	9.2
	Extra thyroidal extension	2	1.5
Final ultrasound diagnosis	Benign looking	61	46.6
	Mildly suspicious	29	22.1
	Moderately suspicious	26	19.8
	Highly suspicious	15	11.5
Shape	Wider than taller	121	92.4
	Taller than wider	10	7.6

6.4 FNAC RESULT

About 80.2% (N =105) were benign and 19.8 % (N= 26) were malignant

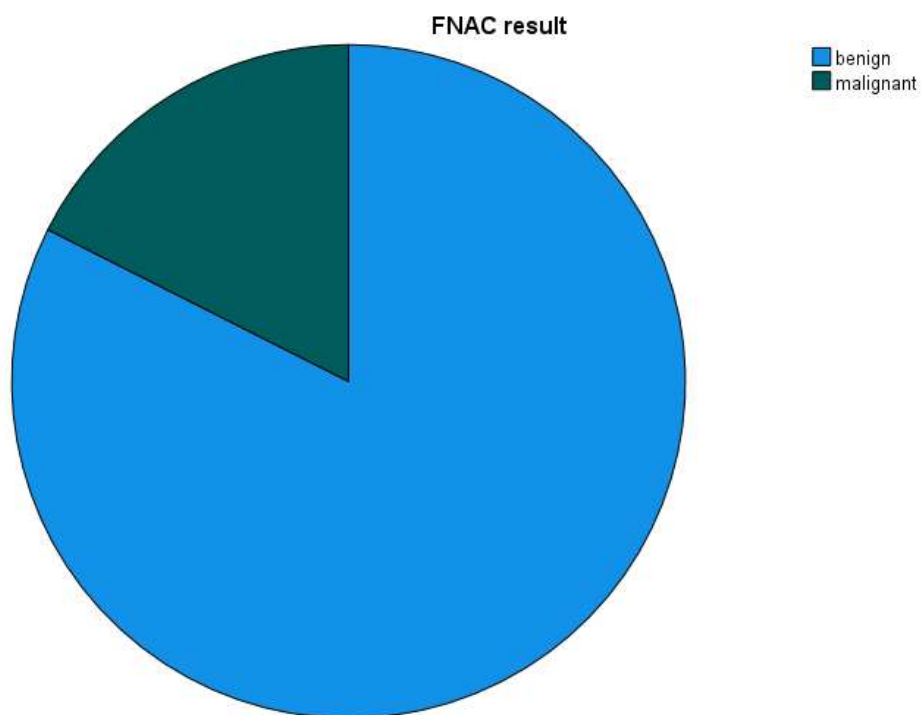


Figure 2 show distribution of FNAC results in TGSH from December to January 2026 (N=131)

6.5 diagnostic accuracy, sensitivity and specificity of ultrasound compared to FNAC

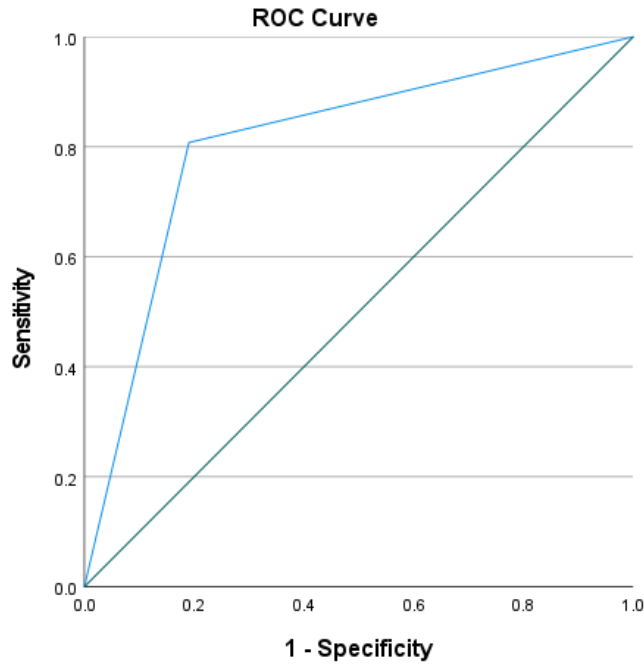
Most of the nodules from the final ultrasound diagnosis were benign comprising about 68.7% (N=90) from this about 94.4% (N=85) were benign by FNAC and the rest 5.6 % (N=5) were malignant on FNAC. the remaining 41 cases were diagnosed as malignant on ultrasound from which 20 cases were benign by FNAC and 21 cases were malignant on FNAC. The overall sensitivity is 80.8% and specificity is 81%. the negative predictive value is 94.4 % and the positive predictive is 51.2%. the overall accuracy of ultrasound to predict malignancy is 80.9%.

Table 3 ASSOCIATION BETWEEN ULTRASOUND DIAGNOSIS AND FNAC RESULTS IN PATIENTS HAVING THYROID NODULE IN TGSH FROM DECEMBER 2025 TO JANUARY 2026 (N=131)

Ultrasound diagnosis	FNAC malignant n(%)	FNAC benign n(%)	Total	X2 (df)	P value
Malignant looking	21(51.2%)	20 (48.8%)	41		
Benign looking	5 (5.6%)	85(94.4%)	90		
Total	26(19.8%)	105 (80.2%)	131	36.92	0.001

Table 4 the validity of thyroid ultrasound diagnosis of thyroid carcinoma in TGSH from December 2025- January 2026 (N=131)

Statics	Value
Sensitivity	80.8%
Specificity	81%
Positive predictive value	51.2%
Negative predictive value	94.4%
Overall accuracy	80.9%
Kappa(K)	0.51



Diagonal segments are produced by ties.

Figure 3 showing the diagnostic accuracy of ultrasound in differentiating malignant and benign nodules in TGSH from December to January 2026 (N=131)

Table 5 showing the diagnostic accuracy of ultrasound in differentiating malignant and benign nodules based on ROC

TEST	AUC	95% CI
ULTRASOUND DIAGNOSIIS	0.809	0.7-09

6.6 Factors that affect the final FNAC diagnosis

Bi-variate and multivariate logistic regression was undertaken to select significant factors associated with thyroid malignancy on FNAC. Bi-variate logistic regression analysis revealed that being male in gender, presence of abnormal echogenicity(hypoechoic or very hyperechoic), taller than wider in shape, irregular margin or extra thyroidal extension, presence of internal calcification (macro, peripheral or punctate) and final ultrasound diagnosis of malignant looking were all significantly related with thyroid malignancy in FNAC. Bi-variables with p-value < 0.25 were a candidate for multivariable analysis. In the multivariable analysis abnormal echogenicity

(being hypoechoic), abnormal shape (taller than wider) and final ultrasound diagnosis were significantly associated with thyroid malignancy with p value of <0.05 . Those patients who had hypoechoic thyroid ultrasound have 4.5 times higher risk of having thyroid malignancy than those anechoic echogenicity (AOR=4.5, 95% CI (1.2-16)). Patients who had taller than wider shape had 12.6 times higher risk of thyroid malignancy than those who wider than taller shape (AOR=12.6, 95% CI (1.1-142)). And patients who had malignant looking ultrasound diagnosis has 5.2 times more likely to be malignant compared to benign looking nodules (AOR=5.2, 95% CI 1.4-19.4).

Table 6 Bivariate and multivariate regression analysis to identify factors associated with thyroid malignancy patients with thyroid nodules in TGSB, from December 2025 to January 2026 (N=131)

Variable name	Category	Benign Malignant	COR (95%CI)	P value	AOD	95%CI	P value
Gender	Male	Benign=10 Malignant=9	5	0.002	1.897	0.396- 9.089	0.423
	Female	Benign=95 Malignant=17					
Abnormal echogenicity	Yes	Benign=11 Malignant=13	8.5	0.001	7.835	2.5-24	<0.001
	No	Benign=94 Malignant=13					
Abnormal internal calcification	Yes	Benign=31 Malignant=16	3.6	0.005	3.6	1.3-10.5	0.018
	No	Benign=72 Malignant=10					
Margin	Smooth/ill-defined	Benign =100 Malignant =16	12.5	0.001	7.8	2.053- 29.9	0.003
	Irregular /extrathyroidal extension	Benign =5 Malignant =15					

7. DISCUSSION

Thyroid carcinoma is the leading cause of death among endocrine cancers following ovarian cancer .it is reported to be one of the fastest growing types of malignancies in the world(36).the prevalence of thyroid cancer in norther Ethiopia is estimated to be 7.5 %(37). The wide spread dissemination of modern medical imaging—in particular, high-resolution ultrasound—has resulted in our ability to detect thyroid nodules in at least 50% of the general adult population, compared with a detection rate of 4–8% by traditional clinical palpation(29). Using latest sonography techniques, evaluation of thyroid nodule and diagnosing as malignant without FNAC has risen to 90% specificity and almost 100% sensitivity(38). This study was conducted to assess the diagnostic accuracy of ultrasound in the characterisation of thyroid nodules compared to FNAC in patients scanned for thyroid nodules and had thyroid nodules in both ultrasound and FNAC TGSH, from December to January 30, 2026 G.C.

From this study, the overall accuracy of ultrasound in characterisation of thyroid nodules compared to FNAC was 80.5 (X²=36.9, P=0.001), the sensitivity was 80.8%, the specificity was 81%, showing a strong association. This overall accuracy was comparable with study done in Indian showing 82% accuracy, but has higher sensitivity (80.8% vs 66.7%,) and lower specificity (81% vs 87.8%).(27).the higher sensitivity in our study suggests improved detection of malignant nodules which is important for early cancers detection in our institution. The lower specificity in our institution shows higher rate of false positive cases indicating some benign nodules misclassified as malignant that indicates ultrasound alone cannot diagnosis thyroid malignant unless we confirm by FNAC in our institution. This can be due to operator experience since ultrasound is operator dependent. The sensitivity and specificity of our study comparable with other study done in India with overall sensitivity and specificity of ultrasound was (81.25%) and (86.54%) respectively (33)

The patterns of ultrasound findings in our study show, most thyroid nodules were solid in composition comprising 58.8%, 92.4% had wider than taller, 89.3% had smooth margin, 66% had hyperechoic/isoechoic and 56.8% had no or large comet tail artifact. These ultrasound findings show most of the thyroid nodules in our study were benign .This show comparable result with the study done on Uganda(26) suggesting regional similarity in sonographic patterns.

In this study, as shown in the multivariate analysis, those patients who has hypoechoic ultrasound findings had an increased chance of being malignant in FNAC (OR=7.8, P<0.001). This indicates that patients with hypoechoic nodules were approximately 7.8 times more likely to

have malignant cytology compared to those with anechoic nodules. This finding is consistent with international literature (39).

The second associated factor with increased malignancy in this study was the presence of abnormal internal calcification (OR=3.6 P=.0.018). Thyroid Nodules having abnormal calcification (macro/rim/peripheral or punctate) were about 3.6 times more likely to have thyroid malignancy than thyroid nodules with no internal calcification or with large comet tail artefact.

The third associated factor in this study with increased malignancy was the presence of irregular /extra thyroidal extension margin (OR=7.8,P=0.003) .Thyroid nodules with irregular margin or with extra thyroidal extension were 7.8 times more likely to have thyroid malignancy than nodules with smooth margin. The finding is consistent with study done at Thailand reported as Malignant nodules were more likely to have irregular or spiculated borders (p-value<0.001)(39).in this study almost all the above variables had strong association but there was wide confidence interval ,it was due to small malignant cases compared with the number of variables.

8 Limitations of the Study:

This study tries to assess the diagnostic accuracy of ultrasound in the diagnosis of thyroid nodules' malignancy, taking FNAC as the standard and ultrasound predictors of

This study had the following limitations:

1. This research takes FNAC as reference but it would have been better if surgical biopsy were taken instead.
2. This study was executed a single-centered study. Results of a multicenter study would be more generalizable.
3. This study used cross-sectional study design and unable to fully capture seasonal or population variability

9. CONCLUSION:

This study was conducted to assess the diagnostic accuracy of ultrasound in the characterization of thyroid nodules compared with the standard FNAC at TGSH. The finding show good diagnostic performance of ultrasound in differentiating benign from malignant thyroid nodules showing high overall diagnostic accuracy compared to FNAC.

There was a statistically significant association between ultrasound diagnosis and FNAC, indicating ultrasound is a reliable tool for initial evaluation of thyroid nodules.

In multivariate analysis hypoechogenecity, having peripheral /rim/punctate calcification and nodules with irregular margin were identified as significant independent predictors of malignancy.

Most of the thyroid nodules in this study had benign ultrasound features including smooth margin, no internal calcification, wider than taller shape and anechoic or isoechoic/hyperechoic echotexture.

Most thyroid nodules in the study were benign on FNAC diagnosis.

10. Recommendation:

The following recommendations were made based on the findings of this study:

For Bahir Dar University, TGSH clinicians who evaluate patients with thyroid nodules:

- ✓ Ultrasound has a high negative predictive value so that patients diagnoses as benign in ultrasound has high probability to have benign FNAC result so it is better to decide based on ultrasound diagnosis than sending every patient for invasive FNAC.but in patients having malignant looking ultrasound diagnosis ,it is recommended to confirm with FNAC since US has high false positive rate.

For the department of radiology:

- ✓ Regular training and mentor radiology residents to reduce high false positive rate.
- ✓ To avail high quality ultrasound machine.

For the department of pathology

- ✓ **It is better take ultrasound guided FNAC rather than free hand FNAC to enhance nodule detection and appropriate diagnosis:**

For researchers

- ❖ It is better to do in multiple institutions with long study period with large sample size.
- ❖ Better to use histopathology result rather than FNAC to assess the diagnostic accuracy.

11.Reference

1. Vigneshwar A, Ashwin K, C.Saravanan. ROLE OF TIRADS IN THE CHARACTERISATION OF THYROID NODULES IN CORRELATION WITH FNAC. JAMP. 2023;2.
2. Mustafa T, MUSTAFA S, SABIRNA A. Accuracy of Ultrasound Scans as Compared to Fine Needle Aspiration Cytology in the Diagnosis of Thyroid Nodules. PUBMED. 2023.
3. Maria B, Michael K, Angeliki C. Diagnostic Accuracy of Ultrasound and Fine-Needle Aspiration Cytology in Thyroid Malignancy. 2024.
4. Habib A, Aad V. TI-RADS -THYROID IMAGING REPORTING AND DATA SYSTEM . RADIOLOGY ASSISSTANT. 2008.
5. AHMET B, HÜLYA Ç, TUĞÇE D, ASUMAN A. Ultrasonographic Characteristics of Thyroid Nodules with Nondiagnostic and Atypia of Undetermined Significance in Fine-Needle Aspiration Cytology. journal of the belgian society of radiology. 2023.
6. bdalwahab R. Abdalwahab ATO, Tarek Khairy, Osman A. Algadir Ali, Mai Gad, Mona Alabrak, Shady Mohammed Elsebai, Reda Tobashy, Amal A. ALI, Mohamed Elmahdy, Mohamed Atef Elkord. Comparative Cross Sectional Study Between Accuracy of Ultrasonography and Cytology in Diagnosis of Thyroid Cancer with Final Histopathology Results. 2025.

7. Lam CA, McGettigan MJ, Thompson ZJ, Khazai L, Chung CH, Centeno BA, et al. Ultrasound characterization for thyroid nodules with indeterminate cytology: inter-observer agreement and impact of combining pattern-based and scoring-based classifications in risk stratification. 2019;66:278-87.
8. Bernadette L. Koch M, Radiology ADo, Center CCsHM, Pediatrics PoCRa, Medicine UoCCo, Cincinnati O, et al., editors. DIAGNOSTIC IMAGING HEAD AND NECK. 3RD ed. Philadelphia,2017.
9. Yisihak Suga EA. tterns of Surgically Treated Thyroid Disease: A Two Years Review at St. Paul Hospital Millennium medical Collage, Addis Ababa, Ethiopia. research gate. 2020:6.
10. Mulatu B. Pattern of Thyroid Cancer and Its Associated Factors Among Thyroid Patients Underwent Thyroidectomy at Jimma Medical Center, Southwest Ethiopia; A Four Years Retrospective Review. research square. 2020:15.
11. Ersumo T. HYPERTHYROIDISM IN A PRIVATE MEDICAL SERVICES CENTER, ADDIS

ABABA: A 5-YEAR EXPERIENC. ethiopian medical journal. 2025;58:9.

12. Tadesse T. Prevalence and Associated Factors of Thyroid Incidentaloma among Adult People Attending Gondar University Hospital, Northwest Ethiopia. PUBMED. 2020:8.
13. Tariq Alam. Diagnostic Accuracy of Ultrasonography in Differentiating

Benign and Malignant Thyroid Nodules Using Fine Needle

Aspiration Cytology as the Reference Standard. sian Pacific Journal of Cancer Prevention,. 2014

15.

14. e m. Ultrasound Characteristics and ACR-TIRADS Classification of

Thyroid Incidentalomas in Adults Undergoing Imaging for NonThyroid Conditions In NAUTH, Nnewi. 2023;1:22.

15. carol m, Stephen R. DIAGNOSTIC ULTRASOUND2013.
16. Jean-Yves Meuwly MDL, MD • Nicolas Theumann, MD, Pierre Schnyder MGE, MD • Judith Hohlfeld, MD, Franc,ois Gudinchet M. Multimodality Imaging

Evaluation of the Pedi

atric Neck: Techniques

and Spectrum of

Findings. 2005.

17. Tuladhar AS. Correlation of American College of Radiology (ACR)-Thyroid Imaging Reporting and Data System (TIRADS) findings in Ultrasonogram (USG) of thyroid nodules with FNAC or Biopsy findings. 2022.
18. MD1 MZ. African Head and Neck Society Clinical Practice guidelines

for thyroid nodules and cancer in developing countries and

limited resource settings. WILEY. 2020:11.

19. Nikita M, Rishika S. Correlation ofUltrasonography and Fine Needle

Aspiration Cytology inEvaluation ofThyroid Nodules

At Tertiary Care Centre. International Journal of Current Medical And Applied Sciences. 2021.

20. Khalighinejad P. ACR Thyroid Imaging Reporting and Data System (ACR TI-RADS)2025.

21. , Garota DSA. The Assessment of Specificity & Sensitivity of FNAC in Thyroid Lesions in Erbil
Zanco J Med Sci, . 2009;13.
22. R. S. Thyroid FNAC: Practice and Pitfalls
indian journal of pathology. 2020;4.
23. BIRHANU. Concordance between BETHESDA cytology classification and ACR-TIRADS ultrasound classification in evaluation of thyroid nodule, at Tikur Anbesa Specialized Hospital, Addis Ababa, Ethiopia: Prospective study from April,2023-october,2023. 2023.
24. Nasut JF. Diagnostic value and cost-effectiveness of on-site evaluation of fine-needle aspiration specimens: review of 5,688 cases
pubmed. 2004.
25. Omar H. Thyroid nodule diagnosis: A comparative analysis of ultrasonography and fine-needle aspiration cytology. Indian Journal of Medical Sciences. 2024.
26. Imran N, Prof. Manjeet S, Prof. Shiekh R. Ultrasound and Fine Needle Aspiration Cytology Correlation of Thyroid Nodules. IOSR Journal of Dental and Medical Sciences (IOSR-JDMS). 2017.
27. Sowmya R, Hemanth V, Nirupama V. SONOGRAPHIC ASSESSMENT OF VARIOUS THYROID NODULES AND THEIR CORRELATION TO HISTOPATHOLOGICAL EXAMINATION. International Journal of Current Pharmaceutical Research. 2025;99-102.
28. Iss HM. Correlation of the ultrasound thyroid imaging reporting and data system with cytology findings among patients in Uganda. BMC. 2023;1:7.
29. Virmani V. sonographic patterns of thyroid nodules. american jornal of radiology. 2010;1:3.
30. Mark A, Kathleen J, Sindeep B. A retrospective study correlating sonographic features of thyroid nodules with fine-needle aspiration cytology in a South African setting. 2019.
31. mohamed h. Correlation of the ultrasound thyroid imaging reporting and data system with cytology findings among patients in Ugand. 2022;22.
32. Burdak P. Study of Diagnostic Efficacy of Ultrasound Guided FNAC Vs Conventional FNAC for Thyroid Nodule at a Tertiary Care Center. International Journal of Toxicological and Pharmacological Research. 2023;1:5.

33. Mohammed HU. Role Of Sonography in Characterization of Thyroid Nodule indian journal of radioology. 2025;1:3.
34. Valderrabano P. The new ATA sonographic patterns for thyroid nodules perform well in medullary thyroid carcinoma: Institutional experience, systematic review and meta-analysis american jornal of radiology. 2024:26.
35. Tuladhar AS, Pudasaini S, Simkhada S, Shrestha A, Pradhan S. Correlation of American College of Radiology (ACR)-Thyroid Imaging Reporting and Data System (TIRADS) findings in Ultrasonogram (USG) of thyroid nodules with FNAC or Biopsy findings. Nepal Medical College Journal. 2022.
36. DENDENA A. Prevalence of thyroid cancer among thyroid swelling in Jimma University Medical Center, South West Ethiopia: A five-year retrospective study. international jounal of medicine and medical science. 2025;10:6.
37. Abebe B. M.D. Lecturer and General practitioner, Girmaye T. M.D. Assistant professor of surgery, Mensur O. M.D. Assistant professor of surgery, Sentayehu T. M.D. General practitioner, surgery SBMDApo. The Patterns Of Surgical Thyroid Diseases And Operative Treatment In Gondar College of Medical sciences, North-western Ethiopia.1,7.
38. BAZAI RR. Role of Ultrasound for Diagnosing and Management of Malignant Thyroid Nodule. P J M H S 2020;14,:3.
39. Cholati Wiratkapun MD*. Ultrasound Predictors of Thyroid Cancer 2013:4.

ANNEX

I Information Sheet

Title of the Study:

Diagnostic accuracy of ultrasound in characterization of thyroid nodules compared to FNAC and associated factors Patients Visiting Tibebe Ghion Specialized Hospital for Thyroid Nodule Scanning, Bahir Dar, Ethiopia, 2026 G.C.

Principal Investigator:

By Simegnew Getahun (MD,Radiology Resident)

Bahir Dar University College of health science department of clinical radiology

ANLEYMOM143@GMAIL.COM

Introduction:

You are being invited to participate in a research study that aims to evaluate the effectiveness of ultrasound in characterizing thyroid nodules by comparing ultrasound findings with FNAC results. This study is being conducted at Tibebe Ghion Specialized Hospital.

Purpose of the Study:

The purpose of this study is to determine how accurately ultrasound can characterize thyroid nodules compared to the results obtained from histopathological examinations. This information may help improve diagnostic accuracy and patient management in the future.

Study Procedures:

If you agree to participate in this study, you will be asked to:

- Undergo an ultrasound examination of your thyroid nodule.

- Provide a sample for FNAC analysis, which may involve a fine needle aspiration (FNA) biopsy (if clinically indicated).
- Complete a questionnaire regarding your medical history and demographic information.

Duration:

The ultrasound scanning will take approximately 30 minutes and FNAC may depend on the clinical schedule.

Confidentiality:

All information collected during this study will be kept confidential and used only for research purposes. Your identity will not be disclosed in any reports or publications resulting from this study. I will use unique study code, data will be stored in password protected device, access limited to investigators and advisors

Risks and Benefits:

- Risks: The ultrasound procedure is generally safe with minimal risks. However, there may be discomfort associated with the FNAC biopsy. FNAC will be done when clinically indicated and no additional procedure will be done solely for research purpose and we will use only existing data
- Benefits: There is no direct clinical benefit for you but your participation may contribute to better understanding and management of thyroid nodules and may potentially benefit future patients.

Voluntary Participation:

Participation in this study is entirely voluntary. You may withdraw at any time without any impact on your medical care. If you withdraw, no new data will be collected, previously collected anonymized data will be used.

Contact Information:

If you have any questions or concerns about this study, please contact:

Simegnew getahun
Bahir Dar Univesrsity department of clinical radiology
Phone number 0912806032
[Email Address] ANLEYMOM143@GMAIL.COM

ANNEX II. Consent Form

Title of the Study:

Percent of Agreement of Ultrasound in Characterization of Thyroid Nodules Compared to Histopathology Results in Patients Visiting Tibebe Ghion Specialized Hospital for Thyroid Nodule Scanning, Bahir Dar, Ethiopia, 2025 G.C.

I have read and understood the information sheet provided to me regarding this study. I have had the opportunity to ask questions and have received satisfactory answers. I understand that my participation is voluntary and that I may withdraw at any time without affecting my medical care.

By signing below, I consent to participate in this study.

Participant's Name _____

Participant's Signature: _____

Date: _____

Investigator's Name : ____Simegnew Getahun (MD,)_____

Investigator's Signature: _____

Date: _____

ANNEX III. ENGLISH version questionnaire:

DATE: -----/-----

Sociodemographic data

1,1	Age	
1.2	Sex	Male female
1.3	Marital status	Married Single Widowed divorced
1.4	Educational level	Illiterate Read and right Complete primary school Complete secondary school Degree and above

Clinical history

2.2	Previous history of thyroid disease	Yes no
2.3	Previous history of thyroid surgery	Yes No
2.4	Family history of thyroid disease	Yes No
2.5	How long the nodule stay	...yrs

Ultrasound findings

Composition	Predominantly solid Predominently cystic Mixed cystic and solid spongiform
Echogenicity	Anechoic

	Iso/hyperechoic Hypoechoic Veryhypoechoic
Echogenic foci	No or large comet tail artifact Macrocalcification Rim or peripheral calcification Punctate calcification
Shape	Wider than taller Taller than wider
Margin	Smooth Ill defined Irregular Extrathyroid extension

FNAC findings

FNAC was taken under ultrasound guidance	Yes no
Final cytology result from the FNAC	benign malignant

ANNEX IV DECLARATION.

This is to certify that the entitled “Assessment of diagnostic accuracy of ultrasound in characterization of thyroid nodules compared to FNAC in TGSH” submitted in partial fulfillment of the requirements for specialty in Clinical radiology department of clinical radiology Bahir dare university is a record of original work carried out by me and has never been submitted to this or any other institution to get any other degree or certificate. The assistance and help I received during the course of this investigation have been duly acknowledged.

Investigator:

Dr. Simegne Getahun (MD, year III clinical radiology resident)

Signature _____

Date _____