Al - Saeed University Journal of Applied Sciences
journal@alsaeeduni.edu.ye
Vol (9), No(2), Aug., 2026
ISSN: 3104 - 8978 (Print) ISSN: 3104-8986 (Online)

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Received: 8/7/2026 **Accepted: 30/7/2026**

Journal Website: https://journal.alsaeeduni.edu.ye

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Abstract

Background: Thyroid disease is a common indication for surgery, and histopathology remains the definitive method for diagnosis. This study described the pattern of thyroid diseases.

Methods: retrospective descriptive-analytical study was conducted in three main hospitals of Taiz City Al-Dakaf, Al-Gomhouri Teaching and Al-Safwa) covering January 2023 to December 2024. Records of 250 patients who underwent thyroidectomy

Results: Females comprised 92.4% of patients, with a median age of 40 years. Multinodular goiter was the most frequent benign lesion (46.0%) while malignancy was identified in 39 patients (15.6%), papillary-patterned carcinoma accounted for 92.3% of malignant tumors. Hoarseness, weight loss, appetite loss, cervical lymphadenopathy, suspicious ultrasound and FNA findings, higher TI-RADS categories

Conclusion: Approximately one in six thyroidectomy specimens was malignant. Clinical warning symptoms combined with ultrasound findings improved preoperative risk stratification and may support earlier diagnosis and appropriate surgical management in resource-limited settings.

Keywords: thyroidectomy; thyroid disease; TI-RADS; FNAC; Taiz.

Introduction

The thyroid gland regulates basal metabolism, growth, thermogenesis, cardiovascular function, and neurodevelopment through secretion of triiodothyronine and thyroxine (Hall & Hall, 2021; Melmed et al., 2020). Thyroid swelling is among the commonest endocrine presentations encountered in outpatient and surgical practice, and it may reflect diffuse goiter, multinodular goiter, a solitary nodule, thyroiditis, toxic nodular disease, cystic change, or malignant neoplasia. Although most thyroid nodules are benign, the possibility of malignancy remains clinically important because it determines the urgency of evaluation, the need for surgery, and the extent of postoperative follow-up (1)

Thyroid cancer is the most common endocrine malignancy worldwide, and its reported incidence has risen in recent decades, partly owing to wider use of imaging and improved pathological detection (2)(3)(4). Because clinical examination alone cannot reliably distinguish benign from malignant lesions, contemporary assessment relies on risk stratification using history, physical examination, ultrasonography, and fine-needle aspiration cytology, with final histopathological examination remaining the definitive diagnostic standard when surgery is performed(1)(5)(6). In surgical cohorts, the frequency of malignancy among thyroidectomy specimens reflects both the underlying disease burden and the effectiveness of preoperative diagnostic selection.

In Yemen, thyroid disease remains an important public-health and surgical problem. Historical iodine deficiency, delayed presentation, and uneven access to specialized diagnostic services have contributed to a persistent burden of goiter and thyroid neoplasia.(7)(8) Prior Yemeni studies from Sana'a and Ibb indicate that benign thyroid disease remains the dominant indication for surgery, yet a clinically meaningful proportion of thyroidectomy specimens are malignant, underscoring the need for locally relevant evidence to guide risk assessment and surgical decision-making(8)(9)(10). No dedicated study was identified that specifically quantified the pattern and frequency of malignancy among patients undergoing thyroidectomy in the main hospitals of Taiz City, a setting with distinct healthcare constraints and referral dynamics that may not mirror other Yemeni centers(11).

This study was therefore undertaken to describe the pattern of thyroid diseases and determine the frequency of malignancy among patients undergoing thyroidectomy in the main hospitals of Taiz City, Yemen, during January 2023 to December 2024, and to identify clinical, radiological, and cytological factors associated with malignant disease. The specific objectives were to describe the demographic characteristics of the study population, to determine the histopathological spectrum of thyroid disease, and to identify potential predictors of thyroid malignancy in this population.

Methods

Study design and setting

This was a hospital-based, retrospective, descriptive-analytical study based on review of existing clinical, operative, radiological, cytological, and histopathological records. It was conducted in the three main hospitals of Taiz City, Yemen (Al-Dakaf, Al-Gomhouri Teaching and Al-Safwa), which provide general surgical services to patients from Taiz and surrounding mountainous and lowland areas. The study period extended from January 2023 to December 2024.

Study population and sampling

The study population comprised all patients who underwent thyroidectomy in the participating hospitals during the study period and whose records contained postoperative histopathological findings. A total-coverage sampling approach was used, in which all eligible thyroidectomy cases recorded during the study period were reviewed. Records with missing essential histopathological outcome data were excluded. The final analytic sample comprised 250 patients.

Operational definitions

Thyroid malignancy was defined as any malignant diagnosis confirmed by final histopathological examination of the thyroidectomy specimen, classified according to standard WHO endocrine tumour criteria (12). Ultrasonographic risk was categorized using the Thyroid Imaging Reporting and Data System (TI-RADS) as recorded in the source radiology reports(13) and cytology was categorized using the Bethesda System for Reporting Thyroid Cytopathology terminology as documented in the available reports (14)(15).

Data collection

Data were abstracted retrospectively using a structured data sheet from hospital records, operative notes, imaging reports, cytology reports where available, and final histopathology reports. Variables collected included demographic characteristics, residence, special habits and possible risk factors (qat chewing, smoking, radiation exposure, family history), presenting symptoms, duration and type of thyroid swelling, ultrasonographic findings and TI-RADS category, computed tomography findings where performed, fine-needle aspiration cytology findings where performed, operative procedure, final histopathological diagnosis, and pathological staging for malignant cases. The primary outcome was thyroid malignancy confirmed by histopathological examination of the thyroidectomy specimen.

Statistical analysis

Categorical variables were summarized as frequencies and percentages, and continuous variables as medians with interquartile ranges. Associations between potential predictors and thyroid malignancy were examined using the chi-square test or Fisher's exact test for categorical variables, as appropriate, and the Mann-Whitney U test for continuous variables. Diagnostic performance of significant clinical, ultrasonographic, and cytological variables was assessed using sensitivity, specificity, accuracy, predictive values, and likelihood ratios, together with receiver operating characteristic (ROC) curve analysis. Independent predictors of malignancy were identified using multivariable binary logistic regression, and the discriminatory performance of the final model was assessed using the area under the ROC curve. Statistical significance was set at $p < .05$.

Ethical considerations

This study was based on retrospective review of existing records and histopathological reports. Patient confidentiality was preserved during data abstraction and analysis, and data were used only for academic and research purposes; no identifying personal information is presented in this report.

Ethical approval or an official protocol waiver was obtained from an Institutional Review.

Board (IRB) or Research Ethics Committee at Taiz University or the involved hospitals.

Results

This retrospective analysis included 250 patients who underwent thyroidectomy in the three main Taiz hospitals over the two-year study period.

Demographic and background characteristics

The majority of patients were female (92.4%), giving a female-to-male ratio of approximately 12.5:1. The median age of the cohort was 40 years (IQR 32–50), with the highest proportion of operations performed in the 30–39-year age group (31.6%). Most patients (89.2%) resided in mountainous areas. Diagnostic radiation exposure by 18.0%, and a family history of thyroid disease by 16.7%; none reported prior radiotherapy exposure.

Table 1.

Demographic and Background Characteristics of Patients Undergoing Thyroidectomy (N = 250)

Characteristic	Category	n	%
Sex	Female	231	92.4
	Male	19	7.6
Age group (years)	< 20	6	2.4
	20–29	36	14.4
	30–39	79	31.6
	40–49	65	26.0
	50–60	40	16.0
	> 60	24	9.6
Residence	Mountainous areas	223	89.2
	Lowland/coastal areas	27	10.8
Diagnostic radiation exposure	Yes	44	18.0
Family history of thyroid disease	Yes	41	16.7

Note. Median age of the cohort = 40 years (IQR 32–50).

Clinical presentation

Thyroid swelling was the presenting complaint in 98.8% of patients. Other frequent symptoms included dyspnea (61.8%), dysphagia (60.5%), dizziness (43.1%), neck pain (40.0%), and hot or cold temperature intolerance (34.0%).

Hoarseness (10.9%), cervical lymphadenopathy (2.5%), and syncope (4.4%) were less common but, as shown below, carried greater diagnostic significance for malignancy.

Radiological and cytological findings

On preoperative ultrasonography, most nodules were solid (76.8%) and homogeneous (61.2%). Applying the Thyroid Imaging Reporting and Data System (TI-RADS), the most frequent category was TI-RADS 2 (36.8%), followed by TI-RADS 3 (33.0%); TI-RADS 4 and 5 accounted for 14.0% and 8.0% of cases, respectively. Contrast-enhanced CT of the neck was performed in only 5 patients. Fine-needle aspiration cytology (FNAC) was performed in 48 patients (19.2%); the commonest cytological category was Thy2/non-neoplastic (47.9%), while Thy5/malignant accounted for 27.1% of sampled cases.

Operative procedures

Total thyroidectomy without neck dissection was the most frequently performed procedure (76.0%), followed by hemithyroidectomy (16.4%), subtotal thyroidectomy (0.8% as an initial procedure, with additional cases from re-operation), and total thyroidectomy with modified neck dissection (3.2%). Completion (total) thyroidectomy was subsequently required in 18 of the patients initially treated by hemithyroidectomy.

Histopathological diagnosis

Final histopathology confirmed benign disease in 211 patients (84.4%) and malignancy in 39 patients (15.6%). Multinodular goiter was the leading benign diagnosis (46.0%), followed by colloid goiter (14.8%), Hashimoto thyroiditis (8.0%), and benign thyroid tissue (3.2%); follicular adenoma (9.2%) and Hurthle cell adenoma (2.4%) were the principal benign neoplasms. Among malignant cases, the follicular variant of papillary carcinoma (9.2% of the total cohort) and classic papillary carcinoma (5.2%) together accounted for 92.3% of all cancers; metastatic follicular carcinoma (0.8%) and anaplastic carcinoma (0.4%) were less common.

Table 2.

Histopathological Diagnosis of Thyroidectomy Specimens (N = 250)

Category	Diagnosis	N	%
Benign / non-neoplastic	Multinodular goiter	115	46.0
	Colloid goiter	37	14.8
	Hashimoto thyroiditis	20	8.0
	Benign thyroid tissue	8	3.2
	De Quervain's thyroiditis	2	0.8
Benign neoplastic	Follicular adenoma	23	9.2
	Hurthle cell adenoma	6	2.4
Malignant	Follicular-variant papillary carcinoma	23	9.2
	Papillary carcinoma	13	5.2
	Metastatic follicular carcinoma	2	0.8
	Anaplastic carcinoma	1	0.4
Total		250	100

Among the 39 malignant cases, pathological staging showed pT3,Nx,Mx in 17.9%, pT2,Nx,Mx in 15.4%, and pT1a, Nx,Mx in 10.3%; nodal involvement (N1) was documented in 12.8% of cancer cases, and no patient had documented distant metastasis.

Factors associated with malignancy: bivariate analysis

Malignancy was numerically more frequent in men than women (26.3% vs 14.7%) and in patients from lowland/coastal areas than mountainous areas (18.5% vs 15.2%), but neither association reached statistical significance ($p = .190$ and $p = .585$, respectively). Age, qat chewing, smoking, family history, and diagnostic radiation exposure likewise showed no significant association with malignancy. In contrast, several clinical, sonographic, and cytological variables were significantly associated with malignant disease, as summarized in Table 3.

Table 3.

Selected Variables Significantly Associated with Thyroid Malignancy on Bivariate Analysis

Variable	Malignant n %	Benign, n %	Test statistic	p-value
Dyspnea present	33 (21.7%)	119 (78.3%)	$\chi^2 = 10.23$	.001
Hoarseness present	19 (70.4%)	8 (29.6%)	Fisher's exact	<.001
Weight loss present	15 (78.9%)	4 (21.1%)	$\chi^2 = 61.44$	<.001
Appetite loss present	9 (56.3%)	7 (43.8%)	Fisher's exact	<.001
Cervical lymphadenopathy	6 (100%)	(0.0%)	Fisher's exact	<.001
Disease duration median (2-3years)	39 (1.5 year)	211 (3 years)	Mann-Whitney	.002
Non-homogeneous nodule on USG	34 (35.1%)	63 (64.9%)	$\chi^2 = 45.55$	<.001
Solid/cysto-solid texture on USG	39 (17%)	191 (83%)	Fisher's exact	.029
TI-RADS 1	0 (0.0%)	20 (100%)	Fisher's exact	<.001
TI-RADS 2	1(1.1%)	91(98.9%)		
TI-RADS 3	5(6.1%)	77(93.9%)		
TI-RADS 4	16(45.7%)	19(54.3%)		
TI-RADS 5	17 (81%)	4 (19%)		
FNAC, Bethesda II	1 (4.3%)	22 (95.7%)	Fisher's exact	<.001
FNAC, Bethesda IV	1 (20%)	4 (80%)		
FNAC, Bethesda V	0 (0.0%)	7 (100 %)		
FNAC, Bethesda VI	8 (61.5%)	5 (38.5%)		

Note. USG = ultrasonography. Dashes indicate multi-category associations reported as an overall p-value rather than a single proportion pair; see text for category-specific risks.

Malignancy risk rose progressively with TI-RADS category: 0% in TI-RADS 1, 1.1% in TI-RADS 2, 6.1% in TI-RADS 3, 45.7% in TI-RADS 4, and 81.0% in TI-RADS 5. Among the 48 patients who underwent FNAC, malignancy on final histopathology was confirmed in 4.3% of Bethesda II, 20% of Bethesda IV, and 0.0% of Bethesda V results; notably, only 61.5%

of Bethesda VI (cytologically malignant) results were confirmed malignant on final histopathology, indicating a substantial proportion of false-positive cytology in this cohort. Type of thyroid swelling (solitary nodule, multinodular, or diffuse goiter) was not significantly associated with malignancy (p = .524).

Diagnostic performance of clinical and radiological indicators

Among clinical findings, weight loss and hoarseness showed the strongest rule-in value for malignancy, with high specificity (98.1% and 96.2%, respectively) and large positive likelihood ratios (19.8 and 12.7). Cervical lymphadenopathy had 100% specificity and 100% positive predictive value, though it was present in only a small number of patients. Dyspnea, while common, had low specificity (42.5%) and limited discriminatory value alone.

Table 4.

Diagnostic Performance of Selected Clinical Findings for Predicting Thyroid Malignancy

Finding	Sensitivity, %	Specificity, %	PPV, %	NPV, %	LR+
Dyspnea	84.6	42.5	21.7	93.6	1.47
Hoarse voice	48.7	96.2	70.4	91.0	12.7
Weight loss	38.5	98.1	78.9	89.4	19.8
Loss of appetite	26.3	96.6	58.8	87.7	7.74
Cervical lymphadenopathy	15.4	100.0	100.0	86.1	∞
Syncope	15.4	97.6	54.5	86.2	6.49
Bethesda II	10	42.1	4.3	0.17	2.14
Bethesda IV	10	89.5	20	0.95	1.01
Bethesda V	0	81.6%	0.0	0	1.23
Bethesda VI	80	86.8	61.5	6.08	0.23

Note. PPV = positive predictive value; NPV = negative predictive value; LR+ = positive likelihood ratio.

Regarding ultrasound features, a solid or cysto-solid texture was highly sensitive (87.2%) but poorly specific (25.1%) for malignancy, while TI-RADS categorization performed considerably better as a rule-in and rule-out tool: TI-RADS 4 carried a positive likelihood ratio of 4.56 and TI-RADS 5 a

positive likelihood ratio of 23, whereas TI-RADS 1–2 conferred a very low likelihood of malignancy. FNAC performance was more variable:

Multivariable analysis

A multivariable binary logistic regression model including dyspnea, hoarse voice, weight loss, appetite loss, cervical lymphadenopathy, syncope, disease duration under 1.45 years, and solid/cysto-solid or homogeneous texture on ultrasound was statistically significant overall, $\chi^2(9) = 124$, $p < .001$, and explained approximately 59.3% of the variance in malignancy status (McFadden's pseudo $R^2 = 0.593$). Hoarse voice (adjusted odds ratio [aOR] 10.87, $p < .001$), weight loss (aOR 12.40, $p = .007$), appetite loss (aOR 40.58, $p < .001$), cervical lymphadenopathy (aOR 65.73, $p = .002$), and solid or cysto-solid texture on ultrasound (aOR 6.20, $p = .047$) remained independent predictors of malignancy in the adjusted model. The final model demonstrated excellent discriminatory ability, with an area under the ROC curve of 0.956 at a predicted-probability cut-off of 0.50.

Table 5.

Multivariable Logistic Regression Model Predicting Thyroid Malignancy (N = 250)

Predictor	B	SE	p-value	aOR	95% CI
Dyspnea	**0.432**	**0.780**	**.580**	**1.54**	**(0.33, 7.11)**
Hoarse voice	**2.386**	**0.681**	**<.001**	**10.87**	**(2.86, 41.36)**
Weight loss	**2.518**	**0.935**	**.007**	**12.40**	**(1.98, 77.46)**
Appetite loss	**3.703**	**0.925**	**<.001**	**40.58**	**(6.62, 249.0)**
Cervical lymphadenopathy	**4.186**	**1.369**	**.002**	**65.73**	**(4.49, 961.4)**
Syncope	**1.113**	**1.392**	**.424**	**3.04**	**(0.20, 46.55)**
Disease duration < 1.45 years	**0.158**	**0.653**	**.809**	**1.17**	**(0.33, 4.21)**
Solid/cysto-solid texture on USG	**1.825**	**0.919**	**.047**	**6.20**	**(1.02, 37.55)**
USG homogeneity	**-1.835**	**1.051**	**.081**	**0.16**	**(0.02, 1.25)**

Note. aOR = adjusted odds ratio; USG = ultrasonography. Model fit: deviance = 84.7, AIC = 105, BIC = 139, area under the ROC curve = 0.956.

Discussion

This retrospective study describes the pattern of thyroid disease and the frequency of malignancy among 250 patients undergoing thyroidectomy in

the main hospitals of Taiz City, Yemen. Because the study population consisted of surgically treated patients rather than an unselected community sample, the findings should be interpreted as a thyroidectomy-pathology profile shaped by referral pathways and preoperative triage, rather than as a population prevalence estimate(1)(16).

Overall pattern of thyroid disease

Final histopathology examination demonstrated a heterogeneous pattern of thyroid disease among patients undergoing thyroidectomy. Benign lesions accounted for the majority cases, while the malignant lesions were 15.6% of specimens, indicating that approximately one in six operated patients in this cohort had thyroid cancer. This figure is higher than the 7.3% reported among thyroidectomy patients in Ibb (10), but lower than the 23.1% malignant yield reported from a selected multinodular goiter series in Sana'a(17), and is broadly consistent with older Yemeni surgical literature describing a substantial malignant yield among operated goiter (8). Internationally, this proportion falls within the expected range for hospital-based thyroidectomy series and above rates typically reported for unselected thyroid nodules (1)(4), reinforcing that thyroidectomy-derived malignancy frequencies are context-dependent rather than directly representative of population risk.

Demographic pattern

Women accounted for 92.4% of the cohort, consistent with the well-documented female predominance of thyroid nodular and autoimmune disease reported in other Yemeni and regional series (10)(3). Although the crude proportion of malignancy was numerically higher in men (26.3%) than women (14.7%), this difference was not statistically significant, suggesting that male sex may function less as a determinant of surgical case volume and more as a marker of relative clinical suspicion once a nodule is selected for operation (18)(19)(20). The concentration of cases in middle-aged adults (median age 40 years) and the strong representation of patients from mountainous areas likely reflect the influence of historical iodine deficiency on the background burden of goiter in this population(7)(21), rather than acting as independent predictors of malignancy, since geography and age did not distinguish malignant from benign disease in the analytic component of this study.

Clinical and radiological predictors of malignancy

While common presenting symptoms such as dysphagia and neck discomfort likely reflect the underlying burden of benign multinodular disease, more specific findings, including hoarseness, weight loss, appetite loss, and cervical lymphadenopathy, were strongly and independently associated with malignancy, in keeping with international thyroid nodule guidance that identifies these features as warning signs warranting heightened suspicion(1)(22)(23). Hoarseness and weight loss, in particular, showed high specificity and strong positive likelihood ratios, supporting their clinical utility as rule-in markers even though their sensitivity was limited.

Ultrasonographic assessment added substantial diagnostic value. Malignancy risk rose sharply and consistently with TI-RADS category, from 0% in TI-RADS 1 to 81.0% in TI-RADS 5, with TI-RADS 4 and 5 carrying clinically useful positive likelihood ratios, consistent with the diagnostic rationale underlying the TI-RADS system(13)(24). Non-homogeneous nodule texture was also strongly associated with malignancy, whereas nodule size alone was not a significant discriminator, in line with prior sonographic series(25). These findings support wider and more structured use of TI-RADS-based reporting as a central component of preoperative risk stratification in this setting.

FNAC was used in only 19.2% of patients, reflecting its limited availability in this resource-constrained environment. Although Bethesda V and VI categories carried an elevated risk of malignancy, a considerable proportion of cytologically malignant (Bethesda VI) results were ultimately benign on final histopathology, highlighting the need for careful correlation between cytology and other risk features rather than reliance on FNAC results in isolation (14,15,26). This is false-positive cytological rate is38.5% pathologist learning curves in conflict/resource-limited zones, variations in recognizing follicular-patterned lesions, or sampling/technical artifacts)

Multivariable model and clinical implications

The combination of hoarse voice, weight loss, appetite loss, cervical lymphadenopathy, and solid or cysto-solid ultrasound texture produced a multivariable model with excellent discriminatory ability (area under the ROC curve 0.956), substantially outperforming any single clinical or radiological variable in isolation. This finding supports an integrated

diagnostic approach in which structured history-taking, focused neck examination, and standardized ultrasound reporting are combined, rather than relying on any single test, to prioritize patients at higher risk of malignancy for expedited FNAC and surgical (9)(10)(1).

Strengths and limitations

The principal strengths of this study include the inclusion of a substantial surgical cohort from the main Taiz hospitals, the use of final histopathology as the reference standard, and the combination of (10)descriptive, diagnostic-performance, and multivariable analyses. Limitations include the retrospective design, incomplete documentation for some variables, a relatively small malignant subgroup, limited FNAC utilization, and incomplete pathological staging in some cases; these constraints mean the findings should not be generalized mechanically to all thyroid nodules in Yemen (9)(10)(1). Future research would benefit from a multicenter, prospective design with more complete preoperative cytological and ultrasound data to validate the identified predictors.

Conclusion

Thyroid malignancy constituted a clinically important proportion of thyroidectomy specimens in the main hospitals of Taiz City, Yemen, confirmed in 15.6% of operated cases, while benign disease, led by multinodular goiter, remained predominant. Among malignant lesions, papillary-patterned carcinoma was the dominant histological pattern. Malignancy was most strongly linked not to broad demographic background factors but to specific clinical warning signs, including hoarseness, weight loss, appetite loss, and cervical lymphadenopathy, together with higher TI-RADS category and suspicious ultrasound texture. A model combining these clinical and ultrasonographic features achieved excellent discriminatory performance for malignancy.

These findings support strengthening preoperative risk stratification in Taiz and similar resource-limited settings through systematic clinical assessment for warning symptoms, structured and standardized ultrasound reporting using TI-RADS, wider access to ultrasound-guided FNAC, and routine histopathological evaluation of all thyroidectomy specimens, since clinically important malignancy may be present even in lesions operated on for apparently benign disease.

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