

Preoperative TSH Levels as an Adjunctive Risk Factor for Malignancy in Thyroid Nodules: Our Single-Center Experience

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Abstract

Objective: To evaluate the association between preoperative thyroid-stimulating hormone levels and postoperative histopathological malignancy in patients undergoing thyroidectomy for thyroid nodules, and to compare the discriminative performance of thyroid-stimulating hormone with that of the Thyroid Imaging Reporting and Data System score. **Material and Methods:** A total of 366 patients operated for thyroid nodules between January 1, 2023 and January 1, 2025 at a tertiary center were retrospectively reviewed. Preoperative thyroid-stimulating hormone, free triiodothyronine, free thyroxine and routine biochemical parameters, Thyroid Imaging Reporting and Data System score, fine-needle aspiration biopsy cytology and type of surgery were recorded. Patients were dichotomized as benign or malignant according to final pathology. Receiver operating characteristic curve analysis was performed for thyroid-stimulating hormone and the Thyroid Imaging Reporting and Data System score, with the optimal cut-off determined by the Youden index. Variables associated with malignancy were assessed by univariate and multivariate logistic regression. **Results:** Final pathology was benign in 223 patients (60.9%) and malignant in 143 (39.1%). Groups were comparable for age and sex ($p=0.737$ and $p=0.477$, respectively). Thyroid-stimulating hormone was significantly higher in the malignant group (median 1.250 vs 1.115 $\mu\text{IU/mL}$; $p=0.029$), as was free triiodothyronine ($p=0.010$). The area under the curve was low for thyroid-stimulating hormone (0.572; 95% confidence interval: 0.508–0.636) but substantially higher for the Thyroid Imaging Reporting and Data System score (0.802; 95% confidence interval: 0.752–0.853). The Youden-derived thyroid-stimulating hormone cut-off was 0.687 $\mu\text{IU/mL}$ (sensitivity 85.8%, specificity 32.8%). In multivariate analysis, thyroid-stimulating hormone $\geq 0.687 \mu\text{IU/mL}$ (odds ratio=6.10; 95% confidence interval: 2.28–16.33), the Thyroid Imaging Reporting and Data System score (odds ratio=3.58; 2.25–5.69) and non-benign fine-needle aspiration biopsy cytology (odds ratio=16.04; 6.63–38.79) were independently associated with malignancy (all $p<0.001$). **Conclusion:** Thyroid-stimulating hormone alone is a weak discriminative test; however, even within the reference range, it may provide independent risk information complementary to the Thyroid Imaging Reporting and Data System and fine-needle aspiration biopsy, and should be interpreted as an adjunctive rather than a stand-alone risk marker.

Keywords: Fine-needle aspiration biopsy; Thyroid neoplasms; Thyroid nodule; Thyrotropin; TI-RADS

1. Introduction

A significant increase in the prevalence of both benign and malignant thyroid disease has been observed, particularly following advances in neck imaging.¹ This increase is reflected both in the identification of thyroid nodules and, consequently, in the detection of thyroid cancers.² An association between thyroid malignancy and TSH levels has been reported in many observational studies.³ TSH is the principal growth factor for thyroid cells and may play a causal role in thyroid cancer. In addition, several clinical features have traditionally been associated with an increased risk of cancer in thyroid nodules, including older age, male sex, and a history of radiation exposure.⁴

Our aim in this study was to analyze the association between preoperative TSH levels and postoperative malignancy in patients with thyroid nodules scheduled for surgery, and to compare the discriminative performance of TSH with that of TI-RADS.

2. Materials and Methods

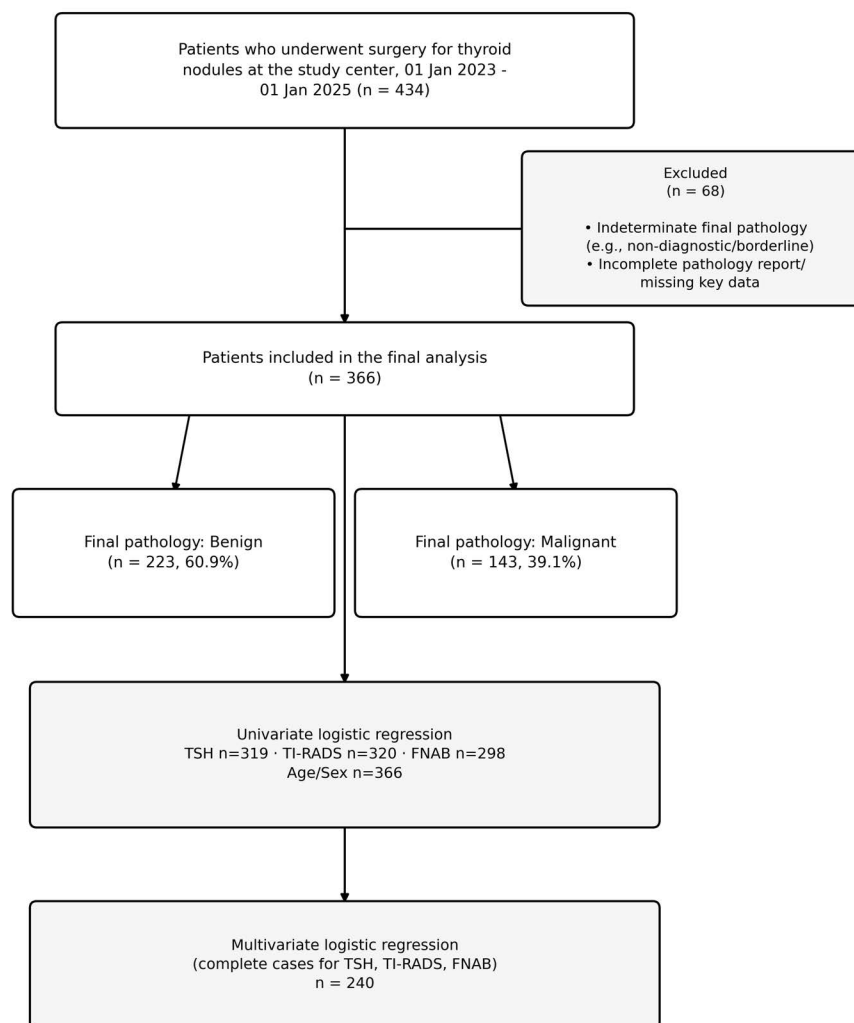
This study was conducted with a single-center, retrospective, cross-sectional design at a tertiary training and research hospital between January 1, 2023 and January 1, 2025. As the center serves as a referral hospital, patients referred from the region and surrounding provinces were included. The study was approved by the Scientific Research Ethics Committee of Adana City Training and Research Hospital (meeting dated 30.04.2026, session no. 25, decision no. 285) and was conducted in accordance with the Declaration of Helsinki.

Inclusion criteria were: (1) a diagnosis of thyroid nodule, (2) surgical treatment, and (3) availability of a definitive surgical pathology result. The exclusion criterion was an indeterminate or incomplete pathology result. Accordingly, 68 patients were excluded from the analysis, comprising patients whose final surgical pathology result was indeterminate (e.g., non-diagnostic or borderline histology) and patients whose pathology report lacked data required for the study variables; a precise numeric split between these two exclusion categories is not reported, as it could not be verified against the full excluded-patient records at the time of this revision. A total of 366 patients were included in the final analysis. The patient selection process is summarized in the flow diagram in Figure 1.

2.1. Data Collection and Laboratory Measurements

Patients' demographic data (age, sex), clinical characteristics, and preoperative laboratory values were obtained retrospectively from the hospital information system. The recorded parameters were: TSH, free T3 (fT3), free T4 (fT4), glucose, ALT, AST, triglyceride, LDL, WBC, hemoglobin, platelet, creatinine, sodium, potassium, and CRP.

Biochemical measurements were performed using an automated analyzer and commercial kits. Preoperative Thyroid Imaging Reporting and Data System (TI-RADS) scoring (1 = lowest risk, 5 = highest risk) was recorded for thyroid nodules (n=320). Fine-needle aspiration biopsy (FNAB) results were coded into three categories according to the Bethesda system: 0 = benign, 1 = suspicious, 2 = malignant (n=298). Type of surgery was classified as partial (0) or total thyroidectomy (1) (n=364). Within this three-tier coding scheme, Bethesda category II was coded as benign (0); Bethesda categories III, IV and V (atypia/follicular lesion of undetermined significance, follicular neoplasm/suspicious for follicular neoplasm, and suspicious for malignancy, respectively) were coded as suspicious (1); and Bethesda category VI was coded as malignant (2). Serum anti-thyroid peroxidase (anti-TPO) and anti-thyroglobulin (anti-Tg) antibody levels were measured only when clinically indicated and were therefore available for a minority of patients (anti-TPO, n=84/366, 23.0%; anti-Tg, n=92/366, 25.1%); because of this substantial and non-random missingness, these variables were not incorporated into the primary regression models (see Limitations).



The exact numeric split between the two exclusion categories above was not available for this revision; authors should confirm/insert these counts before submission if requested by the editor.

Figure 1. Flow diagram of patient inclusion and exclusion (STROBE-style)

2.2. Statistical Analysis

All analyses were performed using SPSS. The conformity of continuous variables to a normal distribution was assessed with the Shapiro-Wilk test. Normally distributed variables were presented as mean $\pm$ standard deviation, and non-normally distributed variables as median [min–max]. For between-group comparisons, the independent-samples t-test was used for normally distributed variables and the Mann-Whitney U test for non-normally distributed variables. For categorical variables, the chi-square (χ^2) test was used; Fisher's exact test was preferred when the expected cell count was below five.

Receiver operating characteristic (ROC) analysis was performed to assess the capacity of TSH to predict malignancy, and the AUC with its 95% confidence interval (CI) was calculated. The optimal cut-off value was determined using the Youden index [maximum (sensitivity + specificity – 1)]. For comparison, ROC analysis was also applied to the TI-RADS score.

In univariate logistic regression analysis, the TSH cut-off value, TI-RADS score, binary-coded FNAB variable, age, and sex were evaluated. The multivariate logistic regression model was constructed to include the TSH cut-off value, TI-RADS score, and binary-

coded FNAB variable. ORs and 95% CIs were reported. Model fit was assessed with the Hosmer-Lemeshow test and Nagelkerke R². Statistical significance was set at $p < 0.05$, and all tests were two-sided. Although free triiodothyronine differed significantly between groups at the univariate level (Table 1), it was not entered into the multivariate model a priori, both because it was not the primary variable of interest of this study and because of its physiological interdependence with thyroid-stimulating hormone through the hypothalamic-pituitary-thyroid axis, which raised concern for collinearity; this finding was instead treated as hypothesis-generating and is addressed further in the Discussion.

3. Results

3.1. Study Population and Demographic Characteristics

A total of 366 patients were included; of these, 223 (60.9%) were diagnosed with benign and 143 (39.1%) with malignant pathology. The mean age of the patients was 47.19 ± 13.39 years, with a female predominance (overall F/M: 290/76; 79.2% female). No statistically significant difference was found between the two groups in terms of demographic variables ($p = 0.737$ for age; $p = 0.477$ for sex) (Table 1).

3.2. Biochemical Parameters

When preoperative biochemical parameters were compared, no statistically significant difference was found between the groups for glucose, triglyceride, LDL, AST, ALT, WBC, hemoglobin, creatinine, sodium, potassium, fT₄, and CRP (all $p > 0.05$; Table 1).

fT₃ values were significantly higher in the malignant group (median 3.70 pg/mL [2.50–5.70]) than in the benign group (median 3.50 pg/mL [0.73–11.00]) ($p = 0.010$). When TSH values were examined, the median was 1.115 μ IU/mL [0.140–591.000] in the benign group and 1.250 μ IU/mL [0.128–2053.000] in the malignant group; this difference was statistically significant (Mann-Whitney U, $p = 0.029$; Table 1).

Table 1. Demographic and Biochemical Parameters in the Benign and Malignant Groups

Variable	n	Benign	n	Malignant	p
Age (years), mean $\pm$ SD	223	47.38 $\pm$ 13.49	143	46.90 $\pm$ 13.28	0.737
Sex (F/M), n	223	174 / 49	143	116 / 27	0.477
Glucose (mg/dL)	196	95.00 [11.00–360.00]	122	95.00 [17.00–254.00]	0.098
Triglyceride (mg/dL)	62	174.50 [60.00–298.00]	44	190.00 [41.00–480.00]	0.247
LDL (mg/dL)	51	112.51 $\pm$ 39.87	37	122.24 $\pm$ 31.60	0.205
AST (U/L)	216	19.00 [7.00–377.00]	137	19.00 [10.00–61.00]	0.310
ALT (U/L)	216	17.50 [6.00–275.00]	139	15.00 [7.00–128.00]	0.050
WBC (/ μ L)	222	7400 [3800–17200]	142	7500 [3000–20700]	0.712
Hemoglobin (g/dL)	201	13.00 [7.60–17.20]	133	12.90 [5.30–16.20]	0.519
Creatinine (mg/dL)	193	0.60 [0.24–1.17]	131	0.57 [0.30–1.20]	0.113
Sodium (mEq/L)	196	139 [133–144]	122	139 [134–145]	0.127
Potassium (mEq/L)	180	4.30 [3.60–5.50]	117	4.30 [3.40–5.00]	0.974
fT ₃ (pg/mL)	187	3.50 [0.73–11.00]	129	3.70 [2.50–5.70]	0.010
fT ₄ (ng/dL)	187	0.80 [0.01–4.20]	128	0.80 [0.40–1.89]	0.627
TSH (μ IU/mL)	192	1.115 [0.140–591.000]	127	1.250 [0.128–2053.000]	0.029
CRP (mg/L)	100	3.00 [0.00–110.00]	59	3.80 [0.05–17.00]	0.920

Normally distributed variables are presented as mean $\pm$ SD; non-normally distributed variables as median [min–max]. The independent-samples *t*-test was used for age and LDL; the Mann-Whitney U test for the other continuous variables; and the chi-square test for sex.

3.3. Clinical and Imaging Characteristics

The TI-RADS score was significantly higher in the malignant group (median 4 [1–5] vs 3 [1–5]; $p<0.001$). The TI-RADS distribution also differed significantly between groups ($p<0.001$); TI-RADS 5 was observed more frequently in the malignant group (62/143; 43.4%). According to FNAB results, 168 patients (75.3%) in the benign group had benign cytology, whereas in the malignant group 42 patients (29.4%) had suspicious and 31 patients (21.7%) had malignant cytology ($p<0.001$). Regarding type of surgery, total thyroidectomy was performed more frequently in the malignant group (85.3% vs 70.4%; $p=0.002$) (Table 2).

Table 2. Clinical Characteristics: TI-RADS Distribution, FNAB Results, and Type of Surgery

Variable	Benign n	Benign %	Malignant n	Malignant %	p
TI-RADS score, median [min–max]		3 [1–5]		4 [1–5]	<0.001
TI-RADS 1	6	2.7	2	1.4	
TI-RADS 2	24	10.8	1	0.7	
TI-RADS 3	95	42.6	19	13.3	
TI-RADS 4	56	25.1	43	30.1	
TI-RADS 5	12	5.4	62	43.4	<0.001
TI-RADS (missing)	30	13.5	16	11.2	
FNAB: Benign	168	75.3	43	30.1	
FNAB: Suspicious	10	4.5	42	29.4	
FNAB: Malignant	4	1.8	31	21.7	<0.001
FNAB (missing)	41	18.4	27	18.9	
Partial thyroidectomy	64	28.7	21	14.7	
Total thyroidectomy	157	70.4	122	85.3	0.002
Type of surgery (missing)	2	0.9	0	0.0	

Percentages were calculated over the total number in each group. The Mann-Whitney U test was used for TI-RADS score; the chi-square test for TI-RADS distribution, FNAB cytology, and type of surgery. FNAB: fine-needle aspiration biopsy. FNAB categories were derived from the Bethesda System for Reporting Thyroid Cytopathology as follows: benign corresponds to Bethesda category II; suspicious corresponds to Bethesda categories III, IV and V (including atypial/follicular lesion of undetermined significance and follicular neoplasm/suspicious for follicular neoplasm); and malignant corresponds to Bethesda category VI.

3.4. ROC Analysis

In the ROC analysis for TSH ($n=319$), the AUC was 0.572 (95% CI: 0.508–0.636). The optimal cut-off value determined by the Youden index was 0.687 $\mu\text{IU/mL}$, at which point sensitivity was 85.8%, specificity 32.8%, positive predictive value 45.8%, and negative predictive value 77.8%. In the TI-RADS ROC analysis performed for comparison, the AUC was 0.802 (95% CI: 0.752–0.853), and at a cut-off of ≥ 3.5 the sensitivity was 82.7% and specificity 64.8%. These findings indicate that the discriminative capacity of TI-RADS is markedly stronger than that of TSH.

3.5. Logistic Regression Analysis

In univariate logistic regression analysis, TSH ≥ 0.687 $\mu\text{IU/mL}$ (OR=2.957; 95% CI: 1.652–5.296; $p<0.001$), TI-RADS score (OR=4.118; 95% CI: 2.941–5.765; $p<0.001$), and non-benign FNAB category (OR=20.372; 95% CI: 10.501–39.524; $p<0.001$) significantly predicted malignancy. Age and sex were not significant (Table 3). In the multivariate model ($n=240$), TSH ≥ 0.687 (OR=6.099; 95% CI: 2.278–16.326; $p<0.001$), TI-RADS (OR=3.581; 95% CI: 2.253–5.691; $p<0.001$), and FNAB (OR=16.041; 95% CI: 6.633–38.789; $p<0.001$) were each

independently associated with malignancy. The explanatory power of the model was Nagelkerke $R^2=0.613$. The Hosmer-Lemeshow test indicated acceptable model calibration ($\chi^2=5.889$; $p=0.436$).

Table 3. Univariate and Multivariate Logistic Regression Analysis for Predicting Malignancy

Variable	OR	95% CI	p	n
Univariate analysis				
TSH ≥ 0.687	2.957	1.652–5.296	<0.001	319
TI-RADS score	4.118	2.941–5.765	<0.001	320
FNAB (non-benign)	20.372	10.501–39.524	<0.001	298
Age	0.997	0.982–1.013	0.737	366
Male sex	0.827	0.489–1.398	0.477	366
Multivariate analysis (n = 240; Nagelkerke $R^2 = 0.613$)				
TSH ≥ 0.687	6.099	2.278–16.326	<0.001	240
TI-RADS score	3.581	2.253–5.691	<0.001	
FNAB (non-benign)	16.041	6.633–38.789	<0.001	

OR: odds ratio; CI: confidence interval. The FNAB category was coded as 0 = benign, 1 = suspicious or malignant. Sample sizes vary by variable because of missing data (TSH, $n=319$; TI-RADS, $n=320$; FNAB, $n=298$; age and sex, $n=366$); the multivariate model was restricted to the $n=240$ patients with complete data for TSH, TI-RADS and FNAB simultaneously, which may introduce selection bias (see Limitations).

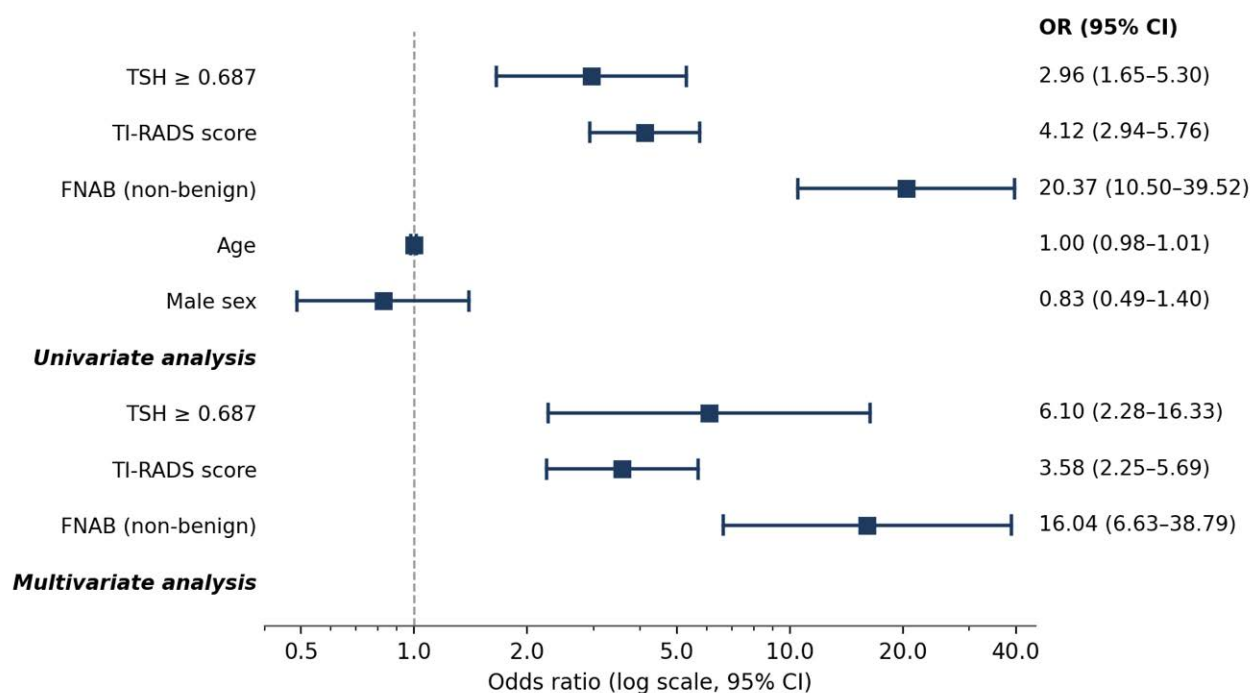


Figure 2. Forest plot of the univariate and multivariate logistic regression analyses for predicting malignancy (based on the data in Table 3)

4. Discussion

In this single-center retrospective study, we examined the association between pre-operative TSH levels and postoperative malignancy in 366 patients who underwent thyroidectomy for thyroid nodules. Our main finding was that TSH was significantly higher in the malignant group and, in the multivariate model, was associated with malignancy independently of the TI-RADS score and FNAB cytology. However, ROC analysis showed that the discriminative power of TSH was low ($AUC=0.572$), indicating that TSH cannot

be used alone as a screening or rule-out test but may provide additional information to existing risk-assessment tools.

The role of TSH in thyroid carcinogenesis has long been debated. TSH is the principal growth factor for thyrocytes, and a positive association between serum TSH levels and thyroid cancer risk has been reported in numerous observational studies. McLeod et al. calculated a pooled OR of 1.23 (95% CI: 1.11–1.37) for higher TSH per mIU/L, but noted that the relationship between TSH and cancer may not be linear.³ Fiore and Vitti showed that in nodular thyroid disease, higher TSH is associated with the risk of papillary thyroid cancer⁸; the same group reported that lower TSH levels — possibly through the protective effect of thyroid autonomy — are associated with lower cancer risk.⁹ The significantly higher TSH found in the malignant group in our study is consistent with this literature.

More recent studies, published within approximately the last three to five years, support and extend these findings. In a cohort of euthyroid patients with indeterminate cytology, Vinod et al. found that a thyroid-stimulating hormone cut-off of 2.185 mIU/L predicted malignancy with 74.2% sensitivity and 73.9% specificity, reinforcing the potential of thyroid-stimulating hormone as a preoperative risk marker even within the reference range.¹² Al-Hakami et al., in a retrospective post-thyroidectomy cohort similar in design to ours, likewise reported higher preoperative thyroid-stimulating hormone in patients with differentiated thyroid cancer than in those with benign nodules, and concluded that thyroid-stimulating hormone is best used as an adjunctive rather than a stand-alone diagnostic tool, a conclusion consistent with our own.¹³ Most recently, Ma et al. incorporated thyroid-stimulating hormone alongside ultrasonographic features into a combined nomogram for papillary thyroid carcinoma, achieving an area under the curve of 0.869–0.872 and underscoring the added value of integrating biochemical and imaging-based risk factors rather than relying on either alone.¹⁴ In contrast, Moradi et al. did not find a significant association between thyroid-stimulating hormone level and the specific histological subtype of malignancy, highlighting that the relationship between thyroid-stimulating hormone and cancer risk may vary depending on the outcome examined (overall malignancy versus malignancy subtype).¹⁵ Taken together, this recent literature is consistent with our interpretation that thyroid-stimulating hormone provides complementary rather than stand-alone diagnostic value.

On the other hand, this association is not universal. Paparodis et al. showed that higher TSH is not associated with cancer risk in the presence of thyroid autoimmunity.⁷ This inconsistency suggests that the relationship between TSH and malignancy is sensitive to the underlying thyroid pathology (autoimmune thyroiditis, nodular autonomy) and to patient selection. Indeed, in our study, the very wide distribution of TSH (with values reaching up to 591 in the benign group and 2053 μ IU/mL in the malignant group) probably reflects concomitant cases of autoimmune thyroiditis or hypothyroidism and limits the discriminative power of TSH. This is also a possible explanation for our low AUC value.

The mechanistic basis of the association between TSH and malignancy is supported by experimental studies. Hoelting et al. showed that in human follicular thyroid cancer cells, TSH stimulates invasion and growth via the protein kinase C pathway rather than protein kinase A.¹⁰ Kraiem et al. demonstrated that the mutual interaction between the TSH/cAMP and PKC/EGF pathways regulates thyroid cell proliferation and differentiation.¹¹ These findings support the possibility that TSH plays a direct mitogenic role in carcinogenesis. However, it is also possible that part of the observed clinical association arises from detection bias rather than causality; higher TSH may increase cancer detection by facilitating the growth of previously latent microcarcinomas to a detectable size.³

A notable finding of our study is that the TSH cut-off value determined by the Youden index (0.687 μ IU/mL) lies within the laboratory reference range, and values above

this threshold were associated with an approximately sixfold increase in the odds of malignancy in the multivariate model. This suggests that TSH may carry risk information not only when it exceeds the upper reference limit but also at levels within the normal range. However, this result should be interpreted with caution: because the cut-off value and the OR based on it were derived from the same dataset, the effect size in the multivariate model may appear larger than it truly is due to in-sample optimism. Therefore, this cut-off value should be validated in independent cohorts before being recommended for clinical use. Given the low specificity (32.8%) of this cut-off, thyroid-stimulating hormone should not be used to reassure patients or to defer cytological or surgical work-up in nodules that are otherwise suspicious on the Thyroid Imaging Reporting and Data System or fine-needle aspiration biopsy; at most, a value above this threshold may modestly raise the index of suspicion when interpreted alongside these established tools, and this message should be conveyed to clinicians with appropriate caution rather than as a definitive recommendation.

Another unexpected finding was that the fT3 level was significantly higher in the malignant group ($p=0.010$). This association has not been consistently demonstrated in the literature and may be a chance finding related to the distribution of measurements within the sample; as its clinical significance is uncertain, confirmatory studies are needed. The absence of a significant difference between the groups in any of the other biochemical parameters underscores the limited value of routine biochemistry in discriminating malignancy.

As expected, TI-RADS (AUC=0.802) and especially non-benign FNAB cytology (OR=16.04) predicted malignancy markedly more strongly than TSH. These findings confirm the central role of ultrasonographic risk stratification and cytology in the evaluation of thyroid nodules. The contribution of TSH is to complement these tools rather than to replace them; in clinical practice, TSH should be positioned as an ancillary biochemical risk indicator evaluated together with TI-RADS and FNAB.

4.1. Limitations

Our study has several limitations. First, its single-center, retrospective design is prone to selection bias and does not permit causal inference. Second, because the TSH cut-off value and the effect sizes based on it were derived from the same dataset, validation in independent, prospective cohorts is required for external validity. Third, the presence of missing data for some parameters (TI-RADS, FNAB, various biochemical measurements) and the fact that the multivariate analysis was performed on 240 patients using listwise deletion narrow the sample and may introduce selection bias. Fourth, malignant cases were grouped together, and papillary thyroid cancer — for which the strongest association with TSH has been reported — was not analyzed separately; this may have masked histological subtype-specific associations. Fifth, because pathological variables such as tumor size, extrathyroidal extension, and lymph node involvement were not recorded, the relationship between TSH and tumor behavior could not be evaluated. Sixth, to verify the impact of missing covariate data, we cross-checked the locked analytic dataset underlying this study against every statistic reported in Tables 1-3 and the receiver operating characteristic analysis; all reproduced exactly, confirming the accuracy of the reported n 's, test statistics and effect sizes throughout. We additionally compared baseline age and sex between the 240 patients with complete TSH, TI-RADS and FNAB data included in the multivariate model and the 126 patients excluded from it because of missing covariates: no significant differences were observed (age, 47.35 ± 13.40 vs 46.89 ± 13.42 years, independent-samples t -test $p=0.757$; sex, χ^2 $p=0.821$), and the malignancy rate was similar between the two groups (41.3% vs 34.9%, $p=0.238$), providing some reassurance against major selection bias from listwise deletion, although residual selection bias cannot be

entirely excluded. Finally, anti-thyroid peroxidase and anti-thyroglobulin antibody levels were available for only a minority of patients (23.0% and 25.1%, respectively), precluding their inclusion in the regression models; in an exploratory comparison limited to this subgroup, anti-TPO levels were numerically lower in the malignant than in the benign group (median 0.5 vs 1.6 IU/mL; Mann-Whitney $p=0.068$) and anti-Tg did not differ significantly (median 0.9 vs 0.9 ng/mL; $p=0.485$), so autoimmune thyroiditis does not appear to be a major driver of the extreme TSH values observed in both groups (up to 591 μ IU/mL in the benign group and 2053 μ IU/mL in the malignant group), although the small subgroup size limits this conclusion; this remains an important area for confirmation in future, adequately powered studies.

5. Conclusion

TSH values within the reference range do not exclude malignancy; in our study, exceeding a threshold within the reference range was associated with malignancy independently of TI-RADS and FNAB. Nevertheless, the discriminative power of TSH alone is low. Therefore, the clinical value of TSH lies not in serving as a diagnostic test but in providing additional biochemical risk information to the standard preoperative evaluation. These findings need to be confirmed by prospective, multicenter studies stratified according to histological subtype.

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Conflict of Interest: The authors declare that they have no conflict of interest.

Ethics Approval: Ethics committee approval was obtained from the Scientific Research Ethics Committee of Adana City Training and Research Hospital (meeting dated 30.04.2026, session no. 25, decision no. 285). The study was conducted in accordance with the Declaration of Helsinki.

Informed Consent: As the study was retrospective in design, written informed consent was not obtained from the patients.

Data Availability Statement: The datasets generated and/or analysed during the current study are available from the corresponding author on reasonable request.

Use of Generative AI: No artificial intelligence was used in the article.

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