



ORIGINAL ARTICLE

Thyroid Imaging Reporting and Data System (TI-RADS) Stratification for Thyroid Incidentalomas in Iraqi Sample

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ABSTRACT

Background: The detection of thyroid incidentalomas is on the rise due to high-resolution ultrasonography. This study aimed to evaluate the prevalence of thyroid incidentaloma in a sample of the Iraqi population through the use of high-resolution ultrasound and to define the TI-RADS classification system.

Method: This cross-sectional study was conducted at AL Kindy Teaching Hospital in Bagdad-Iraq. A total of 303 patients were referred to the ultrasound unit for complaints other than neck pathology. A thyroid ultrasound examination was carried out, and the American College of Radiology (ACR) thyroid imaging reporting and data system TI-RADS was recorded when an incidental thyroid nodule was found. Patients were grouped according to the thyroid ultrasound scan into groups A: 102 participants with incident thyroid nodules; B: 201 participants without identified nodules.

Results: Incidental thyroid nodules were detected in (33.66%) of the current sample, (20.8%) had solitary nodules while multiple nodules were detected in (12.9 %) of the individuals. Compared to those who did not show nodules, incidentaloma was identified in 49 (48%) of the older age group (46–60 years), $P < 0.001$ and (20.59%) of those with enlarged thyroid gland, $P < 0.001$ with no significant sex predilection. According to the internal texture of the nodules (27.45%) had echogenic texture, followed by hypoechoic t (22.55 %). Approximately one-third of incidentaloma were TIRADS 4 nodules forming the majority (33.33%) followed by TIRAD 3 (30.39%).

Conclusion: Ultrasound is a valuable test in detecting incidental thyroid nodules. prevalence of incidental thyroid nodules in Iraqi individuals is (33.7%), and the highest percentage of the detected nodules are classified as moderately suspicious according to the ACR TI-RADS.

Key words: ACR-TI-RADS; Incidentaloma; Thyroid ultrasound.



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INTRODUCTION

Thyroid incidentaloma is defined as a nodule that is asymptomatic and unexpectedly discovered during an examination of an unrelated physical condition. [1]. The prevalence of incidental thyroid nodules detected by clinical examination is estimated to be between 4–7% [2]. However, the prevalence of incidental thyroid nodules detected by various radiological modalities is ten times higher than that of palpation. In neck ultrasound, the prevalence of incidental thyroid nodules reaches 50%, while in neck CT and MRI examinations that include the neck, it is 16–18% [3]. Thyroid nodule incidence rises with age, and it is higher in women, those deficient in iodine, and those exposed to radiation [4]. When they are unintentionally discovered, there will be a markedly higher probability of being benign as they are smaller, exhibiting a lower incidence of lymph node (LN) metastasis, and extra-thyroidal and extra-nodal extension [5]. In the general population, the incidence of malignancy in incidentaloma appears to be not significantly elevated, provided that there is no history of malignant thyroid tumors [6]. A thorough and pertinent history in addition to a physical examination should be part of the initial evaluation of a patient who has a thyroid nodule, whether it was discovered clinically or by accident. Thyroid-stimulating hormone (TSH) levels in the serum should be measured before conducting any laboratory tests. When a patient has low serum TSH, they should have thyroid scintigraphy or radionuclide thyroid scan performed [7].

Ultrasonography is a recommended imaging modality for the initial evaluation of thyroid nodules since it is rapid, inexpensive, safe, and able to evaluate the thyroid glands as well as the cervical lymph nodes (LNs). There are well-established ultrasound findings that differentiate between benign and malignant thyroid nodules [8]. Several classification systems categorize thyroid nodules according to the risk of cancer. The widely used one is proposed by the American College of Radiology (ACR), which has a uniform scoring methodology providing users with recommendations for referring the patients to fine needle aspiration (FNA) or have ultrasound follow-up for worrisome nodules, and when to safely leave alone nodules that are benign/not suspicious. Five categories of ultrasonography findings are used to calculate the scores [9]. These categories evaluate the composition, echogenicity, shape, margins, and echogenic foci of thyroid nodules, assigning a progressive score to each feature. The sum of points determines the final class that is assigned to the nodule. The higher the overall score, the higher the TR (TI-RADS)

level and the likelihood of malignancy [10]. The nodule that has 0 points is categorized as ACR 1 which indicates a benign lesion while the nodule that has 2 points is categorized as ACR 2 which indicates not a suspicious lesion, 3 points lesion is categorized as ACR 3 which is mildly suspicious, (4–6 points) lesion is categorized as ACR 4 which is moderately suspicious, 7 points or more is categorized as ACR 5 which indicate highly suspicious [11]. Some ultrasonography characteristics, like a cystic or spongiform appearance, are reassuring and don't need further investigation. A cytological examination should be prompted by suspicious sonographic patterns, such as solid composition, hypoechogenicity, irregular margins, and microcalcifications [12].

The objective of this study is to determine the prevalence of incidental thyroid nodules in a sample of Iraqi patients who do not have a history of thyroid pathology or complaints using the Thyroid Imaging Reporting and Data System (TI-RADS).

PATIENTS AND METHODS

This is a cross-sectional study that includes 303 patients who were referred to the ultrasound unit in AL-Kindy Teaching Hospital Baghdad-Iraq, with complaints other than neck pathology. The study lasted for 5 months from November 2023 to March 2024, and all patients underwent neck ultrasound by a specialist radiologist.

Included patients were 15 years and older who did not have a history of thyroid pathology, previous thyroid surgery, or administered radioactive iodine before.

The thyroid ultrasound examination was performed by a GE LOGIC S8 machine, using a high-resolution linear array transducer (9 MHz) and small foot print linear array transducer (hockey stick transducer) known as the GE L8-18i (8–18 MHz) to obtain more detailed images for better characterization of the detected nodules, as in Figure 1 E–F. In a supine neutral position, the thyroid was examined in the axial and longitudinal planes as illustrated in (Figure 1).

Patients were grouped according to the thyroid ultrasound scan into groups A: 102 participants with incidental thyroid nodule(s); B: 201 participants with no identified nodule. In group A, each nodule was assessed for the maximum area, shape, margins, composition, echogenicity, and echogenic foci which are the six criteria that the ACR-TIRADS system deemed relevant for characterization. These criteria make it possible to classify the nodule's likelihood of being/ malignant as well as the FNAC indications. A total score summation ranging from 0–5 to determines the quality of the nodule as demonstrated in (Figure 2).

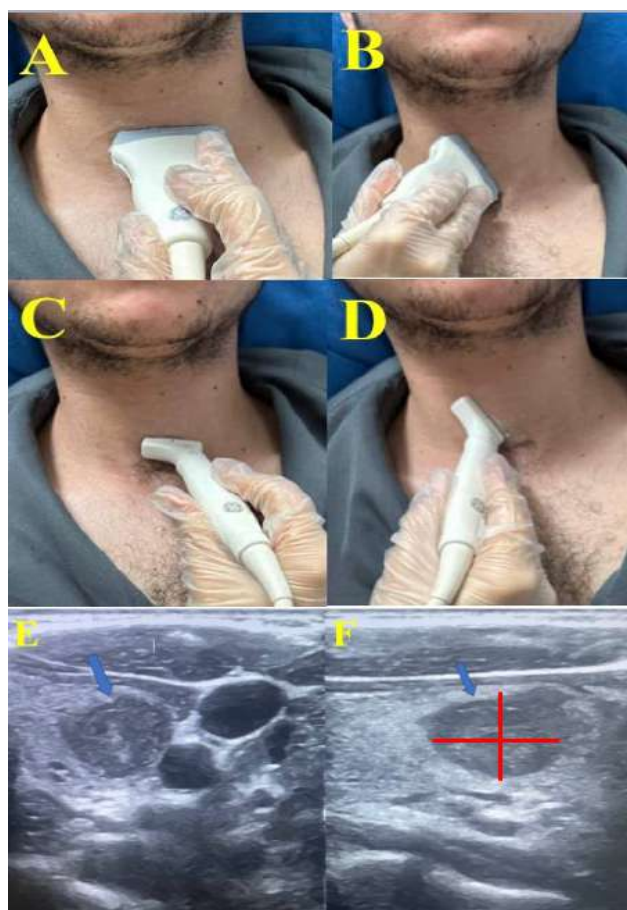


Figure 1. The examination protocol of the thyroid gland (A) and (B) axial and longitudinal planes using a linear probe. (C) and (D) axial and longitudinal planes using a hockey stick transducer. (E) and (F) ultrasonic photos of the Left thyroid lobes show how the nodule (blue arrows) appears in the (E) axial plane and (F) longitudinal plane. The measurement of the nodule area is obtained by estimating two measurements which are the length and the width (red arrows).

According to this classification system, a score of 4 was regarded as the minimal value for determining the risk of malignancy. In cases of multiple thyroid nodules, the nodule with the highest score was considered. All patients were given neck ultrasound reports even if the exam was normal to be considered as a baseline exam.

The study was approved by the Al Kindy Medical College Research Ethical Committee (ethical approval number 213 in 21/1/2024). All the details concerning the examination have been explained to the participants and voluntary verbal consent has been acquired. The statistical software SPSS 25.0 (SPSS, Chicago) was used to conduct the analyses. The continuous data's mean and standard deviation were shown, and the student t-test was employed to compare the groups. Categorical variables, which were given as percentages and numbers, were analyzed using the Chi-square test. A difference that was considered statistically significant was one with a p-value less than 0.05.

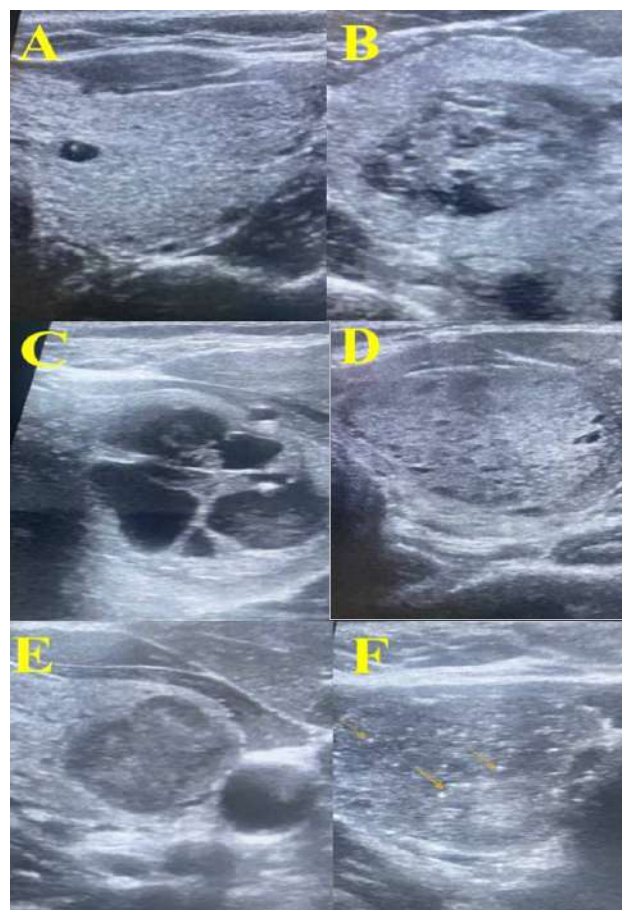


Figure 2. Ultrasonic images (all from the current case study) show the determination of ACR-TIRADS score of different thyroid nodules: A) cystic nodule, B) spongiform nodule, both attained 0 points so they are stratified as TR1 (benign). C) mixed cystic and solid nodule obtained 2 points, therefore was stratified as TR2. D) iso echogenic solid nodule obtained 3 points stratified as TR3. E) Hypoechoic nodules obtained 4 points so classified as TR4. F) A hypoechoic nodule with internal non-shadowing microcalcification (orange arrows) so stratified as TR5.

RESULTS

The participants' mean age was 40.36 ± 15.23 years, ranging between 15 and 84 years. Approximately 36% of the participants were adults between 31 and 45. Females accounted for more than two-thirds of the study population with male to female ratio of 1:1.23. The thyroid gland was normal in size in the vast majority of the study population (90.76%), however, 2 individuals (0.7%) had atrophic small thyroids. Further details are presented in (Table 1).

Out of 303 included individuals, 102 had incidentaloma (33.66%), group A. Of those, 63 patients (20.8%) had solitary nodules, and 39 patients (12.9%) had multiple nodules (Figure 3).

According to the imaging study, echogenic composition was the most common composite accounting for 28(27.45%) of the nodules. Hypoechoic and hypoechoic with calcification were identified in 23 (22.55%) and 12 (11.76%) respectively. The mean size of the nodules was 121.56 ± 135.6 mm², how-

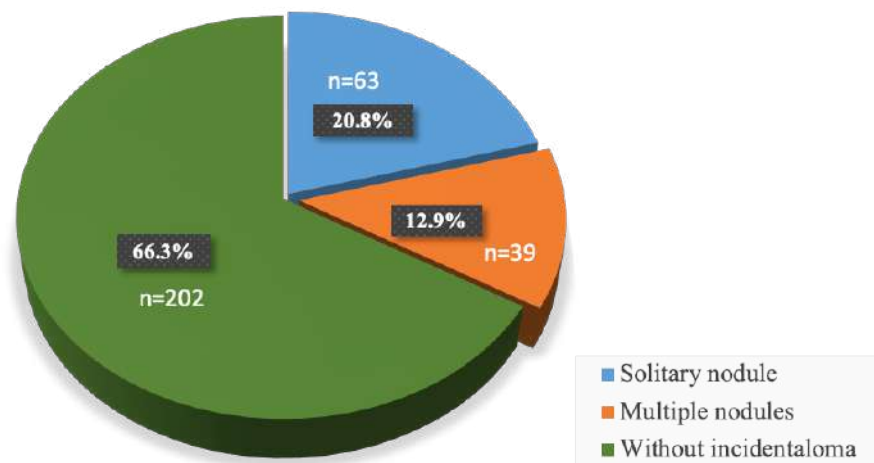


Figure 3. Prevalence and types of incidentaloma

Table 1. Demographic characteristics of the study population

Variables (no.=303)	Category	No. (%)
Age, years	15-30	74 (24.4%)
	31-45	109 (36%)
	46-60	86 (28.4%)
	61-75	24 (7.9%)
	>75	10 (3.3%)
Mean±SD	(40.36 ± 15.23)	
Range	(15-84)	
Sex	Male	91(30%)
	Female	212 (70%)
Thyroid volume	Normal	275 (90.76%)
	Small	2 (0.7%)
	Enlarged	26 (8.58%)

ever, the size of (61.76%) of the nodular size was less than 100 mm². Based on the TIRAD classification, TIRAD₄ was the most common class (33.33%) followed by TR₃ (30.39%). Highly suspicious TIRAD₅ nodules were identified in 8 (7.8%) of incidentaloma. Further details are illustrated in (Table 2).

In comparison to patients with no identified thyroid nodule (group B), incidentalomas were identified more frequently in the older age group (46-60 years), $P < 0.001$ with no significant sex predilection. As would be expected, incidentalomas were significantly associated with enlarged thyroid gland 21 (20.59%) (Table 3).

Within group A, the association of patients demographics and characteristics with thyroid nodularity pattern was evaluated as shown in Table 4. Multiple nodules were significantly associated with an enlarged thyroid gland compared to solitary (33.33% vs. 12.7%).

Furthermore, Hypoechoic and spongiform composition were more common in patients with multiple nodules (25.64% and 12.82%, respectively) than those with solitary nodules (6.35%

and 6.35%, respectively) in contrast, echogenic and cystic composition were more common in patients with solitary nodule (9.52% and 33.33%, respectively) than those with multiple nodules (0% and 17.95%, respectively), the difference was statistically significant (Table 4).

DISCUSSION

Thyroid incidentaloma is a relatively common finding during ultrasound examination of the neck that exerts an increasing interest due to associated cancer incidence (7-15%) [5, 13]. Hence, early detection of these nodules and risk stratification allows for an appropriate early referral of patients for FNAC to exclude malignancy [14].

The prevalence of ultrasound-detected thyroid incidentaloma is different across the world with reported frequency ranging from (0.84%) to (76%) [13, 15]. In the present study, about one-third (33.7%) of asymptomatic Iraqi adults subjected to ultrasound exams had incidentaloma, this is slightly higher than that reported in the south of Iraq by Al-Rikaby et al who reported a prevalence of (27.3%) of thyroid incidentaloma in Basrah province [16]. Other regions of the world exhibited a range of prevalence rates. Far lower prevalence was recorded in Iran (13.6%), the United States (9.4%), and Poland (14.8%), compared to Pakistan (21-26%), Korea (36.67%), and Finland (27.35%) [17]. This variation in prevalence rates is primarily determined by the population under investigation, as nodules are more prevalent in regions with iodine deficiency [18]. Additionally, the detection rate of thyroid incidentalomas can be influenced by the operator's experience and the type of ultrasound used to identify them.

We found that the prevalence of incidentaloma was increased

Table 2. Ultrasound characteristics of the thyroid incidentaloma

Variables (no.=102)	Category	No. (%)
Composition	Echogenic	28(27.45%)
	Hypoechoic	23(22.55%)
	Cystic	14(13.73%)
	Hypoechoic with calcification	12(11.76%)
	Cystic and solid	10(9.8%)
	Echogenic with calcification	9(8.82%)
	Spongiform	6(5.88%)
Size of nodule (mm ²)	< 100	63(61.76%)
	≥ 100	39(38.24%)
Mean ± SD	121.56 ± 135.6	
Range	(6.0 – 690)	
TI-RAD	TR1	20(19.61%)
	TR2	9(8.82%)
	TR3	31(30.39%)
	TR4	34(33.33%)
	TR5	8(7.84%)

TI-RAD = Thyroid Imaging Reporting and Data System

Table 3. Association of demographics and ultrasound characteristics with study groups

Variables	Category	Group B (n=201)	Group A (N=102)	P-Value
Age, years	15–30	60(29.85%)	14(13.73%)	<0.001
	31–45	86(42.79%)	23(22.55%)	
	46–60	37(18.41%)	49(48.04%)	
	61–75	14(6.97%)	10(9.80%)	
	>75	4(1.99%)	6(5.88%)	
Sex	Male	64 (31.84%)	27(26.47%)	0.335
	Female	137(68.16%)	75(73.53%)	
Thyroid volume	Normal	194(96.52%)	81(79.41%)	<0.001
	Small	2(1.00%)	0(0.00%)	
	Enlarged	5(2.49%)	21(20.59%)	

with age and thyroid gland volume (p-value <0.001), these findings are in agreement with previous studies across the world [19, 20]. In contrast to the majority of studies conducted outside of Iraq, which suggest that incidental thyroid nodules are primarily observed in females, we did not identify a significant correlation between female gender and incidentaloma [17, 19]. Simultaneously, a prior study conducted in Iraq by Al-Rikaby was consistent with our findings [16]. This could potentially indicate the existence of additional risk factors in the Iraqi population that understate the impact of gender on the incidence of incidentaloma.

In the current study, 27.45% of thyroid incidentaloma was found to be echogenic, and the majority were of TR4. This contradicts both local and international research [9, 16, 21, 22]. For example, Al-Rikaby et al. reported that the preponderance of incidentalomas were TR2 and TR3, while TR4 was detected in only 4% of cases. This discrepancy could be attributed to the difference in study design and the patient's demographic characteristics. In the current study, recruitment was in a tertiary hospital including patients with no previous symptoms related to thyroid whether a palpable nodule or pressure symptoms while Al-Rikaby et al recruited from a private

clinic including patients and healthy volunteers. On the other hand, thyroid cancer rate has increased in Iraq over the last 20 years and according to the latest Cancer Registry report, it ranked the seventh in the top ten cancer in Iraqi population higher grade of incidentaloma in Iraq compared to studies in other part of the world is expected as Iraq ranked on the 5 th place for thyroid carcinoma globally [23, 24]. This finding is of high concern since incidentaloma with TI-RADS 4 is classified as moderately suspicious with a risk of malignancy reaching 9.1%, therefore, such patients should be referred for FNA biopsy. It is worth mentioning here that several versions of TIRADS have been developed worldwide, some have been validated sufficiently, and others have not been well assessed. In the current study, we used the ACR TI-RADS, which includes 5 tiers and has been associated with the greatest overall performance when compared to other versions and a high specificity with the lowest false positive rates resulting in lower rates of unnecessary fine needle aspiration [25, 26]. Horvath et al, Kwak et al., Russ et al, on the other hand, applied the 6-tiered TIRADS with subdivisions of TR4 (4A,4B,4C) [27] and assigned normal thyroid that does not include any nodule as TR-1 unlike ACR TI-RADS [27, 28].

Table 4. Association of nodular pattern with demographic and ultrasound characteristics of the incidentaloma

Variables	Category	Solitary nodule (n=63)	Multiple nodule (n=39)	P-Value
Age, years	15-30	10(15.87%)	4(10.26%)	0.533
	31-45	13(20.63%)	10(25.64%)	
	46-60	32(50.79%)	17(43.59%)	
	61-75	4(6.35%)	6(15.38%)	
	>75	4(6.35%)	2(5.13%)	
Sex	Male	19(30.16%)	8(20.51%)	0.283
	Female	44(69.84%)	31(79.49%)	
Thyroid volume	Normal	55(87.30%)	26(66.67%)	0.012
	Enlarged	8(12.70%)	13(33.33%)	
Composition	Echogenic	6(9.52%)	0(0.00%)	0.022
	Hypoechoic	4(6.35%)	10(25.64%)	
	Cystic	21(33.33%)	7(17.95%)	
	Hypoechoic with calcification	16(25.40%)	7(17.95%)	
	Cystic and solid	6(9.52%)	6(15.38%)	
	Echogenic with calcification	6(9.52%)	4(10.26%)	
	Spongiform	4(6.35%)	5(12.82%)	
Size of nodule	<100	41(65.08%)	21(53.85%)	0.217
	≥ 100	21(33.33%)	18(46.15%)	
TI-RAD	TR1	11(17.46%)	9(23.08%)	0.809
	TR2	5(7.94%)	4(10.26%)	
	TR3	21(33.33%)	10(25.64%)	
	TR4	22(34.92%)	12(30.77%)	
	TR5	4(6.35%)	4(10.26%)	

TI-RAD = Thyroid Imaging Reporting and Data System

The size of incidentaloma showed marked variability in different studies [16, 22]. In the current study, most of the incidentaloma measured less than 10 mm with only (38.24%) being more than 10 mm. The percentage of nodules larger than 10 mm in our study was higher than that reported by Al-Rikaby et al. [16] and Moifo et al [21] (27.7% and 22%), respectively, while it was lower than that reported by Kamran et al. (43%).

Most of the incidentalomas in the current study were solitary (61.7%). This aligns with findings from previous studies in Iraq [16] and studies from other parts of the world [19, 22]. Since patients with thyroid abnormalities were more likely to have several thyroid nodules in an Iraqi sample, this result is comforting. The composition of the nodule on ultrasound and the thyroid gland volume showed significant association with nodularity pattern (P value = 0.022 and 0.012 respectively). A Significant association was observed between multinodularity and hypoechoic and spongiform composition. We did not find a significant association between multinodular thyroid and patient age or gender. This contradicts the Xu et al study where female gender and advanced age in addition to other metabolic factors were found to be independent risk factors of multiple thyroid nodules [29]. The discrepancy could be attributed to differences in demographics and inclusion criteria between the studies as the latter recruited symptomatic patients with palpable nodules.

The limitations of the current research lay in being a single-center study with a limited sample size, hence the findings may not be representative of the Iraqi population.

Nevertheless, our findings are significant in that they underscore the necessity of screening asymptomatic Iraqi adults with neck ultrasound for incidentaloma a condition that has only been studied in Iraq once [16], for subsequent early detection of thyroid carcinoma.

CONCLUSION

The prevalence of ultrasound-detected thyroid incidentaloma in a sample of asymptomatic Iraqi individuals was around 33.7% and is associated with age. Most thyroid incidentalomas were ACR -TIRAD 4 carrying a moderate risk of thyroid cancer.

ETHICAL DECLARATIONS

• Acknowledgements

None.

• Ethics Approval and Consent to Participate

The study was approved by the Al Kindy Medical College Research Ethical Committee (ethical approval number 213 on 21/1/2024)

• Consent for Publication

Non.

• Availability of Data and Material

The datasets are available from the corresponding author upon reasonable request.

• Competing Interests

The authors declare that there is no conflict of interest.

• Funding

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• Authors' Contributions

The author contributed significantly, directly, and intellectually to the work and consented it to be published.

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