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Original Article

Evaluation of Thyroid Pathologies Detected During School Screening in Healthy School-Age Children

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ABSTRACT

Objective: The authors of this study took part in a screening program in schools in Aydın province (unpublished study). This study assessed the final thyroid pathologies of these children with pathology detected during ultrasonography (USG) screening obtained as part of the screening program.

Methods: A handheld wireless point-of-care USG device was used to screen the thyroid gland. Children with thyroid pathology were invited to the hospital where detailed lab study and an USG was examined. The study obtained the thyroid measurements, parenchymal features, and noted the presence of nodules in the detailed USG examination. Nodules were classified according to the Thyroid Imaging Reporting & Data System (TI-RADS™) and an USG-guided fine needle aspiration (FNA) was performed according to TI-RADS.

Results: A total of 1,553 cases from 21 schools between the ages of 6-17 were evaluated in the screening program. Thyroid pathology was detected in 176 (11.3%) cases. One hundred twenty of 176 patients' families agreed to attend our centre for further examination, where pathology was confirmed in 108 (90.0%) of the 120 cases. Among the 108 thyroid USG pathologies, 52 (48.1%) patients had a nodule and thyroiditis; 28 (25.9%) patients had only a nodule; 28 (25.9%) patients had only thyroiditis. Thyroiditis was present in 74.0% (n=80) of the cases, of those cases 56.3% (n=45) had peripheral thyroiditis, 31.3% (n=25) had diffuse thyroiditis and 12.5% (n=10) had overweight-related changes. Nodules were present in 73.4% (n=80) of the cases. A total of 9 USG-guided FNA were performed, and their pathology results were as followed; 55.6% (n=5) benign cytology, 11.1% (n=1) follicular adenoma, 11.1% (n=1) atypia of indeterminate significance, 11.1% (n=1) non-diagnostic cytology and 11.1% (n=1) papillary thyroid cancer.

Conclusion: This study showed that thyroiditis and nodules in the thyroid gland are common disorders in children. Thyroid nodules may also have a high malignancy potential and the chance of early diagnosis of thyroid cancers with screening is demonstrated.

Keywords: Children, diffuse thyroiditis, nodule, over-weight related changes, peripheral thyroiditis, point of care ultrasound, screening, thyroid, TI-RADS, ultrasound-guided fine needle aspiration

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INTRODUCTION

Whilst thyroid pathologies are common in children, they are often asymptomatic in the initial clinical stages, thereby making the early diagnosis, treatment, and the management of thyroid disease particularly important.[1] The most common thyroid pathologies during childhood include autoimmune thyroid diseases, thyroid nodules, and malignancies.[2]

Hashimato's thyroiditis (HT), an autoimmune chronic inflammatory disease, is the most common cause of acquired hypothyroidism in children and adolescents.[3] Diagnosis of HT is confirmed by high serum levels of anti-thyroid peroxidase antibodies (anti-TPO) and/or thyroglobulin antibodies (anti-TG).[4] Although USG is not usually required to diagnose diffuse thyroid disease, when typical ultrasonography (USG) findings are present, especially in conditions such as subclinical HT, the diagnosis can be made before the disease becomes obvious.[5,6]

The incidence of childhood thyroid nodules and cancers has increased considerably recently, with most cases being asymptomatic and in the absence of any risk factors.[7] The presence of solid nodules in children also presents a higher risk of malignancy compared in adults[8,9]. The Thyroid Imaging Reporting and Data System (TI-RADS) classification was developed to determine the malignancy risk of thyroid nodules in adults. Although there are various studies to have adapted this classification to a pediatric age group, its safety has not yet been clearly demonstrated.[10]

Over the past five decades, there has been an increasing incidence of diagnoses of differentiated thyroid cancer in the pediatric age group. This is largely due to the increased incidence of papillary thyroid cancer. Most pediatric patients diagnosed with differentiated thyroid cancer present with an asymptomatic thyroid nodule found incidentally on physical examination or non-thyroid-related head and neck imaging.[8] Therefore, screening comes to the fore in early diagnosis and treatment. Generally, whilst most thyroid nodules are benign, when a child or adolescent is found to have a thyroid nodule, there is a two to three-fold increased risk of malignancy compared with adults.[11]

Thyroid pathologies can be asymptomatic in children and can be detected during imaging or routine physical examination performed for another purpose.[2] Accordingly, imaging plays an important role in the evaluation of thyroid diseases in pediatric patients. USG provides detailed information about the anatomical structure and characteristics of the thyroid gland and is the first-line diagnostic test to detect thyroid abnormalities.[5,12,13]

The authors of this study conducted a screening program titled "Current Iodine Status and Thyroid Volumes in Healthy School-Age Children" in schools within Aydın province, Türkiye (unpublished study). This retrospective study assesss the final thyroid pathologies of the children with suspected thyroid pathologies detected during screening program.

MATERIALS AND METHODS

The authors were screened 1,553 children between the ages of 6-17 across 21 schools in the study entitled as "Current Iodine Status and Thyroid Volumes in Healthy School-Age Children" (unpublished study). The weight and the height of the children were recorded, and a thyroid was examined using a handheld wireless point-of-care USG device. Thyroid imaging was performed with SonoStar™ Wireless Ultrasound Scanner (Uprobe-C5PL 3 in 1 Linear/Convex /Phased Array Probe, Universal Diagnostic Solutions Inc., California, USA).

Children with suspected thyroid pathologies on physical examination and/or thyroid imaging was invited to the hospital and were investigated for thyroid diseases. Finally, the auxological, clinical, laboratory and radiographical data of the subjects were obtained from the hospital records, retrospectively. Participants were tested for serum-free thyroxine (fT4), thyrotropin stimulating hormone (TSH), anti-TPO and anti-thyroglobulin (anti-TG). In addition detailed thyroid USG was performed with the LA2-9 MHz linear high-resolution probe of the Samsung™ RS80A USG device (Gyeonggi-do, Republic of Korea) in the department of radiology by the same radiologist who was involved with the screening program. Body mass index (BMI) was calculated using the "weight (kg)/[height (m)]^2" formula and body surface area (BSA) was calculated using the Dubois and Dubois formula "0.007184 x height (cm)$^{0.725}$ x weight (kg)$^{0.425}$".[14] BMI percentiles were calculated using the website http://www.ceddcozum.com with >85 percentile considered as overweight.[14]

Thyroid-stimulating hormone (TSH) in laboratory tests: 0.6-5.5 µIU/mL; fT4: 0.8-1.9 ng/dL; anti-TPO: 0-60 IU/mL; anti-TG: 0-60 IU/mL were considered normal. Those with normal TSH and fT4 levels at the time of diagnosis were considered euthyroid, whereas fT4 was normal, those with high TSH were considered subclinical hypothyroidism, and those with low fT4 and high TSH were considered overt hypothyroidism.

In the USG evaluation, the dimensions [antero-posterior (AP), medio-lateral (ML) and longitudinal (long)] and volumes of both lobes of the thyroid glands were measured. The volume of the thyroid gland was calculated using the formula of the World Health Organization (WHO) "[AP x ML x Long]x 0.479".[15] The isthmus thickness was measured. The parenchymal features of each lobe of the thyroid gland were evaluated (parenchymal echo, parenchymal contours). Next, the presence of the nodules investigated. For this purpose, both thyroid glands were scanned craniocaudal. If nodules were detected, they were classified according to the TI-RADS-scoring system. USG-guided fine needle aspiration (FNA) was decided in line with the TI-RADS management strategy.

The patients, who had planned to be performed USG guided fine needle aspiration (FNA), were informed about the procedure. All patients's complete blood count and bleeding parameters were checked before performing the procedure. Patients were placed in the supine position with the neck hyperextension, and USG guidance procedure was performed using a 22-gauge needle. The aspirated material was spread on a glass slide. If the incoming material was insufficient, the FNA was repeated. Finally, the materials were sent to the pathology laboratory and pathological was examined.

Diffuse parenchymal heterogeneity increased thyroid gland sizes, echogenic septations, micronodular or pseudonodular appearance were accepted as HT in the USG examination. Additionally, anti-TPO and/or anti-TG positivity was accepted as HT, regardless of the USG findings. Peripheral thyroiditis was defined as the presence of parenchymal heterogeneity changes and/or accompanying millimetric colloidal cystic changes only in the peripheral zone of the thyroid gland (Figure 1). In children with overweight and thyroiditis, findings in the thyroid parenchyma were accepted as overweight-related changes in autoantibody negativity.

Statistical Analysis

The statistics of the study were obtained using the Statistical Package for Social Science "SPSS" program (IBM Corp. Released 2019, IBM SPSS Statistics for Windows, version 26.0. Armonk, NY: IBM Corp.). The normality of the distribution was evaluated with descriptive statistics, steepness and skewness coefficients, histogram, and Shapiro-Wilk test. Categorical variables n and percent were given as mean ± standard deviation if numerical variables were normally distributed, and median (25-75 percentile) if not normally distributed. In the comparison of the three groups, the ANOVA test was used if the data were normally distributed (Tukey if the variances were homogeneously distributed in the post hoc analysis, Tamhane's T2 test if the variances were not homogeneously distributed), the Kruskal-Wallis H test (Dunn test in the post hoc analysis), and the chi-square test was used for the comparison of the categorical variables. The compatibility between the USG performed during the scan and the USG measurements performed in the hospital was evaluated using the Bland-Altman method. Type 1 error was determined as 5%, a p-value of <0.05 was considered statistically significant.

Informed consent from the parents of the patients had already been obtained before including the patients to the screening programme. This study was approved by the Aydın Adnan Menderes University Faculty of Medicine, Clinical Research Ethics Committee (no: 2022/67, date: 07.04.022).

RESULTS

Thyroid pathology was detected by physical examination and/or USG across 176 participants (11.3%) from the screening program, and they were invited to the hospital (107 girls, 60.8%). One hundred twenty (68.1%) of the 176 participant families agreed to attend our hospital for further examination. Pathology was detected on USG in 108 (90.0%) of the 120 cases, the right lobe hemiagenesis of the thyroid was found in one case but was considered as a normal variant (Figure 2).

The median age of participants was 14.0 (11.0-16.0) years. Sixty point two percent (n=65) of 108 cases were girls. Median height was 160.0 cm [(146.0-166.5 cm), [-0.0±1.0 standard deviation score (SDS)], body weight 54.0 kg [(43.0-65.0 kg), (-0.3±1.4 SDS)], body surface area 1.6 (1.3-1.7) m^2, BMI 20.9 (18.1-24.2) kg/m^2, and 25.9% (n=28) were overweight. All cases were euthyroid and the median TSH was 1.7 (1.1-2.3) µIU/mL, fT4 was 1.0 (0.9-1.1) ng/dL. The right thyroid volume was 4.9 (3.2-6.5) cc, left thyroid volume was 3.2 (2.1-4.4) cc, total thyroid volume 8.0 (5.5-10.5) cc, and isthmus thickness was 2.1 (1.7-2.7) mm (Table 1).

In the Bland-Altman analysis performed in terms of the correlation of detailed USG measurements (right thyroid volume, left thyroid

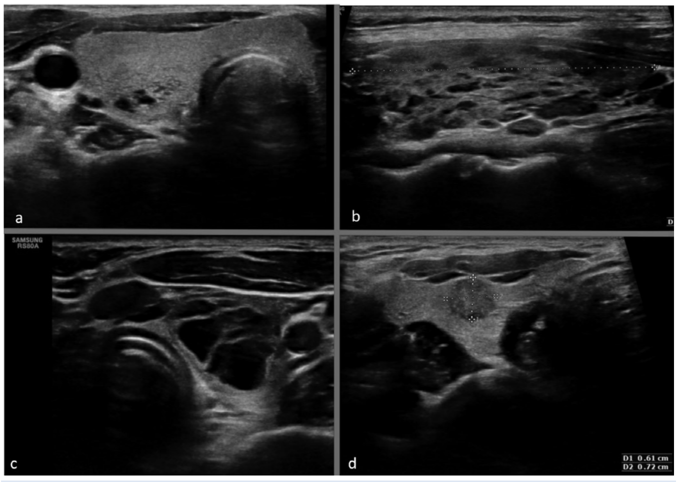

Figure 1 a-d: An axial plane image of a case with peripheral thyroiditis with isolated peripheral heterogeneity and colloidal-cystic changes (a). A longitudinal image of a case with diffuse thyroiditis with diffuse parenchymal heterogeneity and colloidal-cystic changes (b). An axial plane image of a case with a pathologically diagnosed mostly cystic benign nodule (c). An axial plane image of a case with TI-RADS 5 nodule (solid, hypoechoic, with microcalcification), pathologically diagnosed as papillary thyroid cancer (d)

TI-RADS: The Thyroid Imaging Reporting and Data System

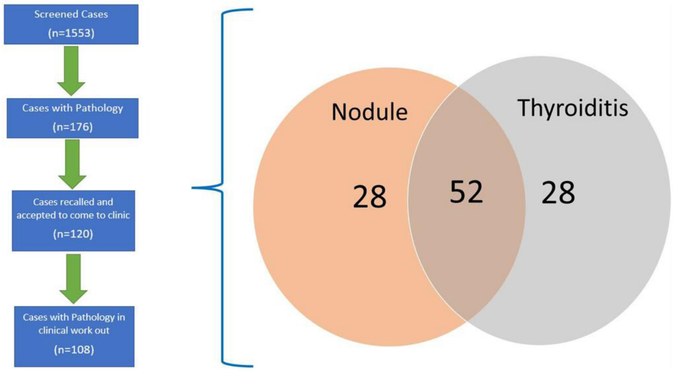

Figure 2. Flowchart of the study cohort and distribution of thyroiditis and nodule cases

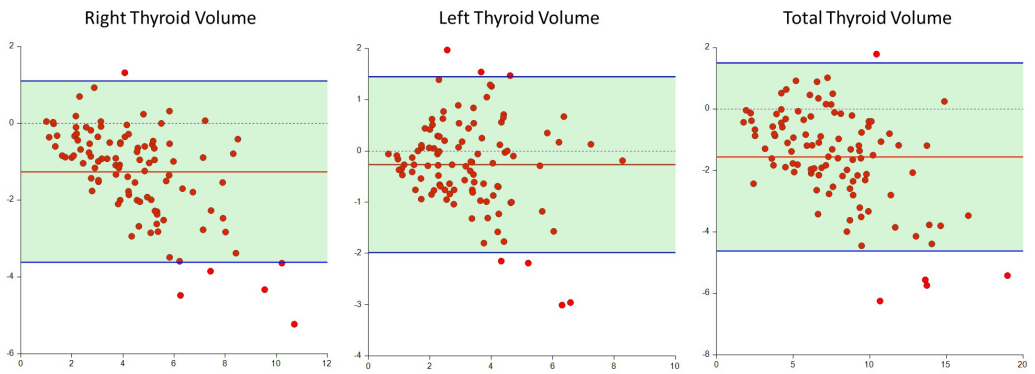

Figure 3. The Bland-Altman analysis of the USG measurements (right thyroid volume, left thyroid volume and total thyroid volume) between screening and detailed USG examination

USG: Ultrasonography

volume and total thyroid volume) that was performed in the hospital with the same age group at the screening; a strong correlation was found between the measurements (Figure 3). The difference between the screening measurements and the measurements made in the hospital is expressed as cc, and -1.3 [(-3.6)-1.1] for the right lobe volume, -0.3 [(-2.0)-1.5] for the left lobe, and -1.6 [(-4.5)-1.5] for the total thyroid volume. The most consistent results among measurements were for left thyroid measurements (Table 2).

Among 108 thyroid USG pathologies, 52 (48.1%) patients had nodule and thyroiditis; 28 (25.9%) patients had only nodule; 28 (25.9%) patients had only thyroiditis (Figure 2).

Thyroiditis was present in 74.0% (n=80) of the cases, of those cases 56.3% (n=45) had peripheral thyroiditis, 31.3% (n=25) had diffuse thyroiditis and 12.5% (n=10) had overweight-related changes. Sixty five percent (n=52) of thyroiditis cases were with nodules. Seventy-six-point nine percent (n=40) of those nodules were multinodular and 23.1% (n=12) were solitary. The median age of the subjects with thyroiditis was 14.0 (12.0-16.0) years [(62.5% (n=50) girls)]. The characteristics of the groups with only nodules, only thyroiditis, and both pathologies are presented in detail in Table 3. The subjects with different types of thyroiditis (diffuse, peripheral, and overweight-related changes) were compared and there was no significant difference between the groups (Table 4).

Nodules were present in 73.4% (n=80) of the cases. Sixty percentage (n=48) of those cases were multi-nodular, 40.0% (n=32) were solitary nodules. Sixty-five percent (n=52) of nodule cases were associated with thyroiditis. The median age of subjects with nodules was 14.0 (11.5-16.0) years [58.8% (n=47) girls]. The TI-RADS classification features of the detected thyroid nodules are given in Table 5. A total of 9 USG-guided FNA performed, and their pathology results were as followed; 55.6% (n=5) benign cytology, 11.1% (n=1) follicular adenoma, 11.1% (n=1) atypia of indeterminate significance, 11.1% (n=1) non-diagnostic cytology and 11.1% (n=1) papillary thyroid cancer (Figure 1) (Table 5).

DISCUSSION

Thyroiditis is an inflammation of the thyroid gland, which can clinically appear as euthyroid, hyperthyroid or hypothyroid. The most common form of these in a pediatric age group is Hashimoto's thyroiditis with prevalence of 1%-3%, peaking during adolescence.[16,17] It is seen more frequently in girls with a female/male ratio previously reported as 4-8:1.[18] HT is the gradual destruction of the thyroid gland by an autoimmune mechanism, with or without an enlargement of the thyroid gland (goiter). The diagnosis of HT is made by the presence of anti-thyroid antibodies (anti-TPO or anti-TG) and/or the presence of typical USG findings. At the time of diagnosis, 52.1% of the thyroid function tests of children with HT were euthyroid, 22.2% were overt, 19.2% were subclinical hypothyroid and 6.5% were overt and subclinical hyperthyroid.[19] In the study of Admoni et al.[20] 75% of the children diagnosed with HT were euthyroid and remained euthyroid. In other studies 87% HTs were asymptomatic, and 50% of them underwent spontaneous resolution.[16,17] For this reason, the literature on the subject still has not reached a consensus on screening for HT. In our study, HT findings were present in 27 (25%) of 108 cases, who were all euthyroid in their thyroid function tests. Thirteen (12.1%) of them had only diffuse parenchymal heterogeneity with serological markers without typical USG findings. Ten (9.3%) had both typical USG findings and positive serological markers, 2 (1.9%) had serological markers only and showed peripheral parenchymal heterogeneity. Autoimmune diseases such as type 1 diabetes mellitus, or chromosomal anomalies such as Turner syndrome increase the risk of HT. As such, it is recommended to routinely screen for HT in these individuals. Screening for HT with USG is not recommended for the healthy populations.

Twenty-eight (25.9%) of the 108 cases were classified as overweight. In 12 of these children's USG, decreases in parenchymal echogenicity, heterogeneity and colloidal cystic changes were detected in the periphery of the thyroid gland. A review by Szczyrski et al.[21] suggested that parenchymal heterogeneity in the thyroid peripheral zone of obese children is

Table 1. Basic demographic information, thyroid function test and USG findings of the cases

	N/mean ± SD	%/med (25-75 P)
Gender		
Boy	43	39.8
Girl	65	60.2
Age (years)	13.1±3.2	14.0 (11.0-16.0)
Height (cm)	156.4±16.0	160.0 (146.0-166.5)
Height (SDS)	0.0±1.0	0.1 (-0.7-0.7)
Weight (kg)	54.3±19.1	54.0 (43.0-65.0)
Weight (SDS)	0.3±1.4	0.1 (-0.6-1.1)
BSA (kg/m²)	1.5±0.3	1.6 (1.3-1.7)
BMI (m²)	21.5±5.0	20.9 (18.1-24.2)
Overweight		
Yes	28	25.9
No	80	74.1
Thyroid function		
Euthyroid	108	100.0
TSH (µIU/mL)	1.9±1.1	1.7 (1.1-2.3)
fT4 (ng/dL)	1.0±0.1	1.0 (0.9-1.1)
Anti-TPO		
Positive	15	13.9
Negative	93	86.1
Anti-TG		
Positive	16	14.8
Negative	92	85.2
Right thyroid volume (cc)	5.1±2.7	4.9 (3.2-6.5)
Right thyroid echogenicity		
Homogeneous	23	21.3
Heterogeneous	85	78.7
Isthmus thickness (mm)	2.3±0.9	2.1 (1.7-2.7)
Left thyroid volume (cc)	3.5±1.8	3.2 (2.1-4.4)
Left thyroid echogenicity		
Homogeneous	23	21.3
Heterogeneous	85	78.7
Total thyroid volume (cc)	8.6±4.2	8.0 (5.5-10.5)

Data were given as n (%), mean±SDS, median (25-75 percentile)

USG: Ultrasonography, SDS: Standard deviation score, BMI: Body mass index, BSA: Body surface area, TSH: Thyrotropin stimulating hormone, fT4: Free thyroxine, Anti-TPO: Anti-thyroid peroxidase antibodies, Anti-TG: Thyroglobulin antibodies, SD: Standard deviation

an obesity-related change. Among the possible causes of these changes observed in thyroid USG in obese children without autoimmunity is fat deposition in the thyroid gland and vasodilation caused by cytokines and inflammatory cells produced in the adipose tissue, and the increase in permeability of the thyroid vessels and plasma exudation in the thyroid parenchyma.[22,23] The improvement in thyroid morphology of obese patients after weight loss supports this view.[24] We associated these findings with overweight and classified them as changes related to weight gain. The sonographic findings of peripheral thyroiditis in patients with normal weight and negative autoantibodies were thought to be a precursor of autoimmune thyroiditis. We believe following up these children for possible autoimmune thyroiditis is advisable.

The incidence of thyroid nodules and cancer has increased significantly recently.[7] Most patients with thyroid nodules or thyroid cancer are asymptomatic at the time of diagnosis. Thyroid lesions of these patients are usually detected incidentally in a routine physical examination, during head and neck imaging, or during the evaluation of lymphadenopathy.[25] The incidence of thyroid nodules increases with age, but in contrast to adults, nodules detected in patients younger than 19 years have higher rates of malignancy (10-15% versus 20%25%, respectively).[11,26] Papillary thyroid cancer is the most common type of thyroid cancer in both adult and pediatric patients.[27] Since papillary cancer spreads through lymphatics, cervical lymph node metastasis is common at the time of diagnosis and is detected in 70% of pediatric patients.[27] Unlike papillary thyroid cancer, follicular thyroid cancer metastasizes by the hematogenous route. However, in the pediatric age group, follicular thyroid cancer has a milder course and remains confined to the thyroid gland.[12]

In this study, nodules were detected in 80 (74.1%) children. The incidence of thyroid nodules in pediatric literature is between 0.05%-5.1%.[11,12,28-31] In our screening program the incidence of thyroid nodules was very close to literature, which was 5.15% (80 cases out of 1,553). The TI-RADS-classification was used for the USG evaluation of these nodules. Although there are few studies in the literature in which the TI-RADS classification is used in the pediatric population, it has been concluded in these studies that the TI-RADS classification can be used easily and reliably for thyroid nodule risk classification in the pediatric population.[32-34] In accordance with the TI-RADS classification and the decision made in our pediatric thyroid nodule council in our institute, 9 of the 80 children underwent USG guided FNA (Table 5). One case was diagnosed with papillary thyroid cancer and invasion of central and lateral lymph nodes was detected (Figure 1).

Although thyroid cancer rates have increased significantly in the pediatric population recently, screening for thyroid nodules and cancer in children remains controversial. In a long-term follow-up study, Anderson et al.[35] found only a minimal increase (<1%) in thyroid cancer mortality in adolescents, suggesting that childhood thyroid cancer rarely causes death.[36] A study by Vaccarella et al.[37], examining the global pattern and incidence of thyroid cancer in children and adolescents, noted that the potential harms of diagnostic pressure outweigh the potential benefits in child and adolescent population. Furthermore, the study found that the increased incidence of thyroid cancer in this population was related to overdiagnosis.[37] Most children with thyroid cancer undergo total thyroidectomy. These children will undergo a lifelong therapy for thyroid hormone replacement, which often affects their quality of life. Thus, it has been debated that thyroid cancer screening should not be performed in asymptomatic children without risk factors.[37] However, this study diagnosed a case with papillary thyroid cancer that had metastasized to the

Table 2. Consistency evaluation of USG thyroid measurements between screening and detailed USG examination

	Right thyroid volume	Left thyroid volume	Total thyroid volume
Mean of differences	-1.3	-0.3	-1.6
Upper limit of the 95% CI	-3.6	-2.0	-4.6
Lower limit of the 95% CI	1.1	1.5	1.5
Correlation coefficient	0.894	0.847	0.926
r	0.957	0.835	0.914
p	<0.001	<0.001	<0.001

USG: Ultrasonography, CI: Confidence interval

Table 3. Characteristics of the groups with only nodules, only thyroiditis, and both pathologies

	Nodule (n=28)	Thyroiditis (n=28)	Nodule and thyroiditis (n=52)	p
Gender				
Boy	13 (46.4)	10 (35.7)	20 (38.5)	0.688
Girl	15 (53.6)	18 (64.3)	32 (61.5)	
Age (years)	13.0 (8.0-15.5)	14.0 (10.0-15.0)	15.0 (12.5-16.0)	0.035
Height (cm)	150.4±20.7	155.3±15.1	160.2±12.4	**0.048**
Height (SDS)	0.0±0.9	0.1±1.2	0.0±1.0	0.781
Weight (kg)	49.7±22.3	58.7±22.0	54.4±15.1	0.268
Weight (SDS)	0.3±1.2	1.0±1.6	0.0±1.4	**0.015**
BSA (m^2)	1.4±0.4	1.6±0.3	1.5±0.3	0.211
BMI (kg/m^2)	20.7±5.3	23.6±5.5	20.8±4.1	**0.030**
Overweight				
Yes	6 (21.4)	12 (42.9)	10 (19.2)	0.058
No	22 (78.6)	16 (57.1)	42 (80.8)	
TSH (µIU/mL)	1.5 (1.1-2.1)	2.0 (1.1-2.5)	1.7 (1.1-2.3)	0.353
fT4 (ng/dL)	1.0 (0.9-1.1)	1.0 (0.9-1.1)	1.0 (0.9-1.1)	0.537
Anti-TPO				
Positive	0 (0.0)	8 (28.6)	7 (13.5)	**0.009**
Negative	28 (100.0)	20 (71.4)	45 (86.5)	
Anti-TG				
Positive	0 (0.0)	8 (28.6)	8 (15.4)	**0.014**
Negative	28 (100.0)	20 (71.4)	44 (84.6)	
Right thyroid volume (cc)	4.3 (2.2-5.6)	4.3 (3.1-7.4)	5.2 (3.7-6.8)	0.060
Right thyroid echogenicity				
Homogeneous	22 (78.6)	0 (0.0)	1 (1.9)	**<0.001**
Heterogeneous	6 (21.4)	28 (100.0)	51 (98.1)	
Isthmus thickness (mm)	2.1 (1.6-2.6)	1.9 (1.6-2.9)	2.3 (1.9,2.8)	0.371
Left thyroid volume (cc)	2.2 (1.6-3.7)	3.3 (2-4.7)	3.5 (2.7-4.5)	**0.009**
Left thyroid echogenicity				
Homogeneous	22 (78.6)	0 (0.0)	1 (1.9)	**<0.001**
Heterogeneous	6 (21.4)	28 (100.0)	51 (98.1)	
Total tytoid volume (cc)	6.8 (3.9-9.2)	7.5 (5.3-11.7)	8.7 (6.6-11.0)	**0.034**

Data were given as n (%), mean±SDS, median (25-75 percentile)

SDS: Standard deviation score, BMI: Body mass index, BSA: Body surface area, TSH: Thyrotropin stimulating hormone, fT4: Free thyroxine, Anti-TPO: Anti-thyroid peroxidase antibodies, Anti-TG: Thyroglobulin antibodies

Table 4. Comparison of different types of thyroiditis				
	Diffuse (n=25)	**Peripheral (n=45)**	**Obesity-related changes (n=10)**	**p**
Gender				
Boy	9 (36.0)	17 (37.8)	4 (40.0)	0.974
Girl	14 (64.0)	28 (62.2)	6 (60.0)	
Age (years)	15.0 (10.0-16.0)	15.0 (12.0-16.0)	13.0 (12.0-14.0)	0.308
Height (cm)	156.7±14.4	159.3±13.3	160.4±12.1	0.696
Height (SDS)	0.1±1.1	-0.1±1.1	0.4±0.6	0.436
Weight (kg)	59.8±22.6	52.2±12.8	66.9±19.5	0.072
Weight (SDS)	0.7±2.0	-0.3±0.9	1.9±1.3	**<0.001**
BSA (m^2)	1.6±0.3	1.5±0.2	1.7±0.3	0.190
BMI (kg/m^2)	23.8±6.0	20.2±3.1	25.5±5.1	*
Overweight				
Yes	11 (44.0)	1 (2.2)	10 (100.0)	*
No	12 (56.0)	44 (97.8)	0 (0.0)	
TSH (µIU/mL)	2.2 (1.1-2.8)	1.6 (1.1-2.2)	2.1 (1.7-2.7)	0.060
fT4 (ng/dL)	1.0 (0.9-1.1)	1.0 (0.9-1.0)	1.1 (0.9-1.1)	0.405
Anti-TPO				
Positive	15 (60.0)	0 (0.0)	0 (0.0)	*
Negative	10 (40.0)	45 (100.0)	10 (100.0)	
Anti-TG				
Positive	14 (56.0)	2 (4.4)	0 (0.0)	*
Negative	11 (44.0)	43 (95.6)	10 (100.0)	
Right thyroid volume (cc)	5.6 (3-8.7)	4.9 (3.6-6.5)	5.4 (3.7-7.6)	0.520
Isthmus thickness (mm)	2.2 (1.6-3.2)	2.1 (1.7-2.6)	2.6 (2-3.3)	0.394
Left thyroid volume (cc)	3.4 (2.3-5.7)	3.3 (2.7-4.2)	4 (2.4-5.1)	0.683
Total tyroid volume (cc)	10.1±5.4	8.7±3.2	10.5±5.3	0.393
Nodule				
Negative	15 (60.0)	9 (20.0)	4 (40.0)	**0.003**
Positive	10 (40.0)	36 (80.0)	6 (60.0)	
Nodule type				
Solitary	5 (50.0)	6 (16.7)	1 (16.7)	0.082
Multi-nodular	5 (50.0)	30 (83.3)	5 (83.3)	

*p-values were not calculated due to data characteristics.

Data were given as n (%), mean ± SDS, median (25-75 percentile).

SDS: Standard deviation score, BMI: Body mass index, BSA: Body surface area, TSH: Thyrotropin stimulating hormone, fT4: Free thyroxine, Anti-TPO: Anti-thyroid peroxidase antibodies, Anti-TG: Thyroglobulin antibodies

central and lateral lymph nodes, without any risk factors and were asymptomatic. It was considered that the relatively early diagnosis and treatment of this case contributed positively to the morbidity and mortality of this patient. With this one case in our screening program the incidence of thyroid cancer was 0.06% (1 case out of 1,553) in our population and this incidence was higher than that in the United States, which has an incidence rate of 0.014%.[38] Therefore, screening should be considered seriously in countries with a high incidence rate of thyroid cancer.

Study Limitations

Not being able to include all the patients where we detected pathology in our screening program, the possibility of missing potential indistinct pathologies (such as mild parenchymal

Table 5. The TI-RADS classification features of the detected thyroid nodules and pathological results of the nodules		
	n	%
TI-RADS classification (score)		
TI-RADS 1 (0)	49	61.3
TI-RADS 2 (2)	4	5.0
TI-RADS 3 (3)	9	11.3
TI-RADS 4 (4-6)	15	18.8
TI-RADS 5 (>6)	3	3.8
Histopathological results of the nodules		
Benign cytology	5	55.6
Follicular adenoma	1	11.1
Atypia of indeterminate significance	1	11.1
Papillary thyroid cancer	1	11.1
Non-diagnostic cytology	1	11.1

TI-RADS: The Thyroid Imaging Reporting and Data System

heterogeneity, mild thyroiditis) using a hand-held USG device in the screening step, performing all USG examinations by a single radiologist and not being able to present long-term data on children included in this study were the limitations of the study. Being adequately representative of the regional population because it evaluates the pathologies detected due to the screening program in a large population, being able to evaluate pathologies in detail after the screening program and in case FNA is required, the fact that the FNA procedure is performed by the same radiologist who conducted the screening program, were study strengths.

CONCLUSION

In conclusion, this study showed that autoimmune thyroiditis and parenchymal changes in the thyroid gland due to obesity are common disorders in children. Also, thyroid nodules may have a high malignant potential and the chance of early diagnosis of thyroid cancers with screening is demonstrated.

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Ethics

Ethics Committee Approval: This study was approved by the Aydın Adnan Menderes University Faculty of Medicine, Clinical Research Ethics Committee (no: 2022/67, date: 07.04.022).

Informed Consent: Informed consent from the parents of the patients had already been obtained before including the patients to the screening programme.

Peer-reviewed: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: M.G., Concept: M.G., A.A., Design: M.G., A.A., Data Collection or Processing: M.G., R.D.S., S.Ö., Analysis or Interpretation: S.Ö., A.A., Literature Search: M.G., R.D.S., A.A., Writing: M.G., R.D.S., A.A.

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