Original Article

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Urinary Iodine Concentration and Thyroid Function in Children and Adolescents: A Cross-sectional Study

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Abstract

Aim: Iodine imbalance may affect thyroid function in children, but its role in suspected thyroid dysfunction in children remains unclear. This study aimed to evaluate urinary iodine status and its relationship with thyroid functional status in a pediatric endocrine referral cohort.

Methods: This retrospective cross-sectional study included 516 children and adolescents who were evaluated between April 2020 and April 2026. Urinary iodine concentration (UIC), thyroid function tests, thyroid autoantibodies, anthropometric data, pubertal status, and thyroid ultrasonography findings were reviewed. Comparisons across UIC categories were adjusted for multiple testing using the Benjamini-Hochberg false discovery rate (FDR) procedure. Univariable and multivariable logistic regression analyses were performed to identify factors independently associated with thyroid dysfunction and iodine deficiency.

Results: Median UIC was 150 µg/L, with 34.1% of patients having UIC <100 µg/L and 8.5% having UIC ≥300 µg/L. Urinary iodine concentration categories were similarly distributed across groups with normal thyroid function, subclinical hypothyroidism, and overt hypothyroidism. Age and pubertal status differed significantly across UIC categories after FDR correction. Body mass index category was independently associated with iodine deficiency, whereas urinary iodine status was not independently associated with thyroid dysfunction.

Conclusion: In this referral-based pediatric cohort, the median UIC indicated overall iodine sufficiency, but individual iodine status varied widely. Spot UIC was not clearly related to thyroid function, thyroid autoimmunity, or ultrasonographic abnormalities. It may identify background nutritional variability but should not be used alone to explain thyroid-stimulating hormone elevation.

Keywords: Hypothyroidism, thyroid diseases, ıodine, child, adolescent

Introduction

Subclinical hypothyroidism (SCH) is defined as an elevated serum thyroid-stimulating hormone (TSH) concentration in the presence of normal circulating free thyroxine (fT4) levels (1,2). It affects approximately 3% of children and adolescents and is a common reason for referral to pediatric endocrinology clinics (3). Although the clinical course of SCH in children is often benign and may remain stable or resolve spontaneously, its etiology is heterogeneous and includes autoimmune thyroiditis, iodine imbalance, obesity, genetic factors, and transient physiological variations (1,4-6). Iodine is an essential micronutrient required for thyroid hormone synthesis, and both iodine deficiency and iodine excess may adversely affect thyroid function (7-9). Urinary iodine concentration (UIC) is widely accepted as a practical biomarker of recent iodine intake and is recommended by the World Health Organization (WHO) for assessing iodine status at the population level (7).

Alterations in iodine intake may affect thyroid physiology, including thyroid hormone production and thyroid morphology (7). Although iodine deficiency remains an important public health concern in some

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pediatric populations, excessive iodine exposure may also be associated with thyroid dysfunction, particularly susceptible individuals (7). Previous studies of childhood SCH predominantly focused on its natural course, thyroid autoimmunity, and predictors of progression to overt hypothyroidism (1,3). However, data on iodine status and its relationship with the biochemical, clinical, and ultrasonographic characteristics of thyroid dysfunction are limited among children referred to a pediatric endocrinology clinic for suspected thyroid dysfunction. Evaluation of UIC together with thyroid function tests, thyroid autoantibodies, anthropometric characteristics, pubertal status, and thyroid ultrasonography may therefore provide a more comprehensive understanding of the potential role of iodine imbalance in these patients.

We hypothesized that iodine imbalance, reflected by low or high UIC, could be associated with biochemical and ultrasonographic features of thyroid dysfunction in children and adolescents referred for suspected thyroid dysfunction. Therefore, this study aimed to determine UICs in these patients and to investigate associations between UIC and anthropometric measurements, pubertal status, serum free triiodothyronine (fT3), fT4, and TSH levels, thyroid autoantibodies, and thyroid ultrasonographic findings. By clarifying the clinical relevance of UIC in this setting, our findings may contribute to a more appropriate interpretation of iodine status and help refine the evaluation of children presenting with TSH elevation in pediatric endocrine practice.

Materials and Methods

Compliance with Ethical Standards

This study was conducted in accordance with the principles of the Declaration of Helsinki. The study protocol was approved by the University of Health Sciences Türkiye, Istanbul Haseki Training and Research Hospital Non-Interventional Clinical Research Ethics Committee (approval no: 120-2026, date: 13.05.2026).

Study Design and Participants

This single-center, retrospective, cross-sectional observational study was conducted in the pediatric endocrinology outpatient clinic. Children and adolescents referred to our clinic between April 2020 and April 2026 for evaluation of suspected thyroid dysfunction were screened for eligibility. At the index outpatient visit, all referred patients underwent a standardized evaluation, including thyroid function tests, thyroid autoantibody measurements, UIC, and thyroid ultrasonography. Patients with complete clinical, laboratory, and imaging data were included unless they met any of the predefined exclusion criteria.

Subclinical hypothyroidism was defined as an elevated serum TSH concentration with a normal serum fT4 level. Overt hypothyroidism was defined as an elevated TSH concentration accompanied by a low serum fT4 level. Patients were excluded if they had congenital hypothyroidism, were receiving levothyroxine treatment, had undergone thyroid surgery, had an acute infectious condition at the time of evaluation, had a chronic systemic disease, were using medications known to interfere with thyroid function tests, or had missing urinary iodine measurements or other essential clinical data.

Data Collection

Demographic, anthropometric, laboratory, and imaging data were obtained from medical records. The recorded variables included age, sex, pubertal status, anthropometric measurements, serum TSH, fT3, fT4, anti-thyroid peroxidase antibody (anti-TPO), anti-thyroglobulin antibody (anti-Tg), hemoglobin, mean corpuscular volume, urinary iodine and creatinine levels, and thyroid ultrasonography findings.

Anthropometric and Pubertal Assessment

Body weight was measured using a digital scale, and height was measured with a stadiometer. Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters (kg/m^2). Anthropometric measurements were evaluated according to national age- and sex-specific reference standards and standard deviation scores were calculated using software (www.ceddcozum.com). For subgroup analyses, BMI was categorized as underweight (<5^{th} percentile), normal weight (5^{th} to <85^{th} percentile), and overweight/obesity (≥85^{th} percentile) according to age- and sex-specific BMI-for-age percentiles (10). Pubertal status was assessed according to Tanner staging (11,12).

Thyroid Examination and Ultrasonography

Thyroid enlargement on physical examination was graded according to the WHO/UNICEF/ICCID classification as grade 0 (no palpable or visible goiter), grade 1 (palpable but not visible), or grade 2 (clearly visible in the normal neck position) (13). Thyroid ultrasonography was performed using a Mindray Resona 9 ultrasound system with an L15-3WU linear probe. Thyroid gland dimensions, echogenicity, parenchymal heterogeneity, and the presence of nodules were evaluated. Thyroid gland size was assessed according to age- and sex-specific reference values, and thyroid enlargement was defined as a thyroid volume SDS >2 (14).

Laboratory Measurements

Urinary iodine concentration was measured in spot urine samples and expressed in μg/L. According to WHO criteria, iodine status was classified as severe deficiency

(<20 μg/L), moderate deficiency (20-49 μg/L), mild deficiency (50-99 μg/L), adequate intake (100-199 μg/L), intake above requirements (200-299 μg/L), or excessive intake (≥300 μg/L). For analytical comparisons, UIC was also categorized as low (<100 μg/L), normal (100-299 μg/L), and high (≥300 μg/L).

Urinary iodine concentrations were measured by inductively coupled plasma-mass spectrometry using a method accredited by the Turkish Accreditation Agency. Serum fT3, fT4, TSH, anti-TPO, and anti-Tg were analyzed on the Atellica IM1600 Immunoassay System (Siemens Atellica IM Analyzer) using competitive biotinylated rabbit polyclonal immunoassays based on direct immunochemiluminescence technology. The analytical sensitivities were 0.1 ng/dL for fT4, <0.2 pg/mL for fT3, and <0.01 mIU/L for TSH. Intra- and inter-assay coefficients of variation were ≤6% for fT4, <15% for fT3, and <5% for TSH. Thyroid autoantibody positivity was defined as the presence of anti-TPO and/or anti-Tg according to the laboratory reference ranges.

Statistical Analysis

The primary outcome was UIC among children and adolescents referred for evaluation of suspected thyroid dysfunction. Secondary analyses evaluated the associations between UIC and anthropometric characteristics, pubertal status, thyroid function tests, thyroid autoantibodies, thyroid examination findings, and thyroid ultrasonographic features. The normality of continuous variables was assessed using the Shapiro-Wilk test. Normally distributed continuous variables were presented as mean ± standard deviation, whereas non-normally distributed variables were expressed as median interquartile range, as appropriate. Continuous variables were compared using Student's t-test or the one-way ANOVA for normally distributed variables and the Mann-Whitney U test or the Kruskal-Wallis test for non-normally distributed variables. Categorical variables were compared using the Pearson chi-square test; when appropriate, the likelihood-ratio and linear-by-linear association tests were used to evaluate categorical associations and ordered trends, respectively. Thus, the principal statistical analyses comprised between-group comparisons of continuous and categorical variables and correlation analyses examining the relationships between UIC and clinical, biochemical, and ultrasonographic parameters. Correlations were assessed using Pearson or Spearman correlation coefficients, as appropriate. To account for multiple comparisons across clinical, anthropometric, biochemical, and ultrasonographic variables evaluated among UIC categories, p-values were adjusted using the Benjamini-Hochberg false discovery rate (FDR) procedure; an FDR-adjusted p-value <0.05 was considered statistically significant.

Univariable and multivariable binary logistic regression analyses were performed to identify factors associated with thyroid dysfunction, defined as SCH or overt hypothyroidism. Age was entered as a continuous variable, whereas sex, pubertal status, BMI category, urinary iodine status, thyroid autoantibody positivity, and thyroiditis were entered as categorical variables. Urinary iodine status was categorized as <100, 100-299, and ≥300 μg/L. Results were expressed as odds ratios (ORs) with 95% confidence intervals (CIs). Multivariable binary logistic regression analysis was also performed to identify factors independently associated with iodine deficiency. Age was entered as a continuous variable, whereas BMI category, pubertal status (prepubertal vs. pubertal), sex, thyroid autoantibody positivity, and thyroiditis were entered as categorical variables. Analyses were performed on an available-case basis for each variable; therefore, denominators varied across comparisons. A two-sided p-value <0.05 was considered statistically significant. Statistical analyses were performed using IBM SPSS Statistics, version 22.0 (IBM Corp., Armonk, NY, USA).

Results

Patient Characteristics

A total of 739 children and adolescents were screened for eligibility. Of these, 516 were included in the final analysis (Figure 1). The median age was 10 (6-13) years; 300 (58%) were female and 216 (42%) were male; 267 (51.7%) were pubertal (Table 1).

Thyroid Function and Autoantibody Status

At initial evaluation, 282 (54.6%) patients had normal thyroid function, 191 (37.0%) had SCH, and 43 (8.3%) had overt hypothyroidism. Thyroid autoantibody positivity differed significantly across thyroid function groups and was lowest in patients with SCH (16%) and highest in those with overt hypothyroidism (30%) (p=0.042). Autoantibody-positive patients were older (p<0.001) and had lower fT4 levels (p=0.011), whereas UIC (p=0.706) and TSH levels (p=0.166) were comparable between autoantibody-positive and autoantibody-negative patients. Thyroid autoantibody positivity was also similar across UIC categories (p=0.742) (Table 1).

Thyroid Examination and Ultrasonographic Findings

Assessment of goiter was available for 465 patients; goiter was present in 73/465 (15.7%). Thyroid ultrasonography was available for 437 patients: thyroid enlargement was detected in 40 (9.1%) patients, thyroiditis-related findings were detected in 165 patients (37.7%), and thyroid nodules were detected in 51 (11.6%) patients. Ultrasonographic findings did not differ significantly across UIC categories (Table 1).

Urinary Iodine Status

The median UIC was 150 μg/L. Overall, 176 (34.1%) patients had iodine deficiency (UIC <100 μg/L), 296 (57.2%) had UIC values of 100-299 μg/L, and 44 (8.5%) had excessive iodine status (UIC ≥300 μg/L). Urinary iodine concentration categories were similarly distributed across the normal thyroid function, SCH, and overt hypothyroidism groups (p=0.801) (Table 2).

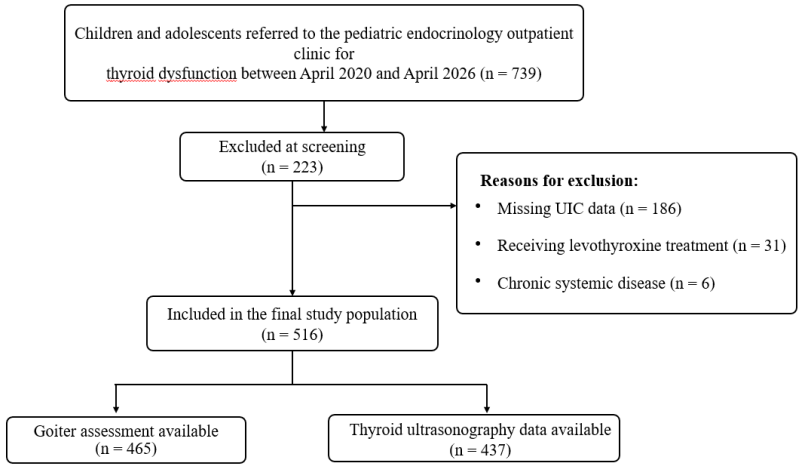

Figure 1. Study flow diagram
UIC: Urinary iodine concentration

Table 1. Clinical and biochemical characteristics according to grouped UIC categories

Variable	UIC<100 μg/L (n=176)	UIC 100-299 μg/L (n=296)	UIC ≥300 μg/L (n=44)	Raw p-value	FDR-adjusted p-value
Age, years	10.1 (6-13)	10.4 (7-14)	6.9 (1-12)	<0.001	<0.010
Sex, female/male, n	103/73	165/129	30/14	0.314	0.449
Pubertal status, prepubertal/pubertal, n	92/84	128/167	29/15	0.009	0.045
BMI SDS	0.41±1.41	0.22±1.33	-0.15±1.72	0.043	0.108
Height SDS	-0.08±1.15	-0.13±1.11	-0.18±1.16	0.966	0.966
TSH, mIU/L	5.13±4.53	4.85±4.17	5.07±2.91	0.216	0.432
fT4, ng/dL	12.0±1.8	12.6±4.2	13.0±2.4	0.034	0.108
Thyroid autoantibody positivity, n	37/153	60/267	7/38	0.742	0.824
Thyroid enlargement positivity, n	18/154	20/251	2/32	0.430	0.538
Thyroid nodule positivity, n	19/154	31/251	1/32	0.294	0.449

Data are presented as median (IQR), mean ± SD, or n, as appropriate. Denominators vary across variables because of missing data. Continuous variables were compared using one-way ANOVA or the Kruskal-Wallis test, as appropriate according to data distribution, and categorical variables were compared using Pearson's chi-square test. p-values for comparisons across UIC categories were adjusted for multiple testing using the Benjamini-Hochberg false discovery rate procedure. An FDR-adjusted p-value <0.05 was considered statistically significant
BMI: Body-mass index, FDR: False discovery rate, fT4: Free thyroxine, IQR: Interquartile range, SDS: Standard deviation score, TSH: Thyroid stimulating hormone, UIC: Urinary iodine concentration, ANOVA: Analysis of variance

Table 2. Urinary iodine concentration categories and median UIC across thyroid function group

Thyroid function group	UIC<100 μg/L n (%)	UIC 100-299 μg/L n (%)	UIC ≥300 μg/L n (%)	p[1]-value	Median UIC, μg/L (IQR)	p[2]-value
Normal thyroid function (n=282)	95 (33.8)	165 (58.7)	21 (7.5)	0.801	145 (81-182)	0.606
SCH (n=191)	64 (33.5)	108 (56.5)	19 (9.9)		156 (83-185)	
Overt hypothyroidism (n=43)	17 (39.5)	22 (51.2)	4 (9.3)		158 (70-196)	

Data are presented as n (%) or median (IQR), as appropriate. [1]The distribution of UIC categories across thyroid function groups was compared using Pearson's chi-square test. [2]Median UIC values across thyroid function groups were compared using the Kruskal-Wallis test. A two-sided p-value <0.05 was considered statistically significant
IQR: Interquartile range, SCH: Subclinical hypothyroidism, UIC: Urinary iodine concentration

Urinary iodine levels were comparable between females and males. Patients with UIC ≥300 μg/L were younger and were frequently prepubertal. Age and pubertal status remained significantly different across UIC categories after FDR correction (adjusted p<0.010 and p=0.045, respectively) (Table 1). Body mass index category was not significantly associated with UIC category, according to Pearson's chi-squared test (p=0.070). Urinary iodine concentration values decreased across BMI categories, from 186 (100-206) μg/L in underweight children to 156 (85-183) μg/L in normal-weight children and to 132 (68-170) μg/L in children with overweight/obesity; however, this difference did not remain statistically significant after FDR correction (raw p=0.034, adjusted p=0.108).

Multivariable binary logistic regression analysis showed that BMI category was independently associated with iodine deficiency (overall p=0.010). Compared with children who were overweight or obese, underweight children (OR=0.338, 95% CI: 0.135-0.847, p=0.021) and normal-weight children (OR=0.484, 95% CI: 0.288-0.813, p=0.006) had lower odds of iodine deficiency. Age, pubertal status, sex, thyroid autoantibody positivity, and thyroiditis were not independently associated with iodine deficiency (all p>0.05).

For analytical comparison, UIC was also categorized as low (<100 μg/L), normal (100-299 μg/L), and high (≥300 μg/L). Mean fT4 levels differed across UIC categories in the unadjusted analysis (p=0.034); however, this difference was no longer statistically significant after FDR correction (adjusted p=0.108) (Table 1). No significant differences were observed in sex, height SDS, fT3, TSH, anti-TPO, anti-Tg, and thyroid volume across UIC groups. Similarly, thyroid enlargement, ultrasonographic findings of thyroiditis, and presence of thyroid nodules were comparable among iodine categories (Table 1). Urinary iodine concentration was not significantly correlated with thyroid function parameters, thyroid autoantibodies, thyroid ultrasonographic findings, height SDS, or BMI SDS.

A univariable binary logistic regression analysis showed that age and pubertal status were significantly associated with thyroid dysfunction. Each one-year increase in age was associated with a 9.7% decrease in the odds of thyroid dysfunction (OR=0.903, 95% CI: 0.869-0.938, p<0.001), while pubertal children had significantly lower odds than prepubertal children (OR=0.451, 95% CI: 0.317-0.643, p<0.001). Sex, thyroid autoantibody positivity, thyroiditis, UIC, BMI category, and goiter were not significantly associated with thyroid dysfunction (all p>0.05). However, in the multivariable binary logistic regression model, age, pubertal status, sex, urinary iodine status, thyroid autoantibody positivity, thyroiditis, and BMI category were not independently associated with thyroid dysfunction. After adjustment for other covariates, urinary iodine status was not significantly associated with thyroid dysfunction (overall p=0.410).

Discussion

Although the median UIC in our cohort was 150 μg/L, indicating iodine sufficiency at the population level according to WHO criteria, the distribution of iodine status was clearly heterogeneous (15). More than one-third of the patients had UIC <100 μg/L, whereas 8.5% had UIC ≥300 μg/L. This coexistence of iodine deficiency and excess, despite an adequate population-level median, represents one of the main findings of our study and emphasizes that a sufficient median UIC does not imply uniform iodine sufficiency at the individual level. Compared with Turkish data, our median UIC was within the range previously reported in pediatric populations (107-175 μg/L) (16-18). A similar heterogeneous pattern was recently reported by Baladastian et al. (19), who observed both iodine deficiency (19.6%) and excessive iodine status (14.0%) despite overall adequate iodine nutrition (median UIC of 190 μg/L). These findings suggest that contemporary pediatric populations may exhibit substantial variability in iodine exposure even in settings considered iodine-sufficient.

The iodine profile observed in our cohort should also be interpreted in the context of the clinically selected population. International studies have reported considerable variation in pediatric UIC across iodine-sufficient and high-exposure settings (20). However, direct comparison of absolute UIC values across populations may be of limited value because dietary iodine sources, iodized salt use, supplement exposure, age distribution, and sampling characteristics differ substantially between studies. More importantly, our cohort consisted of children referred for suspected thyroid dysfunction, rather than being a population-based sample. Thus, the heterogeneity observed in our study may reflect both background iodine exposure and the characteristics of children referred to pediatric endocrinology practice.

A clinically important observation was that the heterogeneous iodine distribution did not translate into a corresponding difference in thyroid function status. Children with normal thyroid function, SCH, and overt hypothyroidism showed broadly similar distributions across iodine categories, suggesting that neither iodine deficiency nor iodine excess alone adequately explains mild thyroid dysfunction in this referral population. This finding differs from some pediatric studies in which either excessive or insufficient iodine exposure was associated with thyroid dysfunction. Yang et al. (21) reported associations between prolonged high iodine exposure and increased thyroid volume and hyperthyrotropinemia, while Korean and Nepalese studies also suggested relationships

between iodine excess and thyroid dysfunction (22,23). Iodine deficiency also remains a recognized cause of acquired hypothyroidism in children, particularly in iodine-deficient settings (6). The differing findings across studies suggest that the thyroid response to iodine may depend not only on the amount of exposure but also on the duration of exposure, background iodine status, individual susceptibility, and population characteristics. A single spot UIC measurement in our study may, therefore, capture recent exposure without fully reflecting the longer-term iodine environment relevant to thyroid dysfunction.

In our cohort, children with excessive UIC were younger, and higher-UIC groups had a larger proportion of prepubertal children. Importantly, differences in age and pubertal status across UIC categories remained significant after correction for multiple tests. Age-related differences in diet, parent-directed feeding, nutritional supplement use, body size, fluid turnover, and urinary iodine handling may contribute to variation in spot UIC. Previous studies have reported different age-related patterns, including greater iodine deficiency in younger children and increasing iodine excess with age (24,25). This inconsistency supports the interpretation that the relationship between age and UIC is population-specific rather than universal. In clinical practice, age and pubertal stage may therefore be important contextual factors when interpreting spot UIC values in children.

The findings related to BMI require a similar interpretation. Although BMI-related differences across UIC groups were not statistically significant, the BMI category remained independently associated with iodine deficiency. Children with overweight or obesity had higher odds of iodine deficiency than normal-weight or underweight children. Children with overweight/obesity may differ from their normal-weight or underweight peers in dietary composition, consumption of iodine-containing foods, supplement use, and hydration patterns, all of which may influence spot UIC. Some pediatric studies have similarly reported lower UIC among children with overweight/obesity (26), whereas other studies, including recent data, have not identified BMI as an independent predictor of low UIC (19,24). The inconsistency across populations, together with the cross-sectional nature of our data, argues against a direct causal interpretation and suggests that BMI may instead act as a marker of differences in diet, lifestyle, or iodine exposure.

Our analyses further strengthen the conclusion that spot UIC has limited explanatory value for thyroid dysfunction in this cohort. This is consistent with studies showing that spot UIC does not necessarily result in abnormal thyroid function tests in children (27,28).

The lack of a link between iodine status and thyroid autoimmunity suggests that recent iodine exposure was not a significant factor in thyroid abnormalities in this cohort. Thyroid autoantibody levels and thyroiditis-related ultrasonographic findings were not clearly related to UIC. Previous pediatric data have similarly failed to demonstrate a consistent association between iodine status and thyroid autoimmunity (29), although iodine excess has been associated with autoimmune thyroid disease in other settings (30,31). One possible explanation is that autoimmune thyroid disease reflects longer-term interactions between genetic susceptibility, immune mechanisms, and environmental exposures, whereas a single spot UIC measurement reflects only recent iodine intake. Therefore, the absence of an association in our study does not exclude a potential effect of prolonged iodine exposure on thyroid autoimmunity.

The ultrasonographic findings should be interpreted within the same temporal framework. Structural thyroid changes are likely to reflect cumulative influences of growth, developmental stage, autoimmunity, and longer-term environmental exposures rather than short-term fluctuations in iodine intake. Consequently, the absence of a relationship between spot UIC and thyroid enlargement, thyroiditis-related changes, or nodules in our cohort is biologically plausible. In healthy Turkish school-age children from an iodine-sufficient region, thyroid volume was reported to correlate more strongly with age and anthropometric variables than with UIC itself (32). More recently, Pang et al. (9) demonstrated the relevance of anthropometric characteristics to thyroid morphology in a large iodine-sufficient pediatric population. Together, these observations suggest that a single UIC measurement may have limited ability to explain structural thyroid findings in children.

From a clinical perspective, our findings argue against using a single spot UIC value as a direct explanation for mild TSH elevation in children referred to pediatric endocrinology. Rather, UIC appears to provide contextual information about recent iodine exposure. The coexistence of deficiency and excess in the same referral population may justify considering iodine exposure when evaluating selected patients, but such interpretation should be integrated with thyroid function tests, thyroid autoantibodies, clinical findings, dietary and supplement history, and, when indicated, ultrasonographic findings. The lack of an independent association between iodine status and thyroid dysfunction further supports this comprehensive, rather than UIC-centered, approach.

Study Limitations

The retrospective cross-sectional design of the study precluded causal inference, and the single-center setting may limit the generalizability of the findings. In addition, spot UIC reflects recent iodine intake and shows

substantial intra-individual variability, limiting individual-level interpretation. Dietary iodine intake, supplement use, iodized salt exposure, and other potential sources of iodine were not systematically assessed. These unmeasured exposures are particularly relevant to the observed associations with age, pubertal status, and BMI, and they limit our ability to determine the mechanisms underlying these relationships. Moreover, the relatively small number of children with excessive iodine status may have limited the ability to detect associations within this subgroup.

Despite these limitations, the study has several strengths. The relatively large pediatric referral cohort allowed simultaneous assessment of iodine status, thyroid function, thyroid autoimmunity, anthropometric characteristics, pubertal stage, and thyroid ultrasonographic findings within the same clinical population. In addition, correction for multiple testing reduced the likelihood of interpreting chance findings as meaningful associations, while multivariable regression analyses allowed the principal relationships to be evaluated after accounting for relevant covariates. Together, these methodological features provide a more conservative assessment of the clinical relevance of spot UIC in children referred for suspected thyroid dysfunction.

Conclusion

The median spot UIC was consistent with overall iodine sufficiency in this referral-based pediatric cohort, despite substantial interindividual variability in iodine status. Importantly, this heterogeneity in iodine exposure was not associated with thyroid dysfunction, thyroid autoimmunity, or ultrasonographic abnormalities after adjustment for relevant covariates. Age and developmental stage appear to influence the distribution of spot UIC, while the association between BMI and iodine deficiency may reflect more complex dietary or behavioral factors. Therefore, a single spot UIC measurement should be interpreted primarily as a marker of recent iodine exposure and should not be used in isolation to explain TSH elevation in individual children. Its clinical value is likely greatest when integrated into a broader assessment rather than considered as an isolated diagnostic indicator.

Ethics

Ethics Committee Approval: The study protocol was approved by the University of Health Sciences Türkiye, Istanbul Haseki Training and Research Hospital Non-Interventional Clinical Research Ethics Committee (approval no: 120-2026, date: 13.05.2026).

Informed Consent: Because of the retrospective design of the study, written informed consent was not obtained from the patients or their parents/legal guardians.

Authorship Contributions

Surgical and Medical Practices: S.K.Y., I.H., Concept: S.K.Y., Design: S.K.Y., Data Collection or Processing: I.H., Analysis or Interpretation: S.K.Y., Literature Search: S.K.Y., Writing: S.K.Y., I.H.

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