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Association of Menopausal Status with Thyroid Nodule Prevalence and Size in Women with Hypothyroidism

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Abstract:

Objective: To examine the association between menopausal status and thyroid nodule prevalence and size in women with hypothyroidism.

Methods: In this retrospective comparative study, we reviewed 149 women with hypothyroidism seen in outpatient clinics at a tertiary care hospital. Hypothyroidism was defined as a documented clinical diagnosis supported by elevated thyroid-stimulating hormone (TSH) with low or normal thyroxine (T4). Women were classified as being in the reproductive period or postmenopausal; postmenopause was defined as amenorrhoea for at least 12 months or documented postmenopausal status in the medical record. Group comparisons used the chi-square test, independent-samples t-test, or Mann-Whitney U test, as appropriate. Crude ORs with 95% CIs were calculated for key dichotomous nodule outcomes.

Results: Of the 149 women, 89 (59.7%) were of reproductive age, and 60 (40.3%) were postmenopausal. Thyroid nodules were present in 61 (40.9%) patients. Postmenopausal women had a higher prevalence of nodules than reproductive-age women (56.7% vs 30.3%; crude OR, 3.00; 95% CI, 1.52–5.94; P=0.002). Nodules >1 cm were also more frequent after menopause (25.0% vs. 9.0%; crude OR, 3.38; 95% CI, 1.33–8.57; P=0.029). TSH, T4, anti-thyroid peroxidase (anti-TPO) levels, anti-TPO positivity, and levothyroxine use did not differ significantly between the groups.

Conclusion: Among women with hypothyroidism, postmenopausal status was associated with a greater thyroid nodule burden and a higher frequency of nodules >1 cm. Because age and menopausal status were closely linked, the findings should be interpreted as unadjusted associations rather than independent effects of menopause.

Keywords: Hypothyroidism, Menopausal Status, Postmenopause, Thyroid Nodule, Thyroid Ultrasonography, Reproductive Age

Hypothyroidism is one of the commonest endocrine disorders in women and, in iodine-replete settings, is most often caused by chronic autoimmune thyroiditis, particularly Hashimoto's thyroiditis [1]. In this setting, lymphocytic infiltration progressively damages thyroid follicular cells and reduces thyroid hormone production. Overt primary hypothyroidism is defined

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by an elevated serum thyroid-stimulating hormone (TSH) concentration together with a low thyroxine (T4) concentration, whereas subclinical hypothyroidism is characterised by an elevated TSH with T4 remaining within the reference range. Because the clinical presentation is often insidious and non-specific, diagnosis rests largely on laboratory assessment. In routine practice, TSH and T4 are the core investigations, while thyroid autoantibodies, especially anti-thyroid peroxidase (anti-TPO) antibodies, support an autoimmune aetiology. Levothyroxine remains the standard treatment and is titrated to achieve biochemical euthyroidism [2, 3].

During the reproductive years, thyroid hormones interact with the hypothalamic-pituitary-gonadal axis at several levels. Even relatively modest thyroid dysfunction can therefore extend beyond the thyroid gland itself and affect menstrual cyclicity, ovulation, fertility, and pregnancy outcomes. Hypothyroidism has also been linked with conditions such as premature ovarian insufficiency and polycystic ovary syndrome. For women of reproductive age, timely recognition and appropriate treatment matter not only for symptom control but also for reproductive physiology and wider endocrine health [4].

The menopausal transition introduces a different endocrine environment. Falling oestrogen concentrations, rising gonadotrophins, changes in body composition, and greater insulin resistance alter metabolic homeostasis just as menopausal symptoms begin to overlap with those of thyroid dysfunction [5]. Recent work has also reinforced that thyroid dysfunction is common in peri- and postmenopausal women and that age, female sex, and metabolic factors are closely tied to thyroid nodularity [6-10]. The thyroid gland itself changes with age; nodules become more common, particularly in women. Both normal and neoplastic thyrocytes express oestrogen receptors, and experimental data suggest that oestrogens can influence thyroid cell proliferation, offering a plausible biological basis for sex-related differences in thyroid structural disease [5, 8, 11].

For clinicians, this means that thyroid function and thyroid morphology should not be treated as interchangeable. A thyroid nodule is a discrete lesion within the gland, and current European guidance recommends clinical assessment, thyroid function testing, and neck ultrasonography in the initial evaluation of nodular thyroid disease, with fine-needle aspiration guided by sonographic risk pattern and nodule size [3]. What remains less clear is whether menopausal status is associated with greater thyroid nodularity in women who already have hypothyroidism. That question matters in daily practice because hypothyroid women are commonly followed with serial laboratory testing, yet similar biochemical results do not necessarily imply similar structural thyroid disease. Data specifically addressing thyroid nodule burden according to menopausal status within a hypothyroid female cohort remains limited. The present study was therefore designed to compare thyroid nodule prevalence and nodule size between women in the reproductive period and postmenopausal women with hypothyroidism.

METHODS

This retrospective observational study was conducted at a tertiary care hospital. We reviewed the records of women who attended the internal medicine, endocrinology, gynaecology, and general surgery outpatient clinics between September 2022 and January 2026 and had a documented diagnosis of primary hypothyroidism. For the study, hypothyroidism was defined as a clinician-recorded diagnosis supported by biochemical evidence of elevated serum TSH with low or normal T4 in the hospital record, consistent with overt or subclinical primary hypothyroidism. Women were classified as being in the reproductive period or postmenopausal. Postmenopause was defined as the absence of menstruation for at least 12 consecutive months or documented postmenopausal status in the medical record. The final cohort comprised 149 women, including 89 in the reproductive period and 60 who were postmenopausal.

The study protocol was approved by the Giresun Training and Research Hospital Ethics Committee (approval no. 04.03.2026/02) and was conducted in accordance with the Declaration of Helsinki. Because of the retrospective design and the use of existing medical records, the requirement for informed consent was waived.

Demographic, clinical, thyroid-related laboratory, and thyroid ultrasonography data were extracted from

TABLE 1. Baseline Demographic, Clinical, and Ultrasonographic Characteristics of Women with Hypothyroidism

Variable	Category	n	%
Menopausal status	Reproductive period	89	59.7
	Postmenopause	60	40.3
Anti-TPO positivity	Negative	75	50.3
	Positive	74	49.7
Levothyroxine use	No	105	70.5
	25 µg	12	8.1
	50 µg	12	8.1
	75 µg	11	7.4
	100 µg	9	6.0
Presence of thyroid nodules	No	88	59.1
	Yes	61	40.9
Number of nodules	No	88	59.1
	1 nodule	30	20.1
	2 nodules	9	6.0
	3 nodules	4	2.7
	Multiple	18	12.1
Nodules <1 cm	No	93	62.4
	1 nodule	31	20.8
	2 nodules	7	4.7
	3 nodules	1	0.7
	Multiple	17	11.4
Nodules >1 cm	No	126	84.6
	1 nodule	18	12.1
	2 nodules	5	3.4
Echogenicity	Hypoechoic	23	34.3
	Isoechoic	36	53.8
	Hyperechoic	8	11.9
Solid structure	No	141	94.6
	Yes	8	5.4
Cystic structure	No	115	77.2
	Yes	34	22.8
Parenchymal tissue	Homogeneous	27	21.1
	Heterogeneous	101	78.9

Data are shown as n and %. Anti-TPO, anti-thyroid peroxidase.
Percentages are based on the available data for each variable. Echogenicity was available for 67 patients.

the hospital record system. The recorded variables included age, menopausal status, anti-TPO positivity, levothyroxine use and dose, and serum TSH, T4, and anti-TPO levels. Levothyroxine treatment was recorded as no treatment or as daily doses of 25, 50, 75, or 100 µg. Anti-TPO positivity was based on the laboratory report available in the medical record.

Ultrasonographic variables included the presence of a thyroid nodule, nodule number, nodules <1 cm, nodules >1 cm, echogenicity, solid or cystic structure, and parenchymal echotexture. Nodules were analysed according to the size categories recorded in the ultrasound report. The primary outcome was the association between menopausal status and the prevalence of thyroid nodules. Secondary outcomes included nodule number, nodule size distribution, and thyroid-related biochemical variables.

Statistical Analysis

Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 26.0. Descriptive data were summarised as numbers and percentages for categorical variables and as means±standard deviations, medians, and minimum–maximum values for continuous variables, as appropriate. Distributional assumptions were assessed using skewness and kurtosis, and values within ±1.96 were considered indicative of approximate normality. Categorical variables were compared using the chi-square test. Continuous variables were compared using the independent-samples t-test when normally distributed and the Mann-Whitney U test when the normal distribution was not met. In addition to p-values, crude odds ratios (ORs) with 95% confidence intervals (CIs) were calculated for the presence of any thyroid nodule and for any nodule >1 cm. Cramér's V was used as an effect-size measure for the between-group comparison of nodule number distribution. Because the observed age ranges of the reproductive and postmenopausal groups did not overlap, age and menopausal status were nearly collinear in this dataset. A multivariable model attempting to estimate an age-adjusted independent effect of menopause was therefore not considered statistically interpretable, and the results are presented as unadjusted associations by menopausal status. A two-sided P-value <0.05 was considered statistically significant.

RESULTS

Of the 149 women included, 89 (59.7%) were of reproductive age and 60 (40.3%) were postmenopausal. Anti-TPO positivity was present in 74 (49.7%) patients. Most patients were not receiving levothyroxine (70.5%); among those treated, 25 µg and 50 µg were the most commonly used daily doses (8.1% each). Thyroid nodules were identified in 61 (40.9%) patients. Most patients had no nodules (59.1%), whereas 20.1% had a single nodule and 12.1% had multiple nodules. Nodules <1 cm were more common than nodules >1 cm, the latter being present in 15.4% of the cohort overall. On ultrasonography, 34.3% of cases were hypoechoic, 53.8% were isoechoic, and 11.9% were hyperechoic. Most nodules were non-solid (94.6%), 22.8% had a cystic component, and parenchymal heterogeneity was present in 78.9% of patients. The mean age of the cohort was 44.05±16.11 years (range, 16–88 years) (Table 1).

Thyroid nodules were significantly more common after menopause: 56.7% of postmenopausal women had nodules, compared with 30.3% of women of reproductive age (P=0.002), corresponding to a crude OR of 3.00 (95% CI, 1.52–5.94). The distribution of nodule numbers also differed between groups (P=0.008; Cramér's V=0.30), with a higher proportion of women with two or more nodules in the postmenopausal group. Nodules >1 cm were more frequent after menopause (25.0% vs. 9.0%, P=0.029), corresponding to a crude OR of 3.38 (95% CI, 1.33–8.57). By contrast, anti-TPO positivity, levothyroxine use, solid structure, cystic structure, and parenchymal heterogeneity did not differ significantly between the groups (all P>0.05). As expected, postmenopausal women were older than women of reproductive age (59.9±9.1 vs 33.37±9.72 years, P<0.001), with no overlap between the observed age ranges (50–86 vs 19–49 years) (Table 2).

Serum TSH, T4, and anti-TPO levels were similar in the reproductive and postmenopausal groups (all P>0.05) (Table 3).

DISCUSSION

The present study showed that postmenopausal women with hypothyroidism carried a heavier thyroid

TABLE 2. Demographic and Clinical Characteristics According to Menopausal Status

Variable	Category	Reproductive period (n=89)	Postmenopause (n=60)	P-value
Anti-TPO positivity	Negative	43 (48.3)	32 (53.3)	0.664
	Positive	46 (51.7)	28 (46.7)	
Levothyroxine use	No	60 (67.4)	45 (75.0)	0.757
	25 µg	8 (9.0)	4 (6.7)	
	50 µg	9 (10.1)	3 (5.0)	
	75 µg	7 (7.9)	4 (6.7)	
	100 µg	5 (5.6)	4 (6.7)	
Presence of thyroid nodules	No	62 (69.7)	26 (43.3)	**0.002**
	Yes	27 (30.3)	34 (56.7)	
Number of nodules	No	62 (69.7)	26 (43.3)	**0.008**
	1 nodule	14 (15.7)	16 (26.7)	
	2 nodules	2 (2.2)	7 (11.7)	
	3 nodules	3 (3.4)	1 (1.7)	
	Multiple	8 (9.0)	10 (16.7)	
Nodules <1 cm	No	62 (69.7)	31 (51.7)	0.188
	1 nodule	15 (16.9)	16 (26.7)	
	2 nodules	4 (4.5)	3 (5.0)	
	3 nodules	0 (0.0)	1 (1.7)	
	Multiple	8 (9.0)	9 (15.0)	
Nodules >1 cm	No	81 (91.0)	45 (75.0)	**0.029**
	1 nodule	6 (6.7)	12 (20.0)	
	2 nodules	2 (2.2)	3 (5.0)	
Solid structure	No	87 (97.8)	54 (90.0)	0.091
	Yes	2 (2.2)	6 (10.0)	
Cystic structure	No	71 (79.8)	44 (73.3)	0.472
	Yes	18 (20.2)	16 (26.7)	
Parenchymal tissue	Homogeneous	14 (18.7)	13 (24.5)	0.561
	Heterogeneous	61 (81.3)	40 (75.5)	
Age (years)		33.37±9.72 33 (19–49)	59.9±9.1 57.5 (50–86)	**<0.001**

Data are shown as mean±standard deviation and median (range) or n (%) where appropriate. Anti-TPO, anti-thyroid peroxidase. Comparisons were performed using the chi-square test or the independent-samples t-test, as appropriate. Statistically significant P-values are shown in bold.

nodule burden than their reproductive-age counterparts. Thyroid nodules were more common after menopause, the distribution of nodule number shifted towards greater nodularity, and nodules larger than 1 cm were seen more often in the postmenopausal group. The crude effect estimates were clinically meaningful: postmenopausal women had approximately threefold higher odds of having any thyroid nodule and any nodule >1 cm. By contrast, serum TSH, T4, anti-TPO levels and positivity,

TABLE 3. Thyroid Biochemical Parameters According to Menopausal Status

Variable	Reproductive period (n=89)	Postmenopause (n=60)	P-value
TSH (mIU/L)	7.71±6.39 5.9 (4.24–57)	8.23±5.02 6.4 (4.4–31.5)	0.270
T4 (ng/dL)	1.01±0.18 1.0 (0.5–1.4)	0.97±0.16 1.0 (0.6–1.4)	0.245
Anti-TPO (IU/mL)	120.97±155.77 43 (3–600)	142.2±201.31 20 (5–600)	0.470

Values are shown as mean±SD and median (range). T4, thyroxine; anti-TPO, anti-thyroid peroxidase; TSH, thyroid-stimulating hormone. Comparisons were performed using the independent-samples t-test or the Mann-Whitney U test, as appropriate.

levothyroxine use, and broad ultrasonographic features such as solid structure, cystic structure, and parenchymal heterogeneity did not differ significantly between the groups. Taken together, these findings suggest that, in women with hypothyroidism, menopausal status is associated more strongly with the structural phenotype of thyroid disease than with routine biochemical severity.

This pattern is consistent with recent epidemiological work showing that female sex and advancing age are among the strongest correlates of thyroid nodularity in the general population [9, 10, 12]. A recent cohort of Hashimoto's thyroiditis also found that older age was a major predictor of nodularity, whereas nodular presentation was not explained by higher TSH and was associated with lower thyroid autoantibody values in multivariable analysis [13]. What our study adds is the clinical context. The same direction of association was seen in a cohort composed entirely of women with hypothyroidism. That point matters because it suggests that a greater nodular burden may be present even when routine thyroid biochemistry appears broadly similar.

A pathophysiological explanation is likely to be multifactorial. The menopausal transition is accompanied by hormonal withdrawal, altered body composition, increased visceral adiposity, insulin resistance, and changes in glucose and lipid handling. These shifts may promote thyroid nodularity through insulin/IGF signalling, adipokine imbalance, low-grade inflammation, and female-specific susceptibility related to oestrogen receptor activity and postmenopausal fat redistribution [5, 8, 11]. At the same time, menopause and thyroid dysfunction frequently coexist and may be clinically difficult to disentangle, particularly in mid-life women [5, 8].

An equally important observation is what did not differ between the groups. Serum TSH, T4, anti-TPO concentrations, anti-TPO positivity, and levothyroxine exposure were similar, suggesting that the higher nodule burden in postmenopausal women was not accompanied by more marked biochemical dysfunction or stronger measurable thyroid autoimmunity. Our findings do not diminish the role of autoimmunity in hypothyroidism, but they do suggest that thyroid biochemistry and thyroid morphology capture related yet distinct dimensions of disease [13].

The question of age deserves particular emphasis. In our cohort, the reproductive and postmenopausal groups had non-overlapping age ranges (19–49 and 50–86 years, respectively). For that reason, the present dataset cannot disentangle menopausal status from age, and our findings should not be interpreted as demonstrating an age-independent effect of menopause. Rather, they describe a clinically relevant association by menopausal status in a real-world hypothyroid cohort. That distinction is important, and it is the reason we have framed the results as unadjusted associations rather than causal or independent effects.

For clinicians, the message is straightforward. In women with hypothyroidism, particularly after menopause, a relatively stable biochemical profile should not be taken to mean that the thyroid gland is structurally unchanged. Ultrasonography remains clinically important because postmenopausal women

appear more likely to harbour nodules and to have nodules large enough to enter a structured surveillance or biopsy pathway. Current European guidance makes clear that nodule size and ultrasound risk pattern together inform decisions about follow-up and fine-needle aspiration [3]. The practical implication is not a more aggressive approach to every postmenopausal patient, but a more attentive, risk-based one.

Strengths and Limitations

This study contributes to the literature in a modest but clinically useful way. Recent epidemiological work has largely examined general adult or ostensibly healthy populations, including large community and occupational cohorts [9, 10, 14]. By focusing specifically on women with hypothyroidism, our analysis addresses a group encountered every day in endocrine and general outpatient practice. The study suggests that postmenopausal status is associated with a more nodular thyroid phenotype, even when standard thyroid laboratory findings are similar. That is the aspect of the paper we would emphasise, because it is both clinically intelligible and directly relevant to routine care.

This study has several limitations. It was retrospective and single-centred, with a modest sample size. Most importantly, age and menopausal status were inseparable in this cohort: all women in the reproductive group were younger than 50 years, whereas all postmenopausal women were aged 50 years or older. The absence of age overlap means that a multivariable model including both age and menopausal status would not have yielded a meaningful estimate of the independent effect of menopause. The variables available for analysis were also limited to routine biochemistry and basic ultrasound descriptors; therefore, this dataset cannot address EU-TIRADS-based malignancy risk, cytology, menopausal hormone therapy, iodine status, body mass index, smoking, menopause duration, or other metabolic confounders. In addition, because mean TSH was elevated whereas mean T4 remained within the reference range in both groups, the cohort may have included a mixture of overt and subclinical hypothyroidism. These limitations do not negate the clinical relevance of the study, but they do mean that the findings should be interpreted as hypothesis-generating rather than definitive.

CONCLUSION

In summary, among women with hypothyroidism, postmenopausal status was associated with a higher prevalence of thyroid nodules and a greater frequency of nodules larger than 1 cm, while routine thyroid biochemistry and thyroid autoimmunity were similar between groups. In practical terms, menopausal status may identify hypothyroid women with a more nodular thyroid phenotype, although this observation cannot be disentangled from age in the present dataset. Prospective studies with overlapping age strata, age-adjusted analyses, and standardised ultrasound risk stratification are now needed to define how this association should influence surveillance and management.

Ethics Approval and Consent to Participate

This study was approved by the Giresun Training and Research Hospital Scientific Research Ethics Committee (Decision No: BAEK-577/02; Date: 04.03.2026). All procedures were conducted in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments. Informed consent was waived because of the retrospective nature of the study and the analysis used anonymous clinical data.

Clinical Trial Registration

Not Available.

Data Availability

All data generated or analyzed during this study are included in this published article. The data that support the findings of this study are available on request from the corresponding author, upon reasonable request.

Authors' Contribution

Study Conception: AMh; Study Design: BA; Supervision: EY; Funding: N/A; Materials: SA; Data Collection and/or Processing: MY; Statistical Analysis and/or Data Interpretation: Kİ; Literature Review: EK; Manuscript Preparation: AMh; and Critical Review: BA.

Conflict of Interest

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The author(s) declare that no artificial intelligence-based tools or applications were used during the preparation process of this manuscript. The all content of the study was produced by the author(s) in accordance with scientific research methods and academic ethical principles.

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