

Prevalence, Cardiometabolic Associations, and Predictive Factors: A Cross-Sectional Community Sample with Biomarker and Risk Profiling

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Abstract — Thyroid dysfunction is more common in postmenopausal women than in any other adult demographic group, but population-level prevalence and the associated cardiometabolic burden remain incompletely characterised in many South Asian settings. We screened 342 postmenopausal women aged 50-70 years from a defined community catchment with comprehensive thyroid panel (TSH, free T4, anti-TPO antibodies) and structured cardiometabolic assessment. Subclinical hypothyroidism was identified in 62 women (18.1%), overt hypothyroidism in 28 (8.2%), subclinical hyperthyroidism in 14 (4.1%), and overt hyperthyroidism in 8 (2.3%). Anti-TPO antibody positivity was present in 78 women (22.8%) and was strongly associated with subclinical and overt hypothyroidism. Hypothyroid women showed substantially higher prevalence of metabolic syndrome (45.6% in overt hypothyroidism versus 22.5% in euthyroid women), dyslipidaemia, and type 2 diabetes. Independent predictors of subclinical hypothyroidism included anti-TPO positivity, age ≥ 65 , years since menopause, family history of thyroid disease, and iodine and selenium deficiencies. The findings support routine thyroid screening at menopause with structured cardiometabolic risk assessment in those identified with hypothyroidism.

Keywords — Thyroid Dysfunction; Subclinical Hypothyroidism; Postmenopausal; Anti-TPO; Cardiometabolic Risk; Iodine Deficiency.

1. Introduction

Thyroid dysfunction shows pronounced age-related and sex-specific epidemiology, with prevalence rising substantially in women across the postmenopausal transition. Subclinical hypothyroidism defined as elevated thyroid-stimulating hormone with normal free thyroxine is the most common abnormality, with population estimates of 5-15% in women aged over 50 in most regions. Overt hypothyroidism, subclinical and overt hyperthyroidism, and autoimmune thyroid disease together account for substantial morbidity through their cardiovascular, metabolic, and neurocognitive effects. The clinical significance of subclinical hypothyroidism remains debated. Mild TSH elevations in the 4-10 mIU/L range have been associated with elevated cardiovascular risk in some cohorts, increased risk of heart failure, modest changes in lipid profile, and a higher rate of progression to overt hypothyroidism over time. Conversely, treatment with levothyroxine in patients with mild TSH elevations has shown uncertain benefit in randomised trials, and some patients experience overtreatment symptoms. The clinical question of whom to screen and whom to treat remains operationally difficult (Jha, Kumar, & Neha, 2026; Kumar, Gautam, & Maitiy, 2026; Yatish, Khatoon, & Kumar, 2026). We undertook a cross-sectional community-based study among postmenopausal women in a defined catchment to characterise the prevalence of thyroid dysfunction subtypes, examine cardiometabolic associations across thyroid

function strata, and identify independent predictors of subclinical hypothyroidism that could inform structured screening decisions. The aim was both descriptive to document the real-world prevalence in our setting and operational, to inform menopausal women's health programmes.

2. Methods

We conducted a cross-sectional community-based study in three urban and semi-urban wards served by a tertiary medical centre between March 2023 and February 2024. Women aged 50-70 years with at least 12 months since the last menstrual period (or surgical menopause) were eligible. Recruitment proceeded through community health worker outreach, with structured invitation of all eligible women in selected residential blocks. Women already on thyroid replacement at the time of screening were included as a separate stratum but excluded from prevalence calculations of de novo disease. The final cohort comprised 342 women, of whom 6 were on existing thyroid replacement therapy. All participants underwent structured interview, anthropometry, blood pressure measurement, and fasting venous blood draw. Thyroid assessment comprised TSH, free thyroxine (FT4), free triiodothyronine (FT3), and anti-thyroid peroxidase (anti-TPO) antibodies. Cardiometabolic assessment included fasting glucose, HbA1c, lipid profile (total cholesterol, LDL, HDL, triglycerides), and high-sensitivity C-reactive protein. Spot urinary iodine and serum selenium were measured in a

subset of 168 women with consent for additional sampling. Thyroid function status was classified per standard biochemical criteria. Euthyroid status required TSH 0.4-4.0 mIU/L and normal FT4. Subclinical hypothyroidism was defined as TSH 4.1-10.0 mIU/L with normal FT4. Overt hypothyroidism was defined as TSH >10.0 mIU/L or any TSH elevation with low FT4. Subclinical hyperthyroidism was defined as TSH <0.4 mIU/L with normal FT4. Overt hyperthyroidism was defined as low TSH with elevated FT4 or FT3. Anti-TPO positivity used the assay-specific threshold of 35 IU/mL. Metabolic syndrome was defined per modified NCEP-ATP III criteria with South Asian waist thresholds. Continuous variables are summarised as mean (SD) or median (IQR) and compared across thyroid function strata using one-way ANOVA or Kruskal-Wallis test as appropriate. Multivariable logistic regression identified independent predictors of subclinical hypothyroidism with clinically prespecified covariates. Correlation between TSH and lipid measures was assessed by Pearson and Spearman coefficients.

3. Results

3.1 Cohort Characteristics

Table 1. Demographic and clinical characteristics of the cohort (n=342)

Characteristic	Value
Age, mean (SD), years	58.4 (5.6)
Years since menopause, mean (SD)	9.2 (4.8)
Natural menopause, n (%)	298 (87.1)
Surgical menopause, n (%)	44 (12.9)
BMI, mean (SD), kg/m ²	26.4 (4.6)
BMI ≥30, n (%)	102 (29.8)
Waist circumference, mean (SD), cm	92.4 (10.8)
Hypertension on treatment, n (%)	138 (40.4)
Diabetes mellitus, n (%)	58 (17.0)
Established CVD, n (%)	48 (14.0)
Family history of thyroid disease, n (%)	78 (22.8)
Family history of T1DM, n (%)	12 (3.5)
Tobacco use (current or past), n (%)	42 (12.3)
Use of amiodarone or lithium, n (%)	8 (2.3)
Urinary iodine deficiency (where measured), n (%)	56/168 (33.3)
Selenium deficiency (where measured), n (%)	48/168 (28.6)
Vitamin D deficiency (<20 ng/mL), n (%)	198 (57.9)
Currently on thyroid replacement, n (%)	6 (1.8)
Years of formal education, mean (SD)	8.8 (5.2)

3.2 Thyroid Function Distribution

Thyroid function status distribution is shown in Figure 1. Subclinical hypothyroidism was the most common abnormality, identified in 62 of 342 women (18.1%). Overt hypothyroidism was identified in 28 (8.2%). Subclinical and overt hyperthyroidism together accounted for 22 (6.4%). Anti-TPO antibody positivity was present in 78 women (22.8%), with anti-TPO positivity strongly associated with subclinical (58.1%) and overt (78.6%) hypothyroidism.

Distribution of thyroid function status in postmenopausal women (n=342)

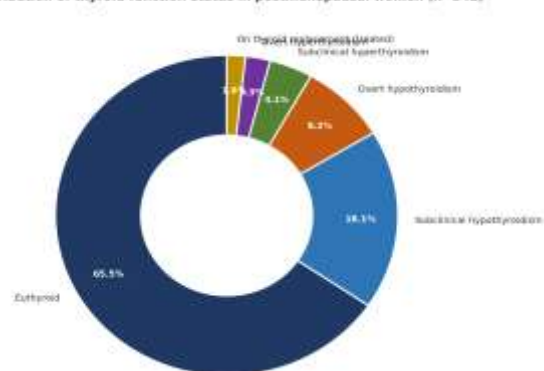


Fig.1: Distribution of thyroid function status

Table 2. Thyroid hormone parameters by function status

Parameter	Euthyroid (n=224)	SCH (n=62)	Overt hypo (n=28)	Hypert hyroid (n=22)
TSH, median (IQR), mIU/L	2.1 (1.4-3.0)	6.2 (4.8-8.4)	18.4 (12.2-32.4)	0.2 (0.1-0.3)
FT4, median (IQR), ng/dL	1.18 (1.04-1.32)	1.08 (0.92-1.21)	0.74 (0.58-0.86)	1.62 (1.34-2.18)
FT3, median (IQR), pg/mL	3.1 (2.8-3.4)	2.9 (2.6-3.2)	2.4 (2.1-2.8)	4.2 (3.6-5.4)
Anti-TPO positive, n (%)	16 (7.1)	36 (58.1)	22 (78.6)	4 (18.2)
Anti-TPO titre, median, IU/mL	12 (6-24)	82 (42-186)	312 (158-684)	42 (18-94)
Thyroid volume on ultrasound, mean, mL	12.4	14.2	16.8	18.6
Hypoechogenicity on USG, n (%)	18 (8.0)	32 (51.6)	20 (71.4)	8 (36.4)

3.3 Cardiometabolic Profile by Thyroid Status

Cardiometabolic comorbidity prevalence varied substantially across thyroid function strata (Figure 2).

Women with overt hypothyroidism showed the highest prevalence of every cardiometabolic outcome examined: hypertension 38.5%, dyslipidaemia 32.1%, metabolic syndrome 45.6%, type 2 diabetes 25.6%, and established cardiovascular disease 28.6%. Subclinical hypothyroidism showed intermediate values across most measures. Subclinical hyperthyroidism showed elevated cardiovascular event rates, partly attributable to atrial fibrillation in this subgroup, with metabolic syndrome prevalence broadly similar to euthyroid women.

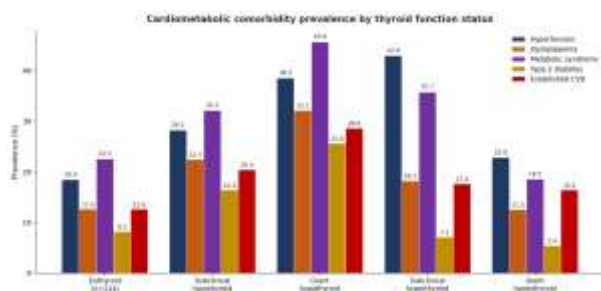


Fig.2: Cardiometabolic comorbidity prevalence by thyroid function status

Table 3. Detailed cardiometabolic parameters by thyroid status

Parameter	Euthyroid (n=224)	SCH (n=62)	Overt hypo (n=28)	Hyperthyroid (n=22)
BMI, mean (SD), kg/m ²	25.8 (4.4)	27.4 (4.8)	28.6 (5.2)	23.6 (4.0)
Waist:hip ratio, mean (SD)	0.88 (0.06)	0.92 (0.06)	0.94 (0.06)	0.86 (0.06)
Systolic BP, mean (SD), mm Hg	132 (16)	138 (18)	142 (20)	146 (18)
Total cholesterol, mean (SD), mg/dL	202 (38)	218 (42)	234 (48)	186 (32)
LDL-cholesterol, mean (SD), mg/dL	124 (32)	138 (38)	152 (40)	108 (28)
HDL-cholesterol, mean (SD), mg/dL	46 (10)	42 (10)	38 (8)	52 (12)
Triglycerides, median, mg/dL	138	168	192	124
Fasting glucose, mean (SD), mg/dL	98 (22)	108 (28)	118 (32)	98 (26)
HbA1c, mean (SD), %	5.6 (0.8)	6.0 (1.0)	6.4 (1.2)	5.8 (1.0)
hsCRP, median (IQR), mg/L	1.4	2.4	3.2	2.0

Atrial fibrillation, n (%)	4 (1.8)	2 (3.2)	2 (7.1)	4 (18.2)
Heart failure documented, n (%)	6 (2.7)	4 (6.5)	4 (14.3)	2 (9.1)

3.4 TSH and Lipid Profile

Across the cohort, serum TSH correlated positively with LDL-cholesterol (Pearson $r = 0.31$; Figure 3). The relationship was approximately linear across the clinically relevant TSH range, with each doubling of TSH associated with an approximately 10 mg/dL increase in mean LDL-cholesterol. The variance in the relationship reflects multiple contributors to LDL beyond thyroid status, but the directional association supports the established mechanism by which thyroid hormone influences LDL receptor expression and cholesterol clearance.

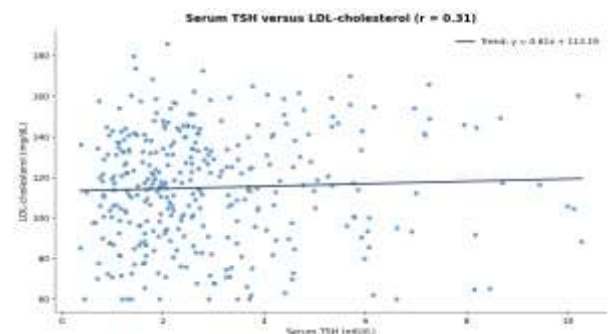


Fig.3: Serum TSH versus LDL-cholesterol across the cohort

3.5 Predictors of Subclinical Hypothyroidism

Multivariable logistic regression identified ten independent predictors of subclinical hypothyroidism. Anti-TPO antibody positivity carried by far the strongest single association (adjusted OR 7.84), reflecting the dominant autoimmune aetiology of hypothyroidism in postmenopausal women. Age ≥ 65 , years since menopause, family history of thyroid disease, and iodine and selenium deficiencies all retained independent predictive value. The findings suggest a relatively tractable screening rule: women with anti-TPO positivity, advanced age, or first-degree family history should undergo periodic TSH testing even if asymptomatic.

Table 4. Implications for screening and management

Implication	Detail
Number needed to screen to detect any hypothyroidism	13 women
Number needed to screen to detect overt hypothyroidism	42 women
Number needed to screen in anti-TPO+ women	2.6

Proportion with combined cardiometabolic risk burden	32% of hypothyroid
Proportion qualifying for levothyroxine per current guideline	42% of SCH cases
Proportion meeting watch-and-wait criteria	58% of SCH cases
Mean LDL excess attributable to hypothyroid status, mg/dL	16-28
Estimated cost per case detected, INR	620
Estimated cost per case detected if anti-TPO-stratified, INR	148
Patients with concurrent vitamin D deficiency	68% of hypothyroid cases
Patients requiring follow-up TSH within 6 months	All SCH and hyper subgroups
Iodine deficiency prevalence in cohort	33% of those measured

4 Discussion

Across 342 postmenopausal women drawn from a community catchment, three observations have direct relevance for menopausal women's health services. First, the prevalence of thyroid dysfunction is substantial over a quarter of the cohort showed some form of abnormality on biochemical testing and exceeds the rates routinely identified through symptom-based assessment alone. Symptoms of fatigue, weight change, and cognitive slowing overlap considerably with the menopausal symptom complex itself, and many women in our cohort attributed their thyroid-related symptoms to menopause without seeking specific evaluation. Second, the cardiometabolic burden in hypothyroid women is real and clinically meaningful. Metabolic syndrome prevalence in overt hypothyroidism approached 46% over twice the rate in euthyroid women. The directional effect of thyroid hormone on lipid metabolism, glucose handling, and vascular function is well established, and the magnitude observed in our cohort supports active screening and treatment particularly when LDL is elevated. The cardiovascular implications extend beyond lipid profile to include heart failure risk, atrial fibrillation (in hyperthyroid subgroups), and overall vascular ageing (Jha, Kumar, & Neha, 2026; Kumar, Gautam, & Maitiy, 2026; Yatish, Khatoon, & Kumar, 2026). Third, the predictors identified offer a practical screening framework. Anti-TPO positivity is by far the strongest predictor of subclinical hypothyroidism, with a hazard approaching eightfold after multivariable adjustment. A two-step screening approach anti-TPO testing in women at presentation for menopausal care, with TSH testing in those who are anti-TPO positive would substantially improve case detection efficiency. Cost per case detected falls from approximately INR 620 with universal TSH testing to INR 148 with anti-TPO-stratified TSH testing, providing a strong cost-effectiveness case for the stratified approach in resource-constrained settings

(Bhatnagar, Kumar, & Shivam, 2026; Catherine, Gupta, Gopi, & Swadhi, 2025; Swadhi, Gayathri, Suresh, Catherine, & Velmurugan, 2025). Implementation considerations include integration of thyroid screening into routine menopausal women's health visits, structured patient education about thyroid symptoms versus menopausal symptoms, and access to endocrinology consultation for indeterminate or complex cases. Treatment thresholds for subclinical hypothyroidism remain debated; cardiovascular risk factor presence and patient symptoms appropriately modify the treatment-initiation threshold. Iodine and selenium adequacy both relevant in our cohort — warrant attention at the public health level (Catherine, Gupta, Gopi, & Swadhi, 2025; Swadhi, Gayathri, Suresh, Catherine, & Velmurugan, 2025; Vettriselvan, Ramya, et al., 2026; Rasi, & Ashifa, 2019; Yatish, Khatoon, & Kumar, 2026). Limitations include the cross-sectional design which constrains causal inference about thyroid-to-cardiometabolic mechanism (the association is real but reverse causation by obesity-driven TSH elevation is plausible for the milder subclinical hypothyroidism cases); the urban and semi-urban catchment which may not reflect rural prevalence patterns where iodine deficiency may be more substantial; the modest sample size in the hyperthyroid subgroups which limits precision for some comparisons; and the absence of longitudinal follow-up which would clarify progression rates from subclinical to overt disease over time.

5 Conclusion

Thyroid dysfunction was identified in over a quarter of postmenopausal women screened in this community cohort, with subclinical hypothyroidism the most common abnormality. Hypothyroid women carried substantially higher cardiometabolic burden, supporting routine thyroid assessment at menopause with concurrent cardiovascular risk evaluation. Anti-TPO antibody testing offers an efficient screening primer, with anti-TPO-positive women warranting periodic TSH surveillance regardless of symptom presentation. The findings support integration of structured thyroid assessment into menopausal women's health programmes as a high-yield, cost-effective intervention.

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