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Original Article

Temporal Distribution and Trends of Thyroid Dysfunctions in Gujrat, Pakistan by Linear Regression Model: A Cross-Sectional Analysis

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ABSTRACT

Background: Thyroid-function abnormalities vary according to sex, age, clinical characteristics, referral patterns, and geographical setting, but temporal laboratory-based data from Gujrat, Pakistan, remain limited. Objective: To describe the annual and sex-specific distribution of biochemical thyroid abnormalities among patients undergoing thyroid-profile testing and to explore temporal changes from January 2020 to July 2025. Methods: This retrospective laboratory record-based observational study included 1,004 thyroid-profile records obtained from Dr. Abdul Rauf Laboratory, Gujrat. The sample comprised 848 females and 156 males. Records were classified as primary hypothyroidism, subclinical hypothyroidism, central hypothyroidism, primary hyperthyroidism, subclinical hyperthyroidism, isolated low T3, or isolated high T3 where available. Frequencies and percentages were summarized by year and sex. Exploratory linear regression estimated annual percentage-point changes for each abnormality. Results: Subclinical hypothyroidism was the most frequently reported abnormality during most study years, decreasing from 22.2% in 2020 to 8.0% during January–July 2025. Its estimated slope was −2.089 percentage points per year ($p=0.0283$; $R^2=0.738$). Isolated low T3 increased descriptively to 8.8% during January–July 2025, but its trend was not statistically significant (slope=1.383; $p=0.2928$). Other abnormalities showed no statistically supported linear trends. Females generally had higher reported proportions of hypothyroid abnormalities, whereas male estimates were more variable because of smaller numbers. Conclusion: Subclinical hypothyroidism was the predominant laboratory-detected abnormality and showed an exploratory decreasing trend. The results reflect a tested laboratory population rather than community prevalence and require confirmation using patient-level, multicentre, or population-based data. Keywords: thyroid dysfunction; subclinical hypothyroidism; thyroid-function tests; temporal trends; laboratory surveillance; hypothyroidism; hyperthyroidism; Pakistan.

INTRODUCTION

Thyroid hormones play an essential role in regulating energy metabolism, growth, development, thermogenesis, cardiovascular function, and the activity of multiple organ systems. The hypothalamic–pituitary–thyroid axis maintains circulating thyroid hormone concentrations through a feedback mechanism involving hypothalamic thyrotropin-releasing hormone, pituitary thyroid-stimulating hormone, and thyroidal secretion of thyroxine and triiodothyronine. Although thyroxine is the principal hormone secreted by the thyroid gland, much of its physiological effect is mediated through peripheral conversion to the more biologically active triiodothyronine (1,2). Disturbances affecting the thyroid gland, pituitary gland, hypothalamus, or peripheral hormone metabolism may therefore produce clinically relevant biochemical abnormalities.

Thyroid dysfunction encompasses a heterogeneous group of biochemical and clinical conditions. Primary hypothyroidism is generally characterized by reduced circulating thyroid hormone concentrations accompanied by an appropriately elevated thyroid-stimulating hormone level, whereas primary hyperthyroidism is characterized by increased circulating thyroid hormone concentrations with suppression of thyroid-stimulating hormone. Subclinical hypothyroidism is defined by an elevated thyroid-stimulating hormone concentration with thyroid hormone levels remaining within the applicable laboratory reference interval. In contrast, subclinical hyperthyroidism is characterized by a reduced thyroid-stimulating hormone concentration with normal circulating thyroxine and triiodothyronine levels (6,7).

Central hypothyroidism typically presents with a reduced free thyroxine concentration accompanied by an inappropriately low, normal, or mildly elevated thyroid-stimulating hormone level due to hypothalamic or pituitary dysfunction (8). Isolated abnormalities of triiodothyronine may also be detected during thyroid-profile testing. In particular, isolated low triiodothyronine may occur in patients with acute or chronic systemic illness, renal disease, malnutrition, inflammatory conditions, or medication exposure. It should therefore be interpreted as a biochemical pattern rather than definitive evidence of primary thyroid gland disease (9,17,18).

The distribution of thyroid abnormalities varies according to age, sex, iodine exposure, genetic susceptibility, pregnancy, medication use, comorbid disease, laboratory testing practices, and the clinical characteristics of the population being investigated. Epidemiological studies have generally shown that thyroid dysfunction is identified more frequently among females than males, although the magnitude and distribution of individual abnormalities differ across regions and study settings (14,15). A hospital-based analysis from Rawalpindi also reported substantial frequencies of subclinical and overt thyroid dysfunction and found that thyroid abnormalities were more frequently identified among females (16).

Estimates obtained from community surveys, tertiary-care hospitals, outpatient clinics, and diagnostic laboratories are not directly interchangeable. Individuals undergoing laboratory testing commonly represent a clinically selected population influenced by symptoms, physician referral, pregnancy-related assessment, treatment monitoring, healthcare access, and previous disease. Laboratory-based proportions should therefore not be interpreted as direct estimates of disease prevalence in the wider community.

Age is another important determinant of thyroid-function abnormalities. The occurrence of hypothyroidism generally increases with advancing age, while hyperthyroidism and thyrotoxicosis may have different causes and clinical presentations in older adults than in younger individuals (19,20). However, age-related distributions among people referred for thyroid testing cannot establish age-specific risk unless the total numbers tested within each age group are available.

Despite the clinical relevance of thyroid dysfunction, temporal descriptions of laboratory-detected thyroid abnormalities in Gujrat, Pakistan, remain limited. Examining annual patterns within a diagnostic laboratory population may provide useful information regarding the relative distribution of biochemical thyroid profiles and may identify changes requiring confirmation through larger, multicentre, or population-based investigations. Such analysis must remain restricted to the tested population and should not be presented as a direct measure of community prevalence.

The present study therefore aimed to describe the annual, sex-specific, and age-related distribution of biochemically classified thyroid abnormalities among individuals whose thyroid profiles were evaluated at Dr. Abdul Rauf Laboratory in Gujrat from January 2020 to July 2025. It also aimed to explore temporal changes in primary hypothyroidism, subclinical hypothyroidism, central hypothyroidism, primary hyperthyroidism, subclinical hyperthyroidism, isolated low triiodothyronine, and isolated high triiodothyronine where these classifications were available in the laboratory records.

MATERIALS AND METHODS

This retrospective laboratory record-based observational study used repeated annual cross-sectional analyses to examine the distribution and temporal patterns of thyroid-function abnormalities among individuals tested in Gujrat, Punjab, Pakistan. The study covered the period from January 2020 to July 2025 and used thyroid-profile records obtained from the Gujrat branch of Dr. Abdul Rauf Laboratory. The participating diagnostic laboratory served patients through its principal facility, associated collection points, and linked healthcare facilities.

The study population consisted of individuals whose thyroid-profile reports were included in the available laboratory dataset during the study period. A total of 1,004 records were analysed, comprising 848 females and 156 males. The records were obtained after written administrative permission from the Research and Development Department of the participating laboratory. Because the data originated from individuals referred for thyroid testing, the analysed sample was considered a laboratory-tested clinical population rather than a representative sample of all residents of Gujrat.

The available variables included year of testing, sex, age group, and biochemical thyroid classification. The evaluated categories comprised primary hypothyroidism, subclinical hypothyroidism, central hypothyroidism, primary hyperthyroidism, subclinical hyperthyroidism, isolated low triiodothyronine, and isolated high triiodothyronine where reported in the source records.

Primary hypothyroidism was identified when reduced thyroid hormone concentrations were accompanied by an elevated thyroid-stimulating hormone level. Primary hyperthyroidism was identified when increased thyroid hormone concentrations were accompanied by a suppressed thyroid-stimulating hormone level. Subclinical hypothyroidism was defined by an elevated thyroid-stimulating hormone concentration with thyroid hormone concentrations remaining within the applicable laboratory reference interval. Subclinical hyperthyroidism was defined by a reduced thyroid-stimulating hormone concentration with circulating thyroid hormone concentrations remaining within the reference interval (6,7).

Central hypothyroidism was identified from a reduced thyroid hormone concentration with a thyroid-stimulating hormone response that was inappropriately low or not correspondingly elevated (8). Isolated triiodothyronine abnormalities were classified when the triiodothyronine concentration was outside the applicable laboratory reference interval while the remaining recorded thyroid-profile parameters did not fulfil the criteria for another predefined category. The classifications were based on the laboratory reference intervals applicable at the time of testing.

The records were organized according to calendar year, sex, age group, and thyroid-function category. Data were entered and initially reviewed in Microsoft Excel 2010. The available records were examined for completeness of the variables required for the planned descriptive and temporal analyses. Frequencies and percentages were calculated for the overall laboratory population and separately for females and males. Annual proportions were calculated using the corresponding number of tested individuals within each reported year and subgroup as the denominator. Age-related distributions were examined descriptively according to sex and year.

The 2025 dataset covered only January through July and was therefore treated as a partial-year observation. Findings from this period were reported separately and interpreted cautiously rather than considered directly equivalent to findings from the five complete calendar years.

The original sample-size estimation was performed using the SurveyMonkey online sample-size calculator. The calculation applied a 95% confidence level and a target margin of error of 3%. The method incorporated the standard normal value for the selected confidence level, the assumed population proportion, the acceptable margin of error, and the estimated size of the source population (12). The final analysis included all 1,004 records contained in the extracted study dataset.

Temporal patterns from 2020 to July 2025 were examined separately for each thyroid-function category. In the original exploratory analysis, annual percentage was treated as the outcome variable and calendar year as the predictor. A simple linear regression model was fitted to estimate the average annual change in percentage points. A positive regression coefficient indicated an increasing temporal pattern, whereas a negative coefficient indicated a decreasing pattern.

Separate exploratory models were fitted for the overall, female, and male distributions where adequate annual observations were available. Statistical significance of the regression coefficient was assessed using a two-sided threshold of 0.05. The results were summarized using the estimated annual slope, p-value, coefficient of determination, and direction of change.

The regression findings were interpreted cautiously because each model was based on only six annual observations, several categories contained sparse counts, and the final observation represented seven months rather than a complete year. The analyses were considered exploratory and were not interpreted as evidence of population-level changes in thyroid dysfunction.

The statistical analysis was conducted in a Jupyter Notebook environment through Anaconda Navigator. Automated coding assistance was used during development of the analytical code. The resulting outputs were reviewed against the source tables and reported annual percentages before interpretation. The statistical code was retained as supplementary material to support analytical transparency and reproducibility.

Written administrative authorization to use the laboratory records was obtained from the Research and Development Department of Dr. Abdul Rauf Laboratory. The analysis was restricted to information contained in the available laboratory dataset, and no direct intervention or contact with patients occurred.

RESULTS

A total of 1,004 thyroid-profile records collected between January 2020 and July 2025 were included in the analysis. Of these, 848 (84.5%) records were from females and 156 (15.5%) were from males. Across the study period, thyroid-function abnormalities were more frequently observed among females than males. The reported mean annual proportion of thyroid dysfunction was 34.8% overall, 36.2% among females, and 29.3% among males. These values represented descriptive averages of the annual laboratory-based proportions and were not interpreted as population prevalence estimates.

Table 1. Annual Distribution of Biochemically Classified Thyroid Abnormalities Among Patients Tested in Gujrat

Year	Thyroid abnormality	Females, n (%)	Males, n (%)	Overall, n (%)
2020	Primary hypothyroidism	2 (10.0)	0 (0.0)	2 (7.4)
	Subclinical hypothyroidism	5 (25.0)	1 (14.3)	6 (22.2)
	Central hypothyroidism	0 (0.0)	1 (14.3)	1 (3.7)
	Primary hyperthyroidism	1 (5.0)	0 (0.0)	1 (3.7)
2021	Primary hypothyroidism	4 (8.7)	0 (0.0)	4 (7.4)
	Subclinical hypothyroidism	8 (17.4)	1 (12.5)	9 (16.7)
	Isolated low T3	1 (2.2)	0 (0.0)	1 (1.9)
	Primary hyperthyroidism	0 (0.0)	1 (12.5)	1 (1.9)
	Subclinical hyperthyroidism	2 (4.3)	0 (0.0)	2 (3.7)
2022	Primary hypothyroidism	8 (9.9)	2 (9.5)	10 (9.8)
	Subclinical hypothyroidism	13 (16.0)	2 (9.5)	15 (14.7)
	Central hypothyroidism	1 (1.2)	0 (0.0)	1 (1.0)
	Primary hyperthyroidism	6 (7.4)	2 (9.5)	8 (7.8)
	Subclinical hyperthyroidism	5 (6.2)	0 (0.0)	5 (4.9)
2023	Primary hypothyroidism	6 (3.0)	4 (9.1)	10 (4.1)
	Subclinical hypothyroidism	36 (17.8)	3 (6.8)	39 (15.9)
	Central hypothyroidism	3 (1.5)	1 (2.3)	4 (1.6)
	Isolated low T3	5 (2.5)	1 (2.3)	6 (2.4)
	Primary hyperthyroidism	8 (4.0)	3 (6.8)	11 (4.5)

Year	Thyroid abnormality	Females, n (%)	Males, n (%)	Overall, n (%)
	Subclinical hyperthyroidism	10 (5.0)	0 (0.0)	10 (4.1)
2024	Primary hypothyroidism	14 (4.9)	0 (0.0)	14 (4.3)
	Subclinical hypothyroidism	45 (15.8)	6 (14.6)	51 (15.6)
	Central hypothyroidism	4 (1.4)	0 (0.0)	4 (1.2)
	Isolated low T3	6 (2.1)	1 (2.4)	7 (2.1)
	Primary hyperthyroidism	8 (2.8)	4 (9.8)	12 (3.7)
	Subclinical hyperthyroidism	14 (4.9)	1 (2.4)	15 (4.6)
January–July 2025	Primary hypothyroidism	23 (10.7)	1 (2.9)	24 (9.6)
	Subclinical hypothyroidism	16 (7.5)	4 (11.4)	20 (8.0)
	Central hypothyroidism	4 (1.9)	0 (0.0)	4 (1.6)
	Isolated low T3	18 (8.4)	4 (11.4)	22 (8.8)
	Primary hyperthyroidism	4 (1.9)	4 (11.4)	8 (3.2)
	Subclinical hyperthyroidism	9 (4.2)	0 (0.0)	9 (3.6)

T3, triiodothyronine. Percentages are reproduced from the source laboratory analysis. January–July 2025 represents a partial calendar year.

Subclinical hypothyroidism was the most frequently reported biochemical abnormality during most of the study period. Its overall annual proportion decreased from 22.2% in 2020 to 8.0% during January–July 2025. Primary hypothyroidism varied across years, ranging from 4.1% in 2023 to 9.8% in 2022 and 9.6% during January–July 2025. Primary hyperthyroidism ranged from 1.9% in 2021 to 7.8% in 2022, while subclinical hyperthyroidism remained between 3.6% and 4.9% during the years in which it was reported.

Isolated low T3 was uncommon during the early study years but increased to 8.8% during January–July 2025. This descriptive rise was not statistically significant in the linear trend analysis. Central hypothyroidism remained relatively infrequent, with reported overall annual proportions ranging from 1.0% to 3.7%.

Sex-stratified findings showed that females generally had higher reported proportions of primary hypothyroidism, subclinical hypothyroidism, and subclinical hyperthyroidism. The mean annual proportions reported for females were 7.87% for primary hypothyroidism, 16.58% for subclinical hypothyroidism, and 4.10% for subclinical hyperthyroidism. In males, relatively higher mean annual proportions were reported for primary hyperthyroidism, central hypothyroidism, and isolated low T3, at 8.33%, 2.77%, and 2.68%, respectively. These male estimates were based on substantially fewer records and therefore demonstrated greater year-to-year variability.

Table 2. Two Most Frequently Represented Age Groups Among Thyroid-Abnormality Records, Stratified by Sex and Year

Year	Female age group, years	Females, n (%)	Male age group, years	Males, n (%)
2020	30–39	2 (22.2)	20–29	4 (25.0)
2020	40–49	2 (22.2)	50–59	4 (25.0)
2021	20–29	4 (25.0)	50–59	1 (50.0)
2021	50–59	4 (25.0)	60–69	1 (50.0)
2022	30–39	11 (33.3)	20–29	2 (33.3)
2022	40–49	9 (27.3)	30–39	1 (16.7)
2023	30–39	17 (24.3)	30–39	3 (27.3)
2023	40–49	20 (28.6)	40–49	4 (36.4)
2024	20–29	22 (23.9)	30–39	4 (33.3)
2024	30–39	27 (29.3)	>70	4 (33.3)
January–July 2025	30–39	23 (30.7)	30–39	6 (46.2)
January–July 2025	40–49	17 (22.7)	>70	3 (23.1)

Percentages represent the distribution of reported thyroid-abnormality records within the corresponding sex and year and should not be interpreted as age-specific population prevalence.

Among females, the age groups most frequently represented varied over time. Women aged 30–39 years were among the two most represented groups in 2020, 2022, 2023, 2024, and January–July 2025. Women aged 40–49 years were also frequently represented, particularly in 2020, 2022, 2023, and January–July

2025. However, the pattern was not uniform across all years, as the 20–29- and 50–59-year groups were the leading female groups in 2021.

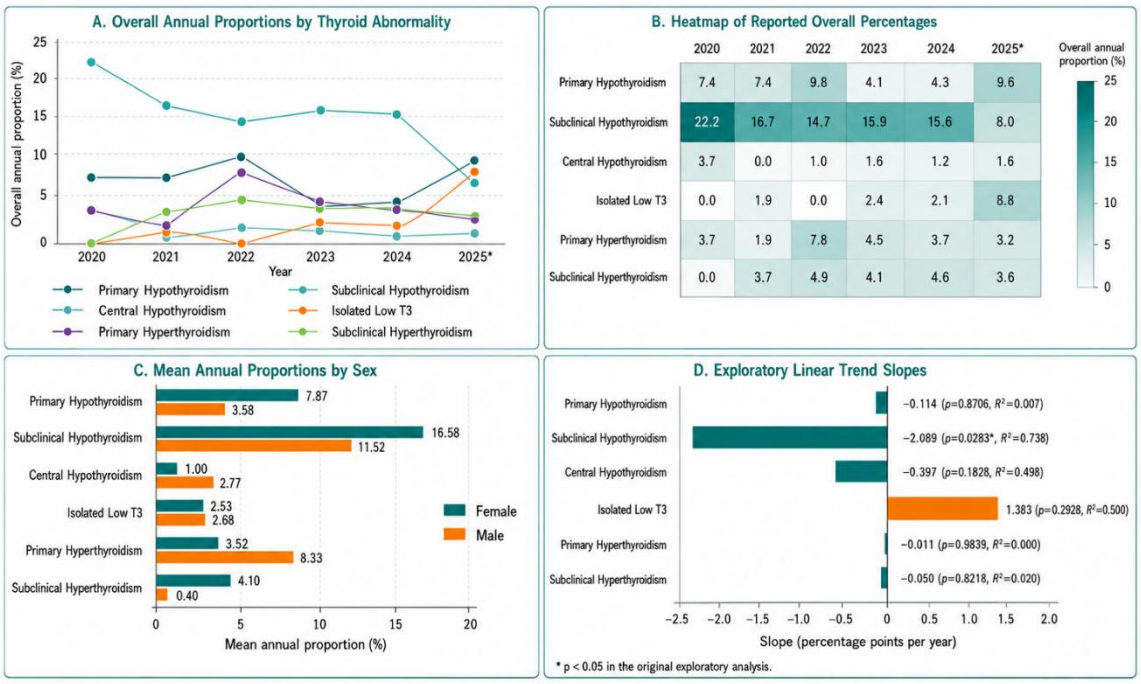
The male age distribution was more variable, partly reflecting the smaller number of male records. Men aged 30–39 years were among the most represented groups from 2022 onward, reaching 46.2% of the male thyroid-abnormality records during January–July 2025. Men older than 70 years were among the two most represented male groups in 2024 and January–July 2025. Because the denominators for all tested individuals within each age-sex stratum were not available in the reported table, these findings described the distribution of abnormal records and did not establish age-specific risk.

Table 3. Linear Trend Analysis of Overall Annual Thyroid-Abnormality Proportions

Thyroid abnormality	Slope, percentage points/year	p-value	R^2	Direction
Primary hypothyroidism	−0.114	0.8706	0.007	Decreasing
Subclinical hypothyroidism	−2.089	0.0283	0.738	Decreasing
Central hypothyroidism	−0.397	0.1828	0.498	Decreasing
Primary hyperthyroidism	−0.011	0.9839	0.000	Decreasing
Isolated low T3	1.383	0.2928	0.500	Increasing
Subclinical hyperthyroidism	−0.050	0.8218	0.020	Decreasing

T3, triiodothyronine; R^2, coefficient of determination. A two-sided p-value <0.05 was used for the original exploratory trend analysis.

The exploratory linear regression analysis identified a nominally significant decreasing trend in subclinical hypothyroidism, with an estimated annual reduction of 2.089 percentage points (p=0.0283; R^2=0.738). Primary hypothyroidism, central hypothyroidism, primary hyperthyroidism, and subclinical hyperthyroidism also had negative slopes, but none of these temporal patterns reached the prespecified significance threshold.



The figure 1 summarizes annual thyroid dysfunction patterns from 2020 to July 2025, showing subclinical hypothyroidism as the most common abnormality despite a significant downward trend, while isolated low T3 increased descriptively but not significantly. Females had higher mean proportions of primary and subclinical hypothyroidism, whereas males showed relatively higher primary hyperthyroidism. The heatmap and trend plots highlight year-to-year variation, with 2025 interpreted cautiously because it represents only a partial year.

Isolated low T3 demonstrated a positive slope of 1.383 percentage points per year, but the trend was not statistically significant (p=0.2928; R^2=0.500). Accordingly, the observed increase in isolated low T3 during

January–July 2025 was interpreted as a descriptive pattern rather than evidence of a confirmed temporal increase.

Overall, the findings indicated that subclinical hypothyroidism remained the most frequently reported thyroid abnormality across the laboratory records, although its annual proportion declined over the study period. Other thyroid-function categories showed fluctuating annual patterns without statistically supported linear changes. The trend estimates were interpreted cautiously because they were based on six annual observations, included a partial-year observation for 2025, and involved smaller numbers in several male and less common diagnostic categories.

DISCUSSION

This retrospective laboratory record-based analysis described the annual distribution of biochemical thyroid abnormalities among 1,004 individuals tested in Gujrat between January 2020 and July 2025. Subclinical hypothyroidism was the most frequently recorded abnormality during most of the study period, although its reported annual proportion declined from 22.2% in 2020 to 8.0% during January–July 2025. The exploratory regression model indicated an estimated reduction of 2.089 percentage points per year, which reached the nominal significance threshold used in the original analysis. In contrast, primary hypothyroidism, central hypothyroidism, primary hyperthyroidism, subclinical hyperthyroidism, and isolated low T3 demonstrated variable annual patterns without statistically supported linear trends. Females accounted for most of the available laboratory records and generally showed higher reported proportions of hypothyroid abnormalities, whereas primary hyperthyroidism and isolated low T3 were relatively more frequent among males. These findings represented patterns within a laboratory-tested population and should not be interpreted as estimates of thyroid dysfunction prevalence in the general population of Gujrat.

The predominance of subclinical hypothyroidism was broadly consistent with evidence showing that subclinical thyroid abnormalities are commonly detected during biochemical screening and diagnostic evaluation. Previous studies from Pakistan have also reported considerable proportions of subclinical and overt thyroid dysfunction among patients evaluated in hospital and laboratory settings, with thyroid abnormalities generally occurring more frequently among females than males (14,16). However, direct numerical comparison between the present findings and previous studies should be made cautiously because thyroid dysfunction estimates vary according to study setting, population structure, clinical referral patterns, assay methods, diagnostic thresholds, iodine exposure, pregnancy status, medication use, and the inclusion or exclusion of patients with known thyroid disease.

The higher representation of females and the generally greater frequency of hypothyroid biochemical patterns among female records were consistent with the well-established sex disparity in thyroid dysfunction. Autoimmune thyroid disease is more common among females, and hormonal, genetic, immunological, reproductive, and environmental factors may contribute to this difference. Large epidemiological analyses have similarly found that hypothyroidism and other thyroid abnormalities occur more frequently among females, although the magnitude of the disparity differs across populations and age groups (15,19). Nevertheless, females constituted 84.5% of the present sample, and this pronounced imbalance may partly reflect sex differences in healthcare-seeking behaviour, clinical suspicion, pregnancy-related testing, autoimmune disease burden, or referral practices rather than an underlying difference of the same magnitude in the wider community.

Subclinical hypothyroidism showed the clearest downward pattern in the exploratory temporal analysis. Several explanations may account for this observation, including changes in referral practices, laboratory testing volume, population composition, treatment exposure, repeat testing, diagnostic thresholds, iodine intake, or the clinical characteristics of patients tested in different years. The early study period also overlapped with the coronavirus disease 2019 pandemic, which may have influenced healthcare access, laboratory attendance, acute illness patterns, and the indications for thyroid testing.

Because the analysis used only six annual observations and the final observation represented seven months rather than a complete calendar year, the apparent decline should be interpreted as an exploratory laboratory trend rather than evidence of a sustained population-level reduction.

Primary hypothyroidism fluctuated across the study period and was highest in 2022 and during January–July 2025. These variations did not demonstrate a statistically significant linear pattern. Primary and subclinical hypothyroidism may be influenced by autoimmune thyroiditis, iodine intake, previous thyroid treatment, pregnancy, medication exposure, and age, but these clinical characteristics were not available in the analysed dataset. The absence of individual clinical information prevented determination of whether the observed changes reflected newly detected disease, previously diagnosed thyroid dysfunction, treatment monitoring, or repeat biochemical assessment.

Primary hyperthyroidism was more frequently represented among male records than female records when the reported mean annual proportions were compared. However, the annual male estimates were based on only 156 records across the entire study period and were therefore vulnerable to pronounced variation from small numbers. The observed sex difference should consequently not be interpreted as evidence that males in Gujrat had a greater population risk of primary hyperthyroidism. Established epidemiological evidence generally indicates that hyperthyroidism is more common among females, although its presentation and aetiology vary with age, iodine status, autoimmune disease, nodular thyroid disease, and study setting (19).

Isolated low T3 increased descriptively during January–July 2025, reaching 8.8% overall and 11.4% among males. However, the regression slope was not statistically significant. Reduced T3 concentrations may occur in acute or chronic systemic illness, renal disease, malnutrition, inflammatory states, medication exposure, and critical illness and may represent non-thyroidal illness rather than primary thyroid gland dysfunction (9,17,18). Because the dataset did not contain clinical diagnoses, hospitalization status, renal function, medication history, or measures of illness severity, the cause and clinical significance of the isolated low-T3 findings could not be determined. The observed increase therefore requires confirmation in a clinically characterized cohort.

The age distribution of abnormal laboratory records varied across sex and year. Women aged 30–39 years were among the most frequently represented groups during most study years, while women aged 40–49 years also contributed a substantial proportion of the abnormal records. This pattern may reflect the greater frequency of thyroid testing during reproductive and middle adulthood, including assessment related to menstrual symptoms, fertility, pregnancy, metabolic complaints, autoimmune disease, or nonspecific symptoms. However, women aged 20–29 and 50–59 years were the leading groups in 2021, demonstrating that the female pattern was not uniform across the complete study period.

The male age distribution was more heterogeneous, with men aged 30–39 years frequently represented during the later study years and men older than 70 years appearing among the two most represented groups in 2024 and January–July 2025. Thyroid dysfunction becomes more common with advancing age, and both hypothyroidism and hyperthyroidism may present atypically in older adults (19,20). Nevertheless, the study did not provide the total number of tested individuals within each age-sex stratum. Consequently, the age-group findings described the composition of abnormal records rather than age-specific prevalence or risk. The data did not permit a valid conclusion that the male distribution was bimodal or that older men represented a high-risk group.

The study had several strengths. It evaluated thyroid-profile records over more than five years, included several categories of biochemical thyroid dysfunction, and described annual, sex-specific, and age-related patterns. The inclusion of exploratory regression estimates also provided a quantitative summary of the direction of annual changes. In addition, retaining the analytical code as supplementary material could improve reproducibility if the code and its source data were independently verified.

The findings must nevertheless be interpreted in light of important limitations. The study was based on records from one diagnostic laboratory network and was therefore subject to referral, selection, and healthcare-access biases. The analysed population was not randomly sampled from the residents of Gujrat, and the findings could not establish community prevalence. It was not reported whether repeat tests from the same individual were removed, creating a possibility that some patients contributed more than one record. The available manuscript did not provide assay methods, analyser details, units, reference intervals, quality-control procedures, or information regarding changes in laboratory platforms across the study period. Diagnostic classifications could therefore not be independently reproduced.

The dataset lacked information on symptoms, clinical diagnoses, pregnancy, thyroid medication, previous thyroid disease, comorbid illness, renal function, hospitalization status, iodine exposure, and the indications for testing. These unmeasured factors may have affected both the likelihood of testing and the biochemical classification. Annual denominators were not presented directly in the original table, and several diagnostic categories with no reported cases were omitted rather than consistently displayed. The male subgroup and several less common diagnostic categories contained sparse observations, resulting in unstable annual percentages. The final study period covered only January through July 2025 and was not directly equivalent to the five complete calendar years. Finally, ordinary linear regression was applied to only six annual proportions without adjustment for unequal denominators, changes in age-sex composition, repeated observations, multiplicity, or the bounded distribution of percentage outcomes. The trend analyses should therefore be regarded as exploratory.

Future investigations should use de-identified patient-level data, remove or model repeated measurements, report annual and subgroup denominators, and apply clearly documented biochemical thresholds based on a stable laboratory platform. Population-based or multicentre studies would provide more generalizable estimates. Regression models based on individual-level binary outcomes could examine temporal changes while adjusting for age, sex, pregnancy, treatment, comorbid disease, and other clinically relevant variables. Complete calendar-year comparisons and sensitivity analyses excluding partial-year observations would further improve temporal interpretation.

CONCLUSION

Among patients undergoing thyroid-profile testing at a diagnostic laboratory in Gujrat between January 2020 and July 2025, subclinical hypothyroidism was the most frequently reported biochemical abnormality and demonstrated a nominally significant decreasing exploratory trend. Other thyroid-function abnormalities showed fluctuating annual distributions without statistically supported linear changes, while females were more frequently represented and generally had higher proportions of hypothyroid patterns. These findings describe laboratory-based distributions rather than community prevalence and require confirmation through multicentre or population-based studies using patient-level clinical information, complete annual denominators, standardized biochemical criteria, and more robust longitudinal analytical methods.

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