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Biochemistry Section

Estimation of Prevalence and Patterns of Thyroid Dysfunction in a Tertiary Care Centre in Uttarakhand, India: A Cross-sectional Study

KAILASH GAIROLA[1], KINGSHUK LAHON[2], BHUPENDER SINGH MINGWAL[3], PALLAVI RAWAT[4]

ABSTRACT

Introduction: Thyroid dysfunction is a common endocrine disorder, defined as the altered serum Thyroid Stimulating Hormone (TSH) levels with normal or altered FT3 and FT4 (triiodothyronine and thyroxine) levels. The spectrum of thyroid disorders includes hypothyroidism, hyperthyroidism, goiter/iodine deficiency disorders, autoimmune thyroiditis, thyroid cancer, as well as subclinical hypothyroidism or hyperthyroidism. However, further research is required on the spectrum of thyroid disorders, apart from goiter/iodine deficiency disorders in the study population mentioned.

Aim: To investigate the prevalence and patterns of thyroid disorders in the clinical biochemistry laboratory of a tertiary care hospital in the hilly region of Uttarakhand, India.

Materials and Methods: Present cross-sectional study was conducted in the clinical biochemistry laboratory of Veer Chandra Singh Garhwali (VCSG) Govt. Institute of Medical Science and Research Centre, Srinagar Garhwal, Uttarakhand, India. The study population consisted of 950 subjects who underwent Thyroid Function Test (TFT) panel investigation from January 1, 2018 to December 31, 2020. The collected data were analysed using descriptive statistical tools (mean, frequency, percentage) and correlation analysis of thyroid disorder with age and gender using Spearman's rank correlation test.

Results: Among 950 TFT panel reports, thyroid dysfunction was prevalent in 386 (40.63%) patients, of which 307 (79.53%) were females and 79 (20.47%) were males. The mean age±SD of the 386 patients with thyroid dysfunction was 32.24±8.77 years. Among these 386 thyroid dysfunction patients, the majority, 264 (68.39%) were in the 19-39 years age group. A very weak statistical correlation was observed between thyroid dysfunction with age and with gender among the 386 patients. Out of the total number of patients (950), 156 patients had euthyroid hyperthyroxinaemia (16.42%), 101 had subclinical hypothyroidism (10.63%), 74 had euthyroid sick syndrome (7.78%), 42 had subclinical hyperthyroidism (4.42%), 10 had primary (overt) hypothyroidism (1.05%), one had primary (overt) hyperthyroidism (0.11%), and two had secondary hyperthyroidism (0.21%).

Conclusion: The prevalence of thyroid dysfunction in the present study was high, with a greater proportion in females and the 19-39 years age group. The most common disorders observed were euthyroid hyperthyroxinaemia, subclinical hypothyroidism, and euthyroid sick syndrome.

Keywords: Euthyroid sick syndrome, Hyperthyroxinaemia, Hypothyroidism, Iodine deficiency

INTRODUCTION

The thyroid gland produces T4 and T3, which play a critical role in cell differentiation and organogenesis during development and helps in maintaining the thermogenic and metabolic homeostasis in adults [1]. Hypothalamic Thyrotropin Releasing Hormone (TRH) stimulates the production of TSH by the thyrotrope cells of the anterior pituitary, which, in turn, stimulates thyroid hormone synthesis and secretion. TSH is the most useful physiological marker of thyroid hormone action [1].

The TFT panel, comprising estimation of serum TSH, free T3, and T4 (fT3, fT4), is commonly used to assess thyroid function [2]. Thyroid dysfunction occurs when there are altered serum TSH levels with normal or altered fT3 and fT4 levels. It is one of the leading endocrine disorders worldwide and may be due to primary failure of the thyroid gland, disorders due to pituitary/hypothalamic dysfunction, or generalised tissue resistance to circulating levels of thyroid hormone. Thyroid disorders include hypothyroidism, hyperthyroidism, goiter/iodine deficiency disorders, autoimmune thyroiditis, thyroid cancer, as well as subclinical hypothyroidism or hyperthyroidism [1-4].

Prevalence estimates for both overt and subclinical hyper and hypothyroidism vary in various studies from different parts of the world [3-8]. According to the American Thyroid Association (ATA), over 12% of the US population is at risk of developing a thyroid disorder during their lifetime, with about 20 million currently suffering from some thyroid disorder [3]. A projected estimate suggests that about 42 million Indians suffer from thyroid diseases [4], and the prevalence of thyroid disorders is rising in the post-iodisation era [5].

According to the World Health Organisation (WHO), an estimated two billion people worldwide are iodine-deficient. In areas with relative iodine deficiency, there is an increased prevalence of goiter, and when deficiency is severe, hypothyroidism and cretinism occur. In areas of iodine sufficiency, autoimmune disease (Hashimoto's thyroiditis) and iatrogenic causes (treatment of hyperthyroidism) are the most common causes of hypothyroidism [1].

Hyperthyroidism specifically denotes disorders involving a hyperactive thyroid gland (Graves' disease, toxic multinodular goiter, toxic adenoma), and thyrotoxicosis refers to excess circulating and tissue thyroid hormone levels [6]. According to Kochupillai N, thyrotoxicosis is widely prevalent in Northern India [4].

Subclinical hypo and hyperthyroidism constitute the subclinical thyroid disorders wherein patients are usually asymptomatic or may present with non specific constitutional symptoms along with changes in TFT. Population studies depict high prevalence of autoimmune thyroiditis in India with anti-Thyroid Peroxidase (TPO) antibodies, which are linked to subclinical thyroid disorders [7,8].

Other conditions that may be diagnosed by measuring serum TSH, fT3, and fT4 include euthyroid sick syndrome, euthyroid hyperthyroxinaemia, and euthyroid hypothyroxinemia [8].

Sareen N et al., conducted a community-based study, in Uttarakhand on iodine deficiency disorders and hypothyroidism, but they did not report the entire spectrum of thyroid disorders [9]. Hence, the present study was conducted in a hospital setting to analyse the prevalence and spectrum of thyroid dysfunction in subjects undergoing TFT panel testing in the clinical biochemistry laboratory of our tertiary care hospital in the Garhwal region of Uttarakhand, India, which mainly caters to the population of the hilly districts of Pauri, Tehri, Rudraprayag, and Chamoli.

MATERIALS AND METHODS

This retrospective cross-sectional study was conducted in the clinical biochemistry laboratory of VCSG Govt. Institute of Medical Science and Research, Srinagar Garhwal, Uttarakhand, India, from 1st January 2018 to 31st December 2020. Permission from the Institutional Ethics Committee (IEC) (vide Letter No. MC/IEC/2022-23/05, dated 8.5.2022) and permission from the Medical Superintendent to access the lab records were obtained prior to the study.

Inclusion criteria: All subjects undergoing TFT panel investigation (fT3, fT4, TSH) in the institution during the study period were included in the study.

Exclusion criteria: Samples received for non TFT investigations were excluded from the study.

Sample size: A total of 950 subjects who presented in our institute for TFT panel investigations within the study duration were enrolled in the study through continuous sampling.

Data collection: Data of the subjects (patient details, fT3, fT4, TSH levels) were collected in a predesigned proforma in MS Excel.

TFT panel investigations were performed using the Erba Lisa Scan ELISA method analyser (Transasia BioMedicals Ltd.). Fasting blood samples (3 mL) of the patients were collected in clot activator vials. Samples were analysed after instrument calibration and acceptable quality control. The laboratory reference range for serum TSH was 0.3-6.2 mIU/mL, fT3 1.4-4.2 pg/mL, and fT4 was 0.8-2.0 ng/mL [10]. Thyroid dysfunction was categorised into six groups, five of which were defined as per the American Association of Clinical Endocrinologists (AACE) in association with ATA guidelines 2013 [11], and the sixth group, as per Jameson JL et al., [1]. All six groups are defined in [Table/Fig-1].

S. No.	Thyroid dysfunction/ disorder	Definition
1	Subclinical hypothyroidism	High serum TSH with normal serum fT4 and fT3 concentrations, associated with few or no signs and symptoms of hypothyroidism.
2	Hypothyroidism (primary)	Elevated TSH in combination with a low fT4.
3	Euthyroid sick syndrome	Changes in TFTs of inpatients with critical illness, causing transient changes in the hypothalamic-pituitary-thyroid axis. Generally, low total T3 and fT3 levels with low or normal fT4 and TSH are seen.
4	Subclinical hyperthyroidism	Persistently low TSH with normal fT3, fT4.
5	Hyperthyroidism (primary or secondary)	Inappropriately high synthesis and/or secretion of fT3, fT4 with elevated fT3 and/or normal/ elevated fT4 and low or suppressed TSH.
6	Euthyroid hyperthyroxinaemia	Transient or persistent increase in serum fT4 and/or fT3, but TSH is normal and the patient is asymptomatic. Unresponsiveness of TSH to TRH may also occur.

[Table/Fig-1]: Types of thyroid dysfunction.

STATISTICAL ANALYSIS

The statistical analysis was conducted using the Statistical Package for Social Sciences (IBM-SPSS software version 20.0). Descriptive data were presented as Mean±SD, frequency, and percentage. Spearman's Rank Correlation test was used to correlate the variables, age and gender with thyroid dysfunction.

RESULTS

A total of 950 subjects (in-patients and out-patients) underwent TFT panel testing in our institute during the study period.

The TFT panel study revealed that 564 subjects had fT3, fT4, and TSH values within the laboratory reference range. Therefore, out of 950 subjects, 564 (59.37%) were euthyroid, and 386 (40.63%) had thyroid abnormalities. Overall, there were 773 females (81.37%) and 177 males (18.63%). Among 386 patients with thyroid disorders, 307 (79.53%) were females and 79 (20.47%) were males.

Out of the 950 subjects, there were 156 patients with euthyroid hyperthyroxinaemia (16.42%), 74 with euthyroid sick syndrome (7.78%), one with primary (overt) hyperthyroidism (0.11%), two with secondary hyperthyroidism (0.21%), 42 with subclinical hyperthyroidism (4.42%), 10 with primary (overt) hypothyroidism (1.05%), and 101 with subclinical hypothyroidism (10.63%). More euthyroid and thyroid dysfunction patients were seen the 19-39 years age group [Table/Fig-2,3]. There were more females than males in all categories of thyroid dysfunction [Table/Fig-4].

Parameters	Total number of subjects evaluated for thyroid function tests (N=950)	
Age (in years)	Subjects with thyroid disorder (386)	Subjects without thyroid disorder (564)
≤18	17 (4.40%)	24 (4.26%)
19-39	264 (68.39%)	387 (68.61%)
40-59	102 (26.43%)	153 (27.13%)
>60	3 (0.78%)	0
Mean age±SD (in years)	32.24±8.77	31.82±8.58
Gender		
Male (177)	79 (20.47%)	98 (17.38%)
Female (773)	307 (79.53%)	466 (82.62%)
TFT investigation		
fT3 (pg/mL)	233 (0.3-1.3 and 4.3-20)	683 (1.4-4.2)
fT4 (ng/mL)	141 (0.1-0.7 and 2.1-14.5)	776 (0.8-2.0)
TSH (mIU/mL)	189 (0.1-0.2 and 6.3-402)	759 (0.3-6.2)

[Table/Fig-2]: Age and gender distribution of patients undergoing TFT panel investigations.

Type of thyroid disorder	Age (in years)				Total No. of patients category wise (N=950)
	≤18	19-39	40-59	>60	
Euthyroid/within normal limits	24 (4.26%)	387 (68.61%)	153 (27.13%)	0	**564**
Thyroid dysfunction, n=386					
Euthyroid hyperthyroxinaemia (156)	10 (2.59%)	102 (26.42%)	43 (11.14%)	1 (0.26%)	156 (40.41%)
Euthyroid sick syndrome (74)	2 (0.52%)	54 (13.99%)	18 (4.66%)	0	74 (19.17%)
Primary (Overt) hyperthyroidism (1)	0	1 (0.26%)	0	0	1 (0.26%)
Primary (Overt) hypothyroidism (10)	0	7 (1.81%)	3 (0.78%)	0	10 (2.59%)
Secondary hyperthyroidism (2)	0	1 (0.26%)	1 (0.26%)	0	2 (0.52%)

Subclinical hyperthyroidism (42)	2 (0.52%)	34 (8.81%)	6 (1.55%)	0	42 (10.88%)
Subclinical hypothyroidism (101)	3 (0.78%)	65 (16.84%)	31 (8.03%)	2 (0.52%)	101 (26.17%)
Total	41 (4.32%)	651 (68.53%)	255 (26.84%)	3 (0.32%)	950

[Table/Fig-3]: Age wise distribution and categorisation of euthyroid and thyroid dysfunction patients.

Type of thyroid disorder	Sex		Total
	Female	Male	
Within normal limits (Euthyroid)	466 (82.62%)	98 (17.38%)	564
Thyroid dysfunction	307 (79.53%)	79 (20.47%)	386
Euthyroid hyperthyroxinaemia	130 (33.69%)	26 (6.73%)	156 (40.41%)
Subclinical hypothyroidism	72 (18.65%)	29 (7.51%)	101 (26.17%)
Euthyroid sick syndrome	57 (14.77%)	17 (4.40%)	74 (19.17%)
Subclinical hyperthyroidism	35 (9.07%)	7 (1.81%)	42 (10.88%)
Primary (overt) hypothyroidism	10 (2.59%)	0	10 (2.59%)
Secondary hyperthyroidism	2 (0.52%)	0	2 (0.52%)
Primary (overt) hyperthyroidism	1 (0.26%)	0	1 (0.26%)
Total	773 (81.37%)	177 (18.63%)	950

[Table/Fig-4]: Gender wise distribution and categorisation of pattern of euthyroid and thyroid dysfunction patients.

Among the 386 patients with thyroid dysfunction, the mean age was 32.24±8.77 years. The mean age of all females was 31.97±8.91 years, and the mean age of males was 32.46±9.52 years [Table/Fig-5]. The mean age in all thyroid dysfunction categories (except subclinical hyperthyroidism) was in the early 4th decade of life [Table/Fig-6].

Sex	Mean Age±SD (in years) Euthyroid patients (564)	Mean Age±SD (in years) Thyroid disorder patients (386)
Female	32.03±8.53	31.97±8.91
Male	30.83±8.79	32.46±9.52

[Table/Fig-5]: Mean age according to gender.
Smean (Age in years)

Euthyroid status or thyroid disorder	Mean±SD of age (in years)
Within normal limits (Euthyroid)	31.82±8.58
Euthyroid hyperthyroxinaemia	32.46±9.39
Euthyroid sick syndrome	30.76±8.45
Primary (Overt) hyperthyroidism	35.00±0.00
Primary (overt) hypothyroidism	34.40±6.55
Secondary hyperthyroidism	31.00±11.31
Subclinical hyperthyroidism	28.90±8.31
Subclinical hypothyroidism	33.51±9.13

[Table/Fig-6]: Mean age according to euthyroid status or thyroid disorder.

A very weak statistical correlation was observed between thyroid disorder and age, [Table/Fig-7] as well as with gender [Table/Fig-8], when the Spearman's rank correlation test was applied.

Correlations			Age	Disorder
Spearman's rho	Age	Correlation coefficient	1.000	0.021
		N	386	386
	Disorder	Correlation coefficient	0.021	1.000
		N	386	386

[Table/Fig-7]: Correlation between age and type of thyroid dysfunction (n=386).
Spearman's rank correlation test

Correlations			Disorder	Gender
Spearman's rho	Disorder	Correlation coefficient	1.000	0.099
		N	386	386
	Gender	Correlation coefficient	0.099	1.000
		N	386	386

[Table/Fig-8]: Correlation between gender and type of thyroid dysfunction (n=386).
Spearman's rank correlation test

DISCUSSION

This study estimated the prevalence and analysed the pattern of thyroid dysfunction among patients undergoing TFT panel investigation in the clinical biochemistry laboratory of our tertiary care hospital during the period from 1st January 2018 to 31st December 2020.

Nafisa A et al., reported a prevalence of 31.7% thyroid dysfunction in a hospital-based study in Pakistan [12]. In two similar studies in Nepal by Aryal M et al., and Dangol RK et al., the prevalence was 25% and 23.31%, respectively [13,14]. In similar studies in India, the prevalence was reported as 15.35% in Madhya Pradesh [15] 33.62% in Kanpur, Uttar Pradesh [16], 24.10% in Chhattisgarh [17], 15.80% in Puducherry [18], and 15.73% in Kerala [19]. In a population-based study in South India, thyroid dysfunction was observed in 19.6% of subjects [20]. Thus, there is wide variation in the prevalence of thyroid dysfunction in different study populations. The prevalence of thyroid dysfunction in the present study was higher (40.63%) in comparison with the afore-mentioned studies conducted in India. However, in comparison to present study, the prevalence was higher in two studies conducted in Nepal by Adhikari BR et al., (74.13%) and by Agrawal A et al., (95.21%), as they reported only 28 euthyroid patients out of 584 [21,22].

In present study, females showed almost four times higher prevalence of thyroid dysfunction compared to males. According to the ATA, females are 5-8 times more likely than males to be affected by thyroid disorders [3]. Castello R and Caputo M also reported similar findings [23]. Chen X et al., observed lower fT3 values and lower fT3/fT4 ratios in females, while fT4 values remained stable [24]. Higher prevalence of thyroid dysfunction in females was also reported by other researchers [12-16,19,21,22,25-28].

All thyroid disorder patients in present study had a mean age in the 4th decade of life, except for subclinical hyperthyroidism (3rd decade of life). Other researchers similarly reported that most thyroid dysfunction patients were in the 3rd to 5th decades of life [11-19,21,22,25,26,28]. In present study, patients with thyroid dysfunction (n=386) were most commonly observed in the 19-39 years age group (68.39%), followed by the 40-59 year age group (26.43%) and the ≤18 year age group (4.40%). The most common thyroid abnormality in present study was euthyroid hyperthyroxinaemia, followed by subclinical hypothyroidism, euthyroid sick syndrome, subclinical hyperthyroidism, primary (overt) hypothyroidism, secondary hyperthyroidism, and primary (overt) hyperthyroidism.

Euthyroid hyperthyroxinaemia may be due to abnormalities of serum fT3 and fT4 binding proteins (inherited or acquired), such as an increase in binding affinity for fT4 and/or fT3 due to mutations in thyroid binding globulin, transthyretin, and albumin, also known as familial dysalbuminaemic hyperthyroxinaemia [1]. Other causes of euthyroid hyperthyroxinaemia are peripheral resistance to fT3 and fT4, acute non thyroidal illness, acute psychiatric illness, or drug-induced [29]. Resistance to Thyroid Hormone (RTH) syndrome is caused by mutations in the thyroid hormone receptor beta, where patients usually do not show features of thyrotoxicosis, but the TFT shows raised fT3 and fT4 [30]. However, RTH has been reported even without this mutation in the thyroid hormone receptor beta [31].

Euthyroid hyperthyroxinaemia in present study could have been due to any of these causes. The prevalence of euthyroid hyperthyroxinaemia in present study was higher than that reported by Okpara C et al., [8].

Subclinical thyroid dysfunctions are laboratory-based diagnoses [32-34]. In subclinical hypothyroidism, only serum TSH is raised [35]. The prevalence of subclinical hypothyroidism in present study was comparable to reports of 3-15% prevalence [20,28,36,37]. It occurs more often in women and elderly. Some researchers reported a higher prevalence with excess dietary iodine [38-40]. Whether subclinical or overt, iodine deficiency is the commonest cause of hypothyroidism worldwide, except in the United States (US) where autoimmune thyroiditis predominates. Postsurgical, central, and drug-induced hypothyroidism are other causes [41]. In present study, subclinical hypothyroidism could be due to any of the above causes.

The prevalence of overt hypothyroidism in present study was comparable to the findings of Deshmukh V et al., Dangol RK et al., and Gopaliah RL et al., [5,14,19], but others have reported a much higher prevalence [7,11,12,15,17,21,22,25,28].

Euthyroid sick syndrome occurs in about 75% of hospitalised patients [42]. It may result from stress in critical states such as starvation, hypothermia, trauma, burns, major surgery, infections, malignancies, metabolic disorders, diseases of the cardiovascular, liver, gastrointestinal, and renal systems, and recently in patients following COVID-19 infection as well [42]. In present study, any of the above causes could be implicated in euthyroid sick syndrome.

In present study, the prevalence of euthyroid sick syndrome was similar to the observations of Agrawal A et al., [22], higher than the observations of Okpara C et al., and lower than those of Hassan-Kadle MA et al., [8,11].

A hyperthyroid state causes thyrotoxicosis, which refers to the effect of excess thyroid hormone on the tissues causing systemic clinical manifestations [43].

Hyperthyroidism can be overt or subclinical. Risk factors for overt hyperthyroidism include smoking, iodine deficiency or excess, selenium deficiency, genetic factors, and the use of certain drugs [44]. Iodine deficiency can lead to both hypothyroidism and hyperthyroidism [45].

Carlé A et al., in their review of subclinical thyrotoxicosis, have reported low TSH in approximately 1-5% [46], and other researchers also reported a similar prevalence of subclinical hyperthyroidism [8,12,16,19,21,46], which was comparable to present study findings. Deshmukh V et al., however, observed a lower prevalence, and Hassan-Kadle MA et al., observed a higher prevalence than present study findings [5,11]. Subclinical thyrotoxicosis may be endogenous or secondary to low serum TSH during pregnancy, non thyroidal illness with low fT3, pituitary and hypothalamic insufficiency, medications such as dopamine or glucocorticoids, or assay problems. Any of these factors could be the underlying cause behind present study observations.

Deshmukh V et al., Bose A et al., Abraham R et al., Usha Menon V et al., and Gopaliah R et al., found a lower prevalence of overt hyperthyroidism compared to our observations [5,15,18-20], whereas other researchers observed a higher prevalence [8,11,12,14,16,17,21,22].

The proportionate frequencies of thyroid disorder pattern found in present study differed from the findings of many other researchers, who have reported hypothyroidism as the most common thyroid disorder observed [14-16,19,21,22,25-27]. Among them, subclinical hypothyroidism was more common than overt hypothyroidism in studies by Sharma PK et al., Gopaliah R et al., Upadhaya et al., and Unnikrishnan AG et al. [16,19,26,28], and overt hypothyroidism was more common in studies conducted by other researchers [14,15,21,22,26]. Some of them have reported subclinical hypothyroidism as the second most commonly observed thyroid disorder, similar to present study findings [8,12,15,27]. Okpara C et al., reported primary hyperthyroidism, Hassan-Kadle MA et al., reported euthyroid sick syndrome, Nafisa A et al., reported subclinical hyperthyroidism, whereas Antony J et al. reported non toxic multinodular goiter as the most common thyroid disorder [8,11,12,25]. The comparison of present study results with comparable and contrasting features of reports from previous researchers is summarised in the table below [Table/Fig-9].

S. No.	Parameter	Study results	Comparable previous studies (Reference no.)	Contrasting previous studies (Reference no.)
1	Prevalence of thyroid dysfunction	40.63%	15.35%-33.62% [12-20]	74.13% and 95.21% [21,22]
2	Gender distribution in thyroid dysfunction patients	Females (79.53%) > Males (20.47%)	Females > Males [12-16,19, 21-28]	
3	Age distribution	4th decade of life except for subclinical hyperthyroidism (3rd decade)	3rd-5th decade [11-19,21,22, 25,26,28]	
4	Pattern of thyroid dysfunction	Euthyroid hyperthyroxinaemia, subclinical hypothyroidism, euthyroid sick syndrome are the commonest diagnoses.	No similar study with the same top three diagnoses.	The proportionate distribution of patients in sub-categories and commonest thyroid disorder in present study was different from other reported studies. Commonest thyroid disorder reported: Overt hypothyroidism [14,15,21,22,26] Subclinical hypothyroidism [16,19,26,28] Overt hyperthyroidism [8] Subclinical hyperthyroidism [8,12] Euthyroid sick syndrome [11] Non toxic multinodular goitre [25]
		Euthyroid hyperthyroxinaemia (16.42%)		0.3% [8]
		Subclinical hypothyroidism (10.63%)	Prevalence 3-15% and 2nd most common thyroid disorder [5,7,8,11,12,14,15, 19,20,27,28,36,37]	0%, 1.37%, 16.96% and 28.30% [16,21,22,25]
		Euthyroid sick syndrome (7.78%)	7.90% [22]	2.1% and 58.80% [8,11]
		Subclinical hyperthyroidism (4.42%)	1-5% [8,12,16,19,21,46]	0% and 5.70% [5,11]

		Overt hyperthyroidism (primary and secondary) (1.26%)	0.4%, 1.2%, 1.3%, 1.79% and 2.77% [5,18,20,15,19]	5%-13.7% [8,11,12,14,16,17,21,22]
		Overt hypothyroidism (1.05%)	1.60%, 3.6%, 4.9% and 4.2% [5,8,14,19]	5.90%-64.48% [7,8,11,12,15,17,21,22,25]

[Table/Fig-9]: Summary of study results in comparison with previous reports.

Limitation(s)

The aetiology of thyroid dysfunction could not be determined in the present study population.

CONCLUSION(S)

The prevalence of thyroid dysfunction in present study population was high. Females were more affected than males and thyroid dysfunction was commonly observed in the 4th decade of life. Euthyroid hyperthyroxinaemia, subclinical hypothyroidism, and euthyroid sick syndrome were the top three thyroid disorders in present study.

There is a need for epidemiological studies to investigate the causes of thyroid dysfunction in present study population, with the help of tests for urinary iodine concentration and anti-TPO antibodies, which would help to detect autoimmune thyroiditis. Additionally, testing for mutations in thyroid hormone receptors or binding proteins may help explain the high prevalence of euthyroid hyperthyroxinaemia.

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PARTICULARS OF CONTRIBUTORS:
1. Associate Professor, Department of Biochemistry, Veer Chandra Singh Garhwali Government Institute of Medical Science and Research, Srinagar, Garhwal, Uttarakhand, India.
2. Professor, Department of Pharmacology, Veer Chandra Singh Garhwali Government Institute of Medical Science and Research, Srinagar, Garhwal, Uttarakhand, India.
3. Tutor, Department of Biochemistry, Veer Chandra Singh Garhwali Government Institute of Medical Science and Research, Srinagar, Garhwal, Uttarakhand, India.
4. Tutor, Department of Biochemistry, Veer Chandra Singh Garhwali Government Institute of Medical Science and Research, Srinagar, Garhwal, Uttarakhand, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Kingshuk Lahon,
Professor, Department of Pharmacology, Veer Chandra Singh Garhwali Government Institute of Medical Science and Research, Srinagar,
Garhwal-246174, Uttarakhand, India.
E-mail: kingshukl@yahoo.co.in

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