Section: Biochemistry

Original Research Article

PREVALENCE OF THYROID DISORDERS IN A TERTIARY CARE HOSPITAL

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ABSTRACT

Background: Hypothyroidism itself contributes to morbidity from osteoporosis, hyperlipidemia, hypercholesterolemia, cardiovascular and neuropsychiatry disease in the population. the prevalence and pattern of thyroid disorders depends on gender, age, ethnic and geographical factors and especially on iodine intake. Still thyroid disorders especially hypothyroidism, both subclinical and overt, contributes significantly to burden of thyroid disorders in India. **Aim:** The aim of the present study was to assess the proportion of various thyroid disorders in subjects attending a tertiary care center.

Materials and Methods: This retrospective hospital based study involved 1227 patients who underwent thyroid function tests (T3, T4 &TSH) in the central clinical biochemistry from sep 2018 to Jan 2019 from Mallareddy Viswavidyapeeth Deemed University Hyderabad. Thyroid function tests were performed on BECKMAN COULTER ACESS. The T3, T4 and TSH levels were also analysed by paramagnetic chemiluminescent immuno assay system. The laboratory's reference values were TSH: 0.38- 5.33 µIU/ml; T3: 0.87-1.78 ng/dl and T4: 6.09-12.23 µg/dl. Analytical sensitivity was 0.005 µIU/ml for TSH, 0.5 µg/dl for T4, 0.1 ng/dl for T3. Coefficient of variation was < 10% for TSH, T4, T3, and FT3. Hypothyroidism was classified as clinical (overt) if TSH was ≥ 5.33 µIU/ml and T4 ≤ 6.09 µg/dl and subclinical if TSH was ≥ 5.33 µIU/ml T4 was within the reference range. Hyperthyroidism was classified as clinical (overt) if TSH was ≤ 0.38 µIU/ml and T4 ≥ 12.23 µg/dl and subclinical if TSH was ≤ 0.38 µIU/ml and T4 was within the reference range. The data collected was analyzed using Excel 2007, R2.8.0 Statistical Package for Social Sciences (SPSS) for windows version 21.0 (SPSS Inc.; Chicago, IL, USA).

Results: Involving 955/1227 subjects (180 males and 775 females) were analyzed for thyroid disorder i.e thyroid function assay.272/1227 subjects were excluded because only TSH was done. The highest number was in the 21-30 age female group (17.82 %) and lowest number in the >60 age group (12.12%). We found 20.39% subjects having thyroid dysfunction in our study population. Out of these, 3.56% were overt hypothyroid, 11.62% were subclinical hypothyroid, 0.83% overt hyperthyroid, 3.97% were found to be subclinical hyperthyroid and 0.41% secondary hyperthyroidism.

Discussion: The impact of EQAS apart from the standardisation process can also be immense in the post analytical phase steps by using the proper unit of measurement.

Conclusion: Significantly improve the quality of our laboratory practices along with good performances providing confidence in furnishing accurate test reports to the patients.

Keywords: Subclinical Hypothyroidism, Euthyroid, Subclinical Hyperthyroidism,Non Thyroid illness.

INTRODUCTION

Thyroid disorders encompass a wide spectrum of conditions ranging from hypothyroidism and hyperthyroidism to more complex disorders like thyroiditis and goiter. These conditions can significantly impact quality of life and overall health, making their accurate diagnosis and prevalence assessment crucial for effective management and intervention. In developed countries, the prevalence of hypothyroidism ranges between 4-5%, with subclinical hypothyroidism affecting approximately 4-15% of the population.[1,2] Conversely, in developing countries like India, iodine deficiency has historically contributed to a higher prevalence of thyroid disorders. However, following the universal salt iodization program initiated in 1983, there has been a notable decrease in iodine deficiency disorders, including goiter.[3,4]

Recent studies indicate a shift from iodine deficiency to iodine sufficiency in India, which has influenced the prevalence and distribution of thyroid disorders.[5] Despite these advancements, the data available from Indian populations, particularly in the context of tertiary care settings, remain limited. Most studies are geographically constrained and often involve smaller sample sizes, limiting their generalizability.[6,7] Comprehensive, large-scale studies are essential to provide a clearer understanding of the current prevalence of thyroid disorders in India and their variations across different regions and populations.

This study aims to assess the prevalence of thyroid disorders within a tertiary care hospital, which serves as a critical point of care for complex and severe cases. By evaluating a diverse patient population, this study seeks to contribute valuable insights into the prevalence and distribution of thyroid disorders, thereby enhancing our understanding and guiding better healthcare strategies.

Aim: The aim of the present study was to assess the proportion of various thyroid disorders in subjects attending a tertiary care center.

MATERIAL AND METHODS

This retrospective hospital-based study analyzed thyroid function tests from 1,227 patients who underwent testing between September 2018 and January 2019 at the central clinical biochemistry laboratory. The tests measured levels of triiodothyronine (T3), thyroxine (T4), and thyroid-stimulating hormone (TSH) using the BECKMAN COULTER ACCESS system. The T3, T4, and TSH levels were assessed through a paramagnetic chemiluminescent immunoassay system, with reference values set as follows: TSH: 0.38-5.33 µIU/ml; T3: 0.87-1.78 ng/dl; and T4: 6.09-12.23 µg/dl. Analytical sensitivity for TSH was 0.005 µIU/ml, for T4 was 0.5 µg/dl, and for T3 was 0.1 ng/dl. The coefficient of variation was less than 10% for TSH, T4, T3, and free T3 (FT3).

Hypothyroidism was classified into two categories: clinical (overt) hypothyroidism was defined as TSH ≥ 5.33 µIU/ml with T4 ≤ 6.09 µg/dl, while subclinical hypothyroidism was characterized by TSH ≥ 5.33 µIU/ml with T4 levels within the reference range. Hyperthyroidism was similarly categorized into clinical (overt) hyperthyroidism, defined as TSH ≤ 0.38 µIU/ml with T4 ≥ 12.23 µg/dl, and subclinical hyperthyroidism, characterized by TSH ≤ 0.38 µIU/ml with T4 levels within the reference range. Data analysis was performed using Excel 2007 and the Statistical Package for Social Sciences (SPSS) version 21.0 for Windows (SPSS Inc.; Chicago, IL, USA).

RESULTS

Involving 955/1227 subjects (180 males and 775 females) were analyzed for thyroid disorder i.e thyroid function assay.272/1227 subjects were excluded because only TSH was done . The highest number was in the 21-30 age female group (17.82 %) and lowest number in the >60 age group (12.12%). We found 20.39% subjects having thyroid dysfunction in our study population.Out of these, 3.56% were overt hypothyroid, 11.62% were subclinical hypothyroid, 0.83% overt hyperthyroid , 3.97% were found to be subclinical hyperthyroid and 0.41% secondary hyperthyroidism.

Table 1 illustrates the distribution of thyroid disorders across genders, presenting both the count and percentage for each category. Among the total sample, 79.58% are euthyroid, with 140 males and 620 females in this category. Subclinical hypothyroidism affects 11.62% of the population, with a higher prevalence in females (100 cases) compared to males (11 cases). Hypothyroidism is observed in 3.56% of individuals, with 28 females and 6 males. Subclinical hyperthyroidism accounts for 2.82% of the cases, again showing a higher prevalence in females (112 cases) compared to males (15 cases). Hyperthyroidism is the least common, affecting 0.83% of the sample, with 6 females and 2 males. Secondary hyperthyroidism is present in 0.41% of cases, equally distributed between genders. Overall, this distribution indicates a higher prevalence of thyroid disorders in females compared to males, particularly for subclinical hypothyroidism and hyperthyroidism. [Table 1]

Table 2: Thyroid Parameters in Different Age Groups

Table 2 provides a breakdown of thyroid parameters across different age groups, differentiating between euthyroid, subclinical hypothyroidism, hypothyroidism, subclinical hyperthyroidism, and secondary hyperthyroidism. The table shows variations in the prevalence of these conditions with age, with the highest number of cases generally observed in the 21-30 year age group. For instance,

the number of euthyroid individuals decreases with age, while subclinical hypothyroidism and hypothyroidism become more prevalent in older age groups. Subclinical hyperthyroidism and secondary hyperthyroidism are relatively less common across all age groups but show some increase with age. This trend highlights the evolving nature of thyroid disorders and their association with advancing age. [Table 2]

Table 3 compares thyroid parameters between males and females for various thyroid disorders. The data shows significant differences between genders in specific thyroid measurements. For instance, T3 levels are significantly higher in females compared to males (p<.000), while T4 levels do not show a significant difference between genders (p=.752). TSH levels are also not significantly different (p=.690). In cases of subclinical hypothyroidism, females have significantly higher T3 levels compared to males (p=.009), but no significant difference is noted for T4 and TSH levels. For hypothyroidism, T4 levels are significantly lower in females (p=.001). Subclinical hyperthyroidism shows a significant difference in TSH levels (p=.030), with higher values in females. These results indicate gender-related variations in thyroid hormone levels across different thyroid disorders. [Table 3]

Table 4 presents reference values for thyroid gland parameters, with separate intervals calculated using parametric, non-parametric, and robust methods. For euthyroid males, the reference range for T3 is between 0.48 to 1.6 ng/mL, for T4 between 6.21 to 14.44 µg/dL, and for TSH between 0.62 to 8.33 µiu/mL. For euthyroid females, T3 ranges from 0.52 to 1.78 ng/mL, T4 from 6.76 to 14.04 µg/dL, and TSH from 0.65 to 8.09 µiu/mL. The reference intervals vary slightly depending on the method used, with the robust method generally providing broader ranges. This table serves as a comprehensive guide for assessing thyroid function in clinical practice, offering detailed reference intervals to aid in the diagnosis and management of thyroid disorders. [Table 4]

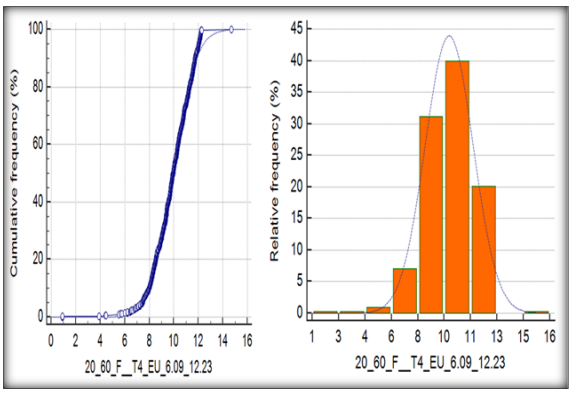


Figure 1: Cumulative frequency and histogram of female euthyroid TSH

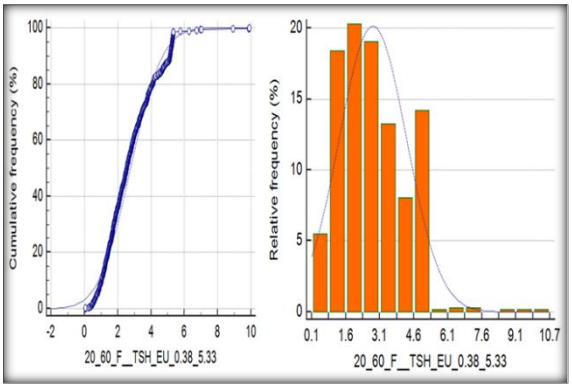


Figure 2: cumulative frequency and histogram of female euthyroid TSH

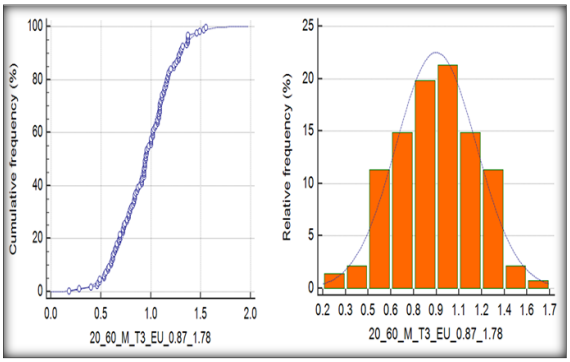


Figure 3. Cumulative frequency and histogram of male euthyroid T3

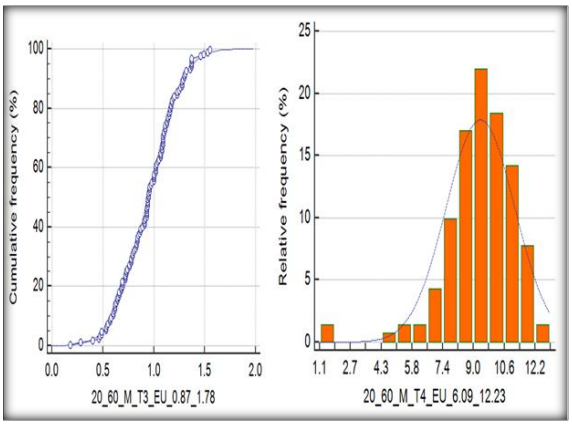


Figure 4: Cumulative frequency and histogram of male euthyroid T4

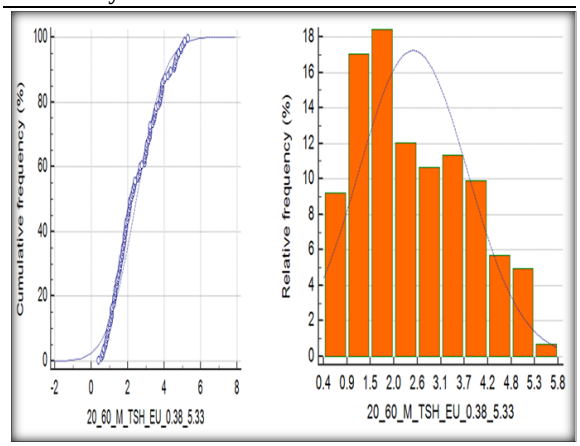


Figure 5: Cumulative frequency and histogram of male euthyroid TSH

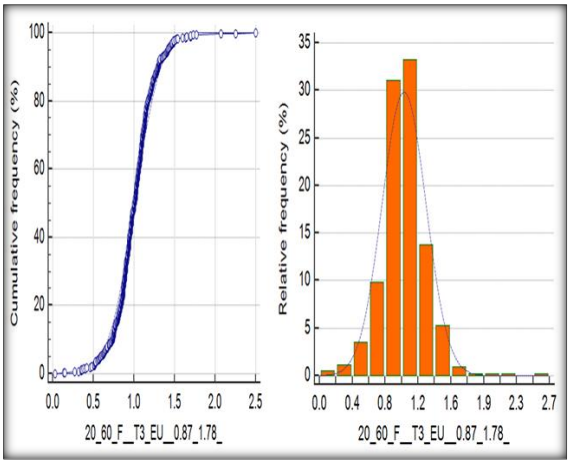


Figure 6: Cumulative frequency and histogram of female euthyroid T3

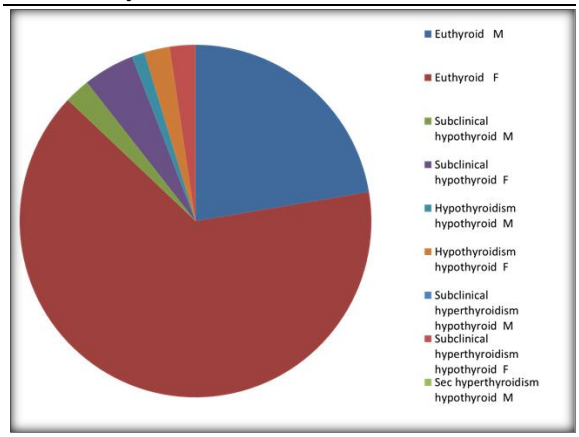


Figure 7: Pie chart for thyroid disorders

The table provides summary statistics for various thyroid hormone measurements in a sample divided by gender and age group (20-60 years). The data has been back transformed after logarithmic transformation. For females in this age group, the mean levels of T3, T4, and TSH are 1.006, 9.849, and 2.769, respectively. The 95% confidence intervals for these means are 0.986 to 1.026 for T3, 9.726 to 9.973 for T4, and 2.650 to 2.887 for TSH. The standard deviations are 0.2540 for T3, 1.5639 for T4, and 1.5013 for TSH. For males, the mean levels are slightly lower, with T3 at 0.940, T4 at 9.355, and TSH at 2.132. The 95% confidence intervals for T3 and T4 are 0.895 to 0.985 and 9.061 to 9.648, respectively. The confidence interval for TSH is 1.938 to 2.347, but the standard deviation is not provided for this measurement. These results indicate a general pattern of thyroid hormone levels in this population, with males showing lower mean levels compared to females.

Table 1: Distribution of thyroid disorders

Category	Male	Female	Percentage(%)
Euthyroid	140	620	79.58
Subclinical hypothyroidism	11	100	11.62
Hypothyroidism	6	28	3.56
Subclinical hyperthyroidism	15	112	2.82
Hyperthyroism	2	6	0.83
Secondary Hyperthyroidism	2	2	0.41
TOTAL	180	775	

Table 2: Thyroid parameters (n) in different age groups

Age (Yrs)	Total		Euthyroid		Subclinical hypothyroid		Hypothy-roidism		Subclinical hyperthyroidism		Sec hyper-thyroidism		Hyper-thyroidism	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
<20	22	63	19	55	2	4	1	2	0	2	0	0	0	0
21-30	25	230	22	189	0	27	1	8	1	3	0	2	1	1
31-40	24	169	24	128	0	26	0	6	6	6	0	0	0	3
41-50	35	177	28	137	6	23	1	10	4	2	0	0	0	1
50-59	24	80	19	69	1	10	4	0	0	0	0	0	0	1
>60	33	58	29	41	2	9	0	2	1	2	0	1	1	0

Table 3: Thyroid parameters in different gender groups

THYROID DISORDERS	F_(M±SD)	M_(M±SD)	T_(M±SD)	Sig. (2-tailed)
T3_F_EU (n=620)*	1±0.25*	0.92±0.26 *(n=140)	0.98±0.25 (n=780)	0
T4_F_EU	9.88±1.54	9.66±1.73	9.84±1.58	0.752
TSH_F_EU	2.73±1.47	2.76±1.62	2.74±1.50	0.69
F_SUBHYPO_T3* (n=100)	0.97±22*	0.80+0.25* (n=11)	0.95±0.23 (n=111)	0.009
F_SUBHYPO_T4	8.64±2.27	8.11±1.3	8.59±2.19	0.205
F_SUBHYPO_TSH	21.38±23.11	20.88±31.60	22.12±24.01	0.377
F_HYPO_T3 (n=10)	0.55±.21	0.46+.44 (n=6)	0.51±0.34 (n=16)	0.342
F_HYPO_T4*	3.62±2.24*	0.86 ± 0.59*	2.48±2.22	0.001
F_HYPO_TSH	61.43±36.95	72.04±42.45	65.80±38.38	0.417
F_SUBHYP_T3 (n=15)	1.04±0.34	0.8±0.25 (n=12)	1.03±0.34 (n=27)	0.512

F_SUBHYP_T4	10.24±1.77	8.11±1.3	9.99±1.79	0.336
F_SUBHYP_TSH*	0.15±0.12*	28.88±31.6*	0.17±0.13	0.03
F_HYPER_T3 (n=6)	1.85±1.01	1.59±1.34 (n=2)	1.82±1.02 (n=8)	0.919
F_HYPER_T4	17.31±5.07	15.25±3.22	17.12±4.93	0.98
F_HYPER_TSH	0.20±0.16	0.1±0.11	0.19±0.25	0.75

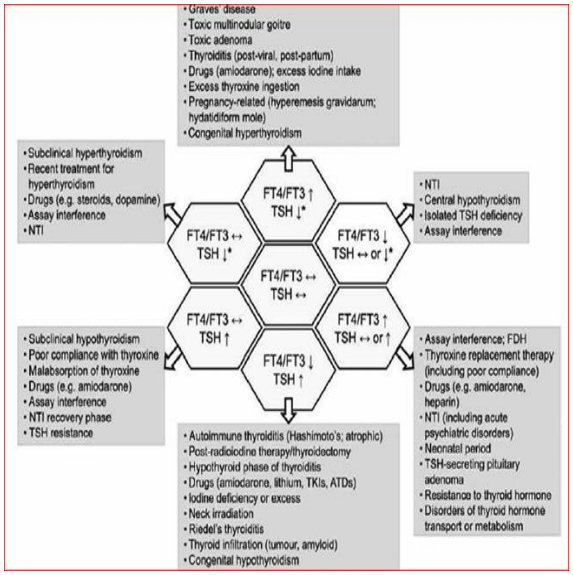
Table 4: Reference values of the thyroid gland parameters

Parameter	n	Reference interval -95% Reference interval, Double-sided					
		Parametric method		Non-parametric method		Robust method	
		LL (90% CI)	UL(90% CI)	LL (90% CI)	UL(90% CI)	LL (90% CI)	UL(90% CI)
M_EU_T3 (ng/mL)	140	0.48 (.45-.51)	1.6(1.5-1.71)	0.43(0.18-0.53)	1.47(1.37-1.55)	0.50(0.46-0.54)	1.72(1.58-1.84)
M_EU_T4 (µg/dL)	140	6.21(5.93-6.51)	14.44(13.78-15.13)	6.58(6.02-7.07)	12.17(12.11-12.20)	6.37(5.76-7.04)	15.01(13.61-.61)
M_EU_TSH (µiu/mL)	140	0.62(0.54-0.72)	8.33(7.22-9.62)	0.61(0.39-0.79)	5.04(4.78-5.30)	0.65(0.55-0.76)	8.88(7.65-10.43)
T3_F_EU (ng/mL)	620	0.52(0.50-0.54)	1.78(1.72-1.84)	0.51(0.38-0.53)	1.49(1.46-1.64)	0.54(0.48-0.60)	1.86(1.68-2.07)
F_EU_T4 (µg/dL)	620	6.76(6.61-6.90)	14.04(13.75-14.34)	6.58(6.02-7.07)	12.17(12.11-12.20)	6.88(6.35-7.35)	14.36(13.47-15.55)
F_EU_TSH (µiu/mL)	620	0.65(0.61-0.70)	8.09(7.53-8.69)	0.55(0.47-0.65)	5.32(5.30-5.33)	0.69(0.62-0.76)	8.76(7.95-9.67)

Table 5: Back transformed after logarithmic transformation

	Mean	95% CI	SD
20_60_F__T3_EU	1.006	0.986 to 1.026	0.254
20_60_F__T4_EU	9.849	9.726 to 9.973	1.5639
20_60_F__TSH_EU	2.769	2.650 to 2.887	1.5013
20_60_M_T3_EU	0.94	0.895 to 0.985	0.2698
20_60_M_T4_EU	9.355	9.061 to 9.648	1.7632
20_60_M_TSH_EU	2.132*	1.938 to 2.347*	

DISCUSSION



Our study suggested that the prevalence of thyroid disorders in our study population is high and hypothyroidism is more common than hyperthyroidism. In the study, the distribution of thyroid disorders showed that the majority of patients were euthyroid, comprising 79.58% of the sample. Subclinical hypothyroidism was present in 11.62% of patients, while 3.56% had overt hypothyroidism. Subclinical hyperthyroidism was observed in 2.82% of the patients, and overt hyperthyroidism was noted in 0.83%. The prevalence of secondary hyperthyroidism was relatively low at 0.41%. The data revealed that thyroid disorders varied significantly with age and gender, with higher rates of hypothyroidism and hyperthyroidism observed in specific age groups and genders.

Further analysis of thyroid parameters across different age groups and genders indicated variations in T3, T4, and TSH levels. For instance, T3 levels were higher in euthyroid females compared to males, while T4 levels showed minimal gender-based differences. The results also highlighted specific patterns in subclinical and overt thyroid disorders. For example, subclinical hypothyroidism showed lower T3 levels in females compared to males, and the prevalence of subclinical hyperthyroidism was notably different between genders. Overall, the study underscores the importance of considering age and gender in evaluating thyroid disorders and emphasizes the need for targeted diagnostic and treatment approaches in diverse patient populations.

To interpret thyroid function tests, begin by assessing the patient's clinical presentation and history, focusing on symptoms such as fatigue, weight changes, or temperature sensitivity, and any relevant medical history, including prior thyroid conditions. Obtain and analyze thyroid function test results, specifically measuring serum levels of T3 (triiodothyronine), T4 (thyroxine), and TSH (thyroid-stimulating hormone). Compare these values to standard reference ranges: TSH (0.38-5.33 µIU/ml), T3 (0.87-1.78 ng/dl), and T4 (6.09-12.23 µg/dl). Classify thyroid status based on these results—euthyroid if all levels are within normal

ranges; hypothyroidism if TSH is elevated and T3/T4 are low, with subclinical hypothyroidism showing elevated TSH but normal T3/T4; and hyperthyroidism if TSH is low and T3/T4 are elevated, with subclinical hyperthyroidism showing low TSH but normal T3/T4. Additional factors, such as free T3, free T4 levels, and thyroid antibodies, should be considered to further evaluate thyroid function and diagnose any autoimmune thyroid conditions. Finally, integrate these findings with the patient's clinical symptoms to guide appropriate management and treatment strategies.

An algorithm to guide interpretation of thyroid function tests.

Various studies have shown female preponderance in thyroid disorders.

The table presents data on thyroid dysfunction prevalence across various studies, including both euthyroid and dysthyroid conditions. [Table 6]

Table 6

Study et all	Sample size	Thyroid dys	euthyroid	subhypo	hypo	subhyper	hyper
Present study	955	20.42	79.58	11.62	3.56	2.82	0.83
Deokar PG1 et al	2076	22.16%	77.84 %	9.44%	4.24%	5.97%	2.5%
Arindam Bose et al	28677	15.35	84.65%	6.13	7.45%		1.79
Rebecca Abraham Et al	505	15.8%	84.2%	9.5%	11.5%		1.8%
J canaris et al	25862	11.7	88.3	9.0	0.4	2.1	0.1
UG Unnikrishnan et al	5376	21.47	78.53	8.02%	10.75%	1.8	0.9

The table presents data on thyroid dysfunction prevalence across various studies, including both euthyroid and dysthyroid conditions. The current study with a sample size of 955 shows a distribution of 20.42% thyroid dysfunction, with the majority being euthyroid at 79.58%. Among those with thyroid dysfunction, 11.62% are subclinical hypothyroid, 3.56% are hypothyroid, 2.82% are subclinical hyperthyroid, and 0.83% are hyperthyroid. Deokar PG1 et al. report a similar distribution with 22.16% having thyroid dysfunction, 77.84% euthyroid, and a breakdown of 9.44% subclinical hypothyroid, 4.24% hypothyroid, and 2.5% hyperthyroid. Arindam Bose et al. observe a lower rate of thyroid dysfunction at 15.35%, with 84.65% euthyroid, and 6.13% subclinical hypothyroid, 7.45% hypothyroid, and 1.79% hyperthyroid. Rebecca Abraham et al. show 15.8% thyroid dysfunction, 84.2% euthyroid, with 9.5% subclinical hypothyroid, 11.5% hypothyroid, and 1.8% hyperthyroid. J. Canaris et al. report the lowest prevalence of thyroid dysfunction at 11.7%, with 88.3% euthyroid, and a breakdown of 9.0% subclinical hypothyroid, 0.4% hypothyroid, and 2.1% hyperthyroid. UG Unnikrishnan et al. provide a moderate prevalence of thyroid dysfunction at 21.47%, with 78.53% euthyroid, and 8.02% subclinical hypothyroid, 10.75% hypothyroid, and 1.8% hyperthyroid.

CONCLUSION

Our study indicates a high prevalence of thyroid disorders within the study population, with hypothyroidism being more prevalent than hyperthyroidism. The highest prevalence of thyroid disorders was observed in the 21-30 years age group. Additionally, mean TSH concentrations increased with age among both euthyroid and hypothyroid individuals, whether overt or subclinical. Notably, the highest TSH concentrations were recorded in males with hypothyroidism, while the lowest TSH levels were seen in males with hyperthyroidism. These findings underscore that a significant number of individuals may have thyroid dysfunction without being aware of it. The study highlights the importance of routine screening for thyroid function, as early detection and treatment are crucial for mitigating the adverse effects of thyroid disorders and improving overall health outcomes.

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