Chettinad Health City Medical Journal
Volume 14, Issue 1 - 2025, Pg. No. 4-11
Peer Reviewed & Open Access Journal

Research Article

A Comparative Study on the Prevalence of Thyroid Disorders among Residents of a Tribal and Rural Area of Salem District, Tamil Nadu

Vijayakarthikeyan M[1], Arul Prakash S[2], Prema Priya G[3], Angayarkanni P[4]

[1]Associate Professor, [2]Assistant Professor, Department of Community Medicine, Vinayaka Mission's Kirupananda Variyar Medical College and Hospitals, Salem, Affiliated to Vinayaka Missions Research Foundation, India
[3]Professor, Department of Obstetrics and Gynaecology, Vinayaka Mission's Kirupananda Variyar Medical College and Hospitals, Salem, Affiliated to Vinayaka Missions Research Foundation
[4]Postgraduate, Department of Community Medicine, Sri Devaraj Urs Medical College, Kolar, Karnataka, Affiliated to Sri Devaraj Academy of Higher Education and Research
DOI: https://doi.org/10.24321/2278.2044.202502

I N F O

Corresponding Author:
Vijayakarthikeyan M, Department of Community Medicine, Vinayaka Mission's Kirupananda Variyar Medical College and Hospitals, Salem, Affiliated to Vinayaka Missions Research Foundation
E-mail Id:
vijay.doc09@gmail.com
Orcid Id:
https://orcid.org/0000-0002-3580-4418
How to cite this article:
Vijayakarthikeyan M, Prakash S A, Priya G P, Angayarkanni P. A Comparative Study on the Prevalence of Thyroid Disorders among Residents of a Tribal and Rural Area of Salem District, Tamil Nadu. Chettinad Health City Med J. 2025;14(1):4-11.

Date of Submission: 2024-09-23
Date of Acceptance: 2025-02-20

A B S T R A C T

Introduction: An important contributing factor to thyroid dysfunction is an iodine shortage in the diet. Thyroid diseases remain common in this post-iodisation period even after 30 years of implementation of Universal Salt Iodisation (USI).
Objectives:

1. To determine the thyroid disorder prevalence in the Salem district's rural and tribal populations
2. To explore the risk factors for thyroid disorders in the Salem district's rural and indigenous populations

Materials and Methods: 400 inhabitants of the Salem district (200 from each of the rural and tribal areas) participated in the community-based analytical cross-sectional study. A pre-tested, semi-structured questionnaire was used to gather data. The amount of iodine in the salt sample was measured using a Rapid Diagnostic Kit (MBI Kit). Blood samples were collected in order to assess the thyroid condition. The study variables were described using both descriptive and analytical statistics.

Results: Nearly 33% in the tribal area and 24% in the rural area had any form of thyroid disorder. The most common was subclinical hypothyroidism (rural: 12.4% vs tribal: 18%). Findings of the bivariate logistic regression analysis revealed that the female sex (rural AOR: 2.15 vs tribal AOR: 3.71) and usage of inadequately iodised salt (rural AOR: 4.89 vs tribal AOR: 4.18) were significantly associated with thyroid disorders in both the population.

Conclusion: A multifaceted strategy including legislative, administrative, and educational initiatives must be put in place to curb this menace. It is imperative to implement effective communication techniques and provide education involving interested stakeholders at all levels.

Keywords: Iodine, Micronutrient, Goitre, Diet

Introduction

Diabetes mellitus is the most prevalent endocrine condition, followed by thyroid issues.[1] Dietary iodine deficiency is a significant contributing factor to thyroid dysfunction.[2] Commonly there are subclinical and overt variants of the two types of thyroid diseases, hyperthyroidism and hypothyroidism.[3]

Thirty years since universal salt iodisation in India, thyroid diseases remain common in this post-iodisation period.[4] About 42 million Indians suffer from one or more thyroid conditions. Thyroid problems are primarily influenced by age (older age > younger age) and sex (females > males).[5] In India, the incidence of hypothyroidism is higher than in developed countries.[6,7]

In addition to communicable diseases and malnourishment, the tribal population is currently burdened with psychiatric disorders and non-communicable diseases. Due to poverty, a lack of diversity in their diets, restricted access to healthcare, and customary eating habits, tribal and rural communities are particularly vulnerable to various forms of micronutrient deficiencies and malnutrition. This leads to impaired immunity, cognitive deficits, and increased disease burden, perpetuating the cycle of malnutrition. The expert group on tribal health has set a target to improve the health of the marginalised tribal community by 2027.[8,9]

The results of a nationwide survey showed that the prevalence of hyperthyroidism was 7.3% and hypothyroidism was 0.3%.[10] According to a study done in the Himalayan region, thyroid diseases of any type affected more than 33.2% of the tribal population.[11] About 9.4% of South Indians in the iodine-sufficient Cochin region (11.4% of women and 6.2% of men) had sub-clinical hypothyroidism according to another recent study.[12]

Information regarding thyroid function status is conspicuously lacking. Therefore, determining the factors influencing thyroid function status and thyroid problem prevalence among Tamil Nadu's tribal and rural communities is the aim of the current study.

Materials and Methods

Study Design

This cross-sectional comparative analytical study is community-based.

Study Setting

Periyaseeragapadi (rural area) and Melur (tribal area) from Salem district served as the locations for this study.

Study Population

Those who were at least eighteen years old and had lived in the study region for at least two years comprised the study population.

Study Period

The study was carried out for a period of 12 months from July 2023 to June 2024.

Sample Size and Sampling Technique

The sample size was determined using data from a prior study on the tribal population of Jammu and Kashmir in 2020 by Ganie et al.[11] The sample size calculation was based on the reference value of 33.2%, which was the prevalence of thyroid diseases. The formula $N = Zpq/[L^2]$ was used to get the sample size (where p = 33.2, q = 66.8, L = 5). The final sample size was rounded to 400 after adding a 20% non-response rate (200 in rural and tribal areas).

The sampling frame included 590 households in the rural area and 360 households in the tribal area (as per the recent local records). Systematic random sampling technique was used to select the study participants. Every third household in the rural area and an alternate household in the tribal area was chosen.

Exclusion Criteria

The study excluded those with severe disabling illnesses, pregnant women and those with psychiatric disorders.

Data Collection Process

After receiving the necessary consent from local authorities, data was gathered through in-person interviews utilising a pre-tested semi-structured questionnaire. It consisted of socio-demographic characteristics, details pertaining to the use of iodised salt, details pertaining to the knowledge regarding iodised salt, clinical symptoms and examination findings. After administering the questionnaire from each household, a spoonful of salt samples was collected and Rapid Diagnostic Kit (MBI Kit) was used to measure the level of iodine present in the salt sample. If the salt samples turn dark blue it indicates that the salt is adequately iodised (≥ 15 ppm). Then blood samples were collected under aseptic precautions for biochemical examination (Free T3, T4 and TSH).

Ethical Clearance and Informed Consent

Institutional Ethical Committee clearance of VMKVMCH was obtained (Ref ID: VMKVMC&H/IEC/23/001). Written consent was obtained from all participants prior to data gathering.

Statistical Analysis

MS Excel was used to enter the data, while SPSS Version 22 was used for analysis. Frequency and percentage were used to describe categorical variables. The mean and standard deviation were used to characterise continuous variables. For univariate analysis, the association was tested using the chi-square test, and a p value of less than 0.05 was deemed statistically significant. The enter method was used to do a multivariate binomial logistic regression analysis.

ISSN: 2278-2044
DOI: https://doi.org/10.24321/2278.2044.202502

Operational Definitions

- **Subclinical Hypothyroidism:** If blood TSH levels were elevated (> 6.5 µIU/mL) and serum T4 levels were normal, subclinical hypothyroidism (SCH) was identified.[11]
- **Subclinical Hyperthyroidism:** When serum T4 levels were normal and TSH was low (< 0.45 µIU/mL), subclinical hyperthyroidism was identified.[11]
- **Overt Hypothyroidism:** When T4 is low (< 4.5 µg/dL) and TSH is high, overt hypothyroidism is diagnosed.[11]
- **Overt Hyperthyroidism:** A low TSH level (< 0 1 µIU/mL) and a high T4 level (> 12 µg/dL) were used to identify overt hyperthyroidism.[11]

Results

Among 450 study samples, more than half (58.2%) belonged to 41–60 years of age and around 60% were females. Nearly 17% were illiterate and only 17.5% had education above high school. Due to the study's female preponderance, 28.7% of respondents were unemployed in terms of occupation, and nearly half of them came from lower socio-economic backgrounds (Table 1).

In our study, 76% of the participants from the rural area were euthyroid and 67% were euthyroid in the tribal population. The most common thyroid disorder in both populations was subclinical hypothyroidism (rural: 12.4% vs tribal: 18%) followed by overt hypothyroidism (rural: 6% vs tribal: 7.5%) as depicted in Figure 1.

Table 1.Socio Demographic Details of Study Participants

N = 450

Socio-Demographic Characteristic	Rural (225)	Tribal (225)	Total (450)
	n (%)	n (%)	n (%)
Age (in years)			
20–40	59 (26.2)	39 (17.5)	98 (21.8)
41–60	124 (55)	138 (61.3)	262 (58.2)
> 60	42 (18.8)	48 (21.2)	90 (20)
Sex			
Male	94 (41.9)	84 (37.2)	178 (40)
Female	131 (58.1)	141 (62.8)	272 (60)
Education			
Illiterate	34 (15)	42 (19)	76 (17)
Primary school/ middle school/ high school	135 (60)	161 (71)	296 (65.5)
> High school	56 (25)	23 (10)	79 (17.5)
Occupation			
Unemployed	70 (31.0)	59 (26)	128 (28.7)
Unskilled/ semi-skilled	115 (51.0)	153 (68)	268 (59.5)
≥ Skilled	40 (18.0)	13 (6)	53 (11.8)
Socio-economic status			
Upper	25 (11)	11 (5)	36 (8)
Middle	37 (16.3)	24 (10.8)	61 (13.6)
Upper-lower	87 (38.6)	70 (31)	157 (34.9)
Lower	76 (34)	120 (53.2)	196 (43.5)

ISSN: 2278-2044
DOI: https://doi.org/10.24321/2278.2044.202502

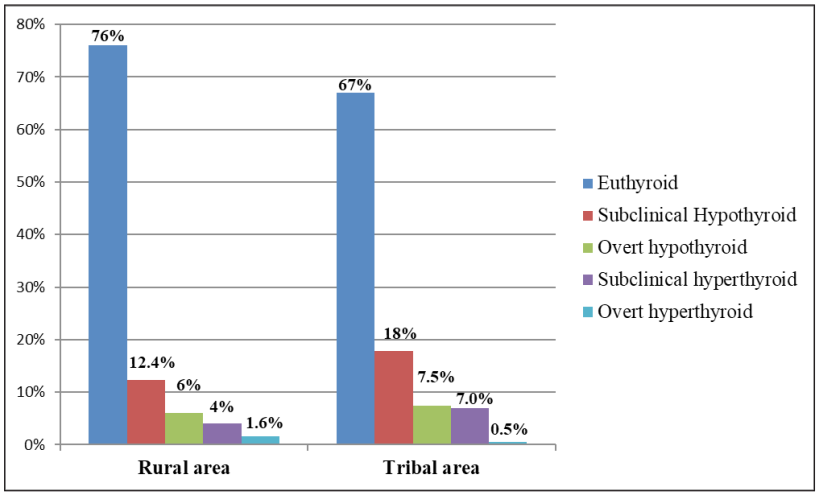

Figure 1. Prevalence of Thyroid Disorders among the Study Population (N = 450)

As per the Rapid Testing Kit findings, only 68% of the household salt samples were adequately iodised (≥ 15 ppm) in the tribal area, whereas it was 81.9% in the rural area. More than half (58.4%) of the respondents were using both rock salt and powdered salt. Almost 85.6% were using packed salt and only 13.6% looked at whether the salt was iodised while purchasing. Only 63.8% had adequate knowledge regarding iodised salt in this study (rural: 67.5% vs tribal: 60%). Nearly 10.7% of the respondents in our study had clinical goitre (Table 2).

Determinants of thyroid disorder in the rural population include female sex (p value = 0.0004), lower socio-economic status (p value = 0.003), usage of inadequately iodised salt (p value < 0.0001), and presence of clinical goitre (p value = 0.0002). On the other hand, in the tribal area, female sex (p value < 0.0001), lower socio-economic status (p value = 0.006), inadequate knowledge regarding iodised salt (p value = 0.001), usage of inadequately iodised salt (p value = 0.0002), presence of clinical goitre (p value < 0.0001) were significantly associated with thyroid disorders as per the univariate analysis (Table 3).

Findings of the bivariate logistic regression analysis using the enter method (Table 4) revealed that female sex usage of inadequately iodised salt was significantly associated with thyroid disorders in both populations. The presence of clinical goitre was significant statistically in the tribal area.

Table 2.Salt Usage Characteristics among the Study Population

N = 450

Salt Usage Characteristic	Rural Area (225)	Tribal Area (225)	Total (450)
	n (%)	n (%)	n (%)
Usage of adequately iodised salt at the household level			
Yes	184 (81.9)	153 (68)	337 (74.9)
No	41 (18.1)	72 (32)	113 (25.1)
Type of salt preferred			
Rock salt	36 (16)	63 (28.1)	100 (22.2)
Powdered salt	49 (21.6)	38 (17)	87 (19.4)
Both	140 (62.4)	123 (54.9)	263 (58.4)
Source of purchase of salt			
Weekly market/ ration shop	66 (29.5)	122 (54)	188 (41.8)
Supermarket	20 (8.8)	7 (3.1)	27 9 (6)
Nearby shop	139 (61.7)	96 (42.9)	235 (52.2)
Use packed salt			
Yes	205 (91.1)	180 (80)	385 (85.6)
No	20 (9.9)	45 (20)	65 (14.5)

ISSN: 2278-2044
DOI: https://doi.org/10.24321/2278.2044.202502

While purchasing salt you look for*			
Brand	52 (23)	25 (11)	77 (17.1)
Cost	152 (67.5)	178 (79.3)	230 (51.1)
Packaging	47 (21)	43 (19)	90 (20)
Iodised	36 (16)	25 (11)	61 (13.6)
Place of salt storage			
Dry area	18 (7.9)	20 (9.1)	38 (8.4)
Wet area	207 (92.1)	205 (90.9)	412 (91.6)
Salt storage equipment			
Polythene bag	16 (7.1)	38 (17)	54 (12)
Container with lid	180 (79.8)	138 (61.1)	318 (70.7)
Container without lid	29 (13.1)	49 (21.9)	78 (17.3)
Whether the salt storage area is exposed to sunlight			
Yes	52 (23)	40 (18)	92 (20.4)
No	173 (77)	185 (82)	358 (79.6)
Adequate knowledge of iodised salt			
Yes	152 (67.5)	135 (60)	287 (63.8)
No	73 (32.5)	90 (40)	163 (36.2)
Clinical goitre			
Yes	17 (8.3)	29 (13.1)	48 (10.7)
No	206 (91.7)	196 (86.9)	402 (89.3)

*Multiple responses allowed

Table 3.Univariate Analysis between Thyroid Disorders and Selected Variables

Variable	Rural Area				Tribal Area			
	Thyroid Disorder		p Value	Odds Ratio (95% CI)	Thyroid Disorder		p Value	Odds Ratio (95% CI)
	Yes (54)	No (171)			Yes (74)	No (151)		
Age of the study participants (years)								
< 45	24	98	0.099	0.59 (0.32–1.10)	36	87	0.205	0.69 (0.39–1.2)
≥ 45	30	73	Reference		38	64	Reference	
Sex								
Female	43	88	0.0004**	3.68 (1.78–7.62)	60	81	< 0.0001*	3.70 (1.90–7.19)
Male	11	83	Reference		14	70	Reference	
Education								
Upto high school	40	129	0.839	0.93 (0.46–1.87)	64	139	0.148	0.51 (0.21–1.26)
> High school	14	42	Reference		10	12	Reference	

ISSN: 2278-2044
DOI: https://doi.org/10.24321/2278.2044.202502

Occupation								
Up to semi-skilled	38	147	0.052	0.48 (0.22–1.00)	69	143	0.660	0.77 (0.24–2.44)
≥ Skilled	14	26	Reference		5	8	Reference	
Socio-economic status								
Lower class	48	115	0.003*	3.92 (1.58–9.73)	70	120	0.006*	2.52 (1.53–13.34)
Upper/ middle class	6	56	Reference		4	31	Reference	
Adequate knowledge of iodised salt								
No	15	56	0.493	0.78 (0.40–1.55)	41	49	0.001*	2.58 (1.46–5.73)
Yes	39	115	Reference		33	102	Reference	
Usage of adequately iodised salt								
No	28	14	< 0.0001*	12.07 (5.62–25.92)	36	36	0.0002*	3.02 (1.67–5.45)
Yes	26	157	Reference		38	115	Reference	
Presence of clinical goitre								
Yes	12	7	0.0002*	6.69 (2.48–28.04)	21	8	< 0.0001*	11.37 (4.63–27.92)
No	42	164	Reference		33	143	Reference	

*p value < 0.05 is statistically significant.

Discussion

Our study's mean age was 36.29 ± 13.68 years, and 60% of the participants were female (58.1% in rural areas and 62.8% in tribal areas). Similar to our findings, research by Wanjari et al., Yadav et al., and Tayal et al. also showed a plurality of females.[13–15] Mean age of the participants reported in research conducted on thyroid disorders by Ganie et al, Chatterjee et al. and Akinepalli et al. were comparable to our study findings.[11,16,17]

Nearly 33% of the tribal population and 24% from the rural background had any form of thyroid. The most common form of thyroid disorder was subclinical hypothyroidism (rural: 12.4%, tribal: 18%). Similar findings among the tribal population were seen in studies by Ganie et al. 33.2% had thyroid disorders with subclinical hypothyroidism accounting for 24.7%.[11] On the other hand, the studies by Valiyaparambil et al., Manjula et al. and Chatterjee et al. the prevalence of thyroid disorders were 3.2%, 7.32% and 14.8%, respectively.[18,6,16] Among the rural population, in Menon et al.'s study, 19.6% had any form of thyroid disorder and 9.4% had subclinical hypothyroidism.[12] Studies by Akinepalli et al., Ozair et al., Yadav et al., Chakrabarti et al. and Tayal et al. reported a thyroid disorder prevalence of 30.2%, 19.9% 18.8%, 17% and 15%.[17,19,14,20,15]

Contrary to our study, thyroid disorder prevalence was seen to be 50.4%, 66%, and 79.4% respectively in studies by Wanjari et al., Bansal et al. and Skaria et al.[13,21,22] According to research by Marwaha et al., Velayudham et al., and Arakeri et al., the primary thyroid condition was subclinical hypothyroidism.[7,23,24]

Following multivariate analysis, thyroid disorders were substantially correlated with the female sex, the use of inadequately iodised salt, and the presence of clinical goitre in both study populations. Studies by Yadav et al., Tayal et al., Akinepalli et al., and Baruah et al. found a similarly strong correlation with female sex due to interlink between various factors like hormonal influence (effect of oestrogen and progesterone), autoimmune predisposition, genetic factors pregnancy-related effects and higher diagnosis rates.[14,15,17,25] In Wanjari et al.'s study female sex, age, educational status

ISSN: 2278-2044
DOI: https://doi.org/10.24321/2278.2044.202502

and family history were significantly associated with thyroid disorders.[13] Female sex, dyslipidaemia, comorbidities and glycaemic control were found to be significantly associated in the study conducted by Ozair et al.[19]

Despite every effort to determine the answer to the research question, the study has several limitations. First, a limited number of study participants due to logistic constraints. Second, additional variables such as smoking, nutritional deficiencies and goitrogen intake that have a separate impact on thyroid function and autoimmunity were not evaluated. Third, because the study is cross-sectional, it is unable to estimate risk or causal associations. Therefore, this constraint can be overcome in a future analytical investigation of the study population.

Conclusion

Prevalence of thyroid disorders was 33% and 24% respectively among tribal and rural populations probably due to iodine deficiency. To address this issue, a multifaceted strategy including legislative, administrative, and educational initiatives must be put in place. To raise awareness of iodine nutrition and its effects on health, it is imperative to implement effective communication techniques and provide education to the needy population, involving interested stakeholders at all levels. Concerned authorities should visit stores and markets to frequently check the amounts of iodised salt using quick kits, and they should take the necessary corrective action afterwards.

Conflict of Interest: None

Source of Funding: This project was funded by Vinayaka Missions Research Foundation (VMRF) Deemed to be University as an Institutional Seed Money project of Vinayaka Mission's Kirupananda Variyar Medical College and Hospitals, Salem for October 2022 with a sanctioned fund of INR 2,00,000 (Ref No: VMRF/Research/SeedMoney/2022-23/VMKVMC-3).

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process: None

References

1. Institute of Medicine (US) Committee on Medicare Coverage of Routine Thyroid Screening; Stone MB, Wallace RB. Medicare coverage of routine screening for thyroid dysfunction. Washington, DC: National Academies Press; 2003. [PubMed] [Google Scholar]
2. Kumar KV, Patnaik SK. Incidence of endocrine disorders in Indian adult male population. Indian J Endocrinol Metab. 2017 Nov-Dec;21(6):809-11. [PubMed] [Google Scholar]
3. Islam MI, Ali MZ, Islam MS, Solayman M, Hoque S. Hypothyroidism-a new view on an old disease. KYAMC J. 2016;7(1):707-13. [Google Scholar]
4. Pandav CS, Yadav K, Srivastava R, Pandav R, Karmarkar MG. Iodine deficiency disorders (IDD) control in India. Indian J Med Res. 2013;138(3):418-33. [PubMed] [Google Scholar]
5. Bianco AC, Anderson G, Forrest D, Galton VA, Gereben B, Kim BW, Kopp PA, Liao XH, Obregon MJ, Peeters RP, Refetoff S, Sharlin DS, Simonides WS, Weiss RE, Williams GR; American Thyroid Association Task Force on Approaches and Strategies to Investigate Thyroid Hormone Economy and Action. American Thyroid Association guide to investigating thyroid hormone economy and action in rodent and cell models: report of the American Thyroid Association Task Force on approaches and strategies to investigate thyroid hormone economy and action. Thyroid. 2014 Jan;24(1):88-168. [PubMed] [Google Scholar]
6. Manjula KS, Reena R, Jaswanth S, Usha SM. Thyroid function and anti-TPO antibody status among tribal perimenopausal women near Bengaluru, Karnataka, India. J Clin Diagn Res. 2020 Oct 1;14(10):28. [Google Scholar]
7. Marwaha RK, Tandon N, Ganie MA, Kanwar R, Sastry A, Garg MK, Bhadra K, Singh S. Status of thyroid function in Indian adults: two decades after universal salt iodization. J Assoc Physicians India. 2012;60:32-6. [Google Scholar]
8. Kumar MM, Pathak VK, Manisha R. Tribal population in India: a public health challenge and road to future. J Family Med Prim Care. 2020;9(2):508-12. [PubMed] [Google Scholar]
9. Roy S, Hegde HV, Bhattacharya D, Upadhya V, Kholkute SD. Tribes in Karnataka: status of health research. Indian J Med Res. 2015;141(5):673-87. [PubMed] [Google Scholar]
10. Unnikrishnan AG, Kalra S, Sahay RK, Bantwal G, John M, Tewari N. Prevalence of hypothyroidism in adults: an epidemiological study in eight cities of India. Indian J Endocrinol Metab. 2013;17(4):647-52. [PubMed] [Google Scholar]
11. Ganie MA, Charoo BA, Sahar T, Bhat MH, Ali SA, Niyaz M, Sidana S, Yaseen A. Thyroid function, urinary iodine, and thyroid antibody status among the tribal population of Kashmir valley: data from endemic zone of a sub-Himalayan region. Front Public Health. 2020;8:555840. [PubMed] [Google Scholar]
12. Menon VU, Sundaram KR, Unnikrishnan AG, Jayakumar RV, Nair V, Kumar H. High prevalence of undetected thyroid disorders in an iodine sufficient adult south Indian population. J Indian Med Assoc. 2009;107(2):72-7. [PubMed] [Google Scholar]
13. Wanjari M, Patil M, Late S, Umate R. Prevalence of thyroid disorder among young adults in the rural areas of Wardha district: a cross-sectional study. J Family Med

Prim Care. 2022; 11(12):7700-4. [PubMed] [Google Scholar]
14. Yadav A, Yadav GA, Narsingrao KK, Kumar LG, Yadav GS. Prevalence of thyroid disorders among patients with diabetes in rural South India. Diabetes Metab Syndr. 2021; 15(3):885-9. [PubMed] [Google Scholar]
15. Tayal D, Goswami B, Gupta N, Chawla R, Gupta VK, Singh B, Chawla A. Prevalence of thyroid disorders in patients visiting a tertiary care center in New Delhi: a three-year study. Asian J Med Sci. 2012;3(4):15-23. [Google Scholar]
16. Chatterjee S, Banerjee S, Ray T, Bhattacharyya SK. Relationship of thyroid hormone status and serum fluoride level among the tribal peoples–a cross-sectional descriptive study. J Med Sci Clin Res. 2016; 4(6):11143-7.
17. Akinepalli P, Badam A, Vithpala P, Bandaru AK. Prevalence of thyroid disorders in and around Nalgonda District, Telangana, India: a cross-sectional study. Natl J Lab Med. 2023;12(3):20-4. [Google Scholar]
18. Valiyaparambil PP, Menon UV, Lakshmanan V, Vasudevan S, Kumari A, Kumar H. Iodine and thyroid status in a tribal village in Wayanad, Kerala in the post iodization era–observations and implications. Natl J Community Med. 2013 Mar 31;4(1):86-90. [Google Scholar]
19. Ozair M, Noor S, Raghav A, Siddiqi SS, Chugtai AM, Ahmad J. Prevalence of thyroid disorders in North Indian type 2 diabetic subjects: a cross sectional study. Diabetes Metab Syndr. 2018 May; 12(3):301-4. [PubMed] [Google Scholar]
20. Chakrabarti P, Chatterjee S, Mondal K, Banerjee S, Sarkar P. Spectrum of thyroid disorders in Bankura District, West Bengal, India: a cross-sectional observational study. IOSR J Dent Med Sci. 2016;15(7):41-4. [Google Scholar]
21. Bansal A, Kaushik A, Sarathe H. Effect of thyroid on lipid profile and renal function: an observational study from tertiary care centre of tribal region of Bastar. Ann Med Health Sci Res. 2014;4(Suppl 2):140-3. [PubMed] [Google Scholar]
22. Skaria LK, Sarkar PD, Agnihotram G, Thakur AS, Pamidamarri G. Thyroid dysfunctions in tribal women of the Bastar region of Chattisgharh, India. Thyroid Sci. 2011;6(6):1-5. [Google Scholar]
23. Velayutham K, Selvan SS, Unnikrishnan AG. Prevalence of thyroid dysfunction among young females in a South Indian population. Indian J Endocrinol Metab. 2015; 19(6):781-4. [PubMed] [Google Scholar]
24. Arakeri S, Vasu G. Correlation of anti-thyroid peroxidase antibody levels with status of thyroid function among the tribal population residing in hilly area. J Diagn Pathol Oncol. 2016; 1(2):21-3. [Google Scholar]
25. Baruah MP, Duttachoudhury S, Saikia M, Saikia UK, Bhuyan SB, Bhowmick A, Barman AK, Bora AR, Barkakoti M. Guwahati thyroid epidemiology study: high prevalence of primary hypothyroidism among the adult population of Guwahati city. Thyroid Res Pract. 2019; 16(1):12-9. [Google Scholar]

ISSN: 2278-2044
DOI: https://doi.org/10.24321/2278.2044.202502