Section: Medicine

Original Research Article

STUDY OF THYROID PROFILE IN PATIENTS WITH HIV AND ITS CORRELATION WITH CD4 COUNT

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Received : 16/04/2026
Received in revised form : 07/06/2026
Accepted : 22/06/2026

Keywords:
HIV, Thyroid dysfunction, Subclinical hypothyroidism, CD4 count, Antiretroviral therapy.

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DOI: 10.47009/jamp.2026.8.4.187

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2026; 8 (4); 1114-1124

ABSTRACT

Background: Thyroid dysfunction is increasingly recognized among people living with HIV particularly in the era of antiretroviral therapy (ART). Immune dysregulation, opportunistic infections and drug related effects may contribute to altered thyroid function. The objective is to evaluate thyroid function in HIV-infected patients and determine its correlation with CD4 count. **Materials and Methods:** This hospital-based cross-sectional study was conducted at Regional Institute of Medical Sciences, Imphal, Manipur, India, from May, 2023 to December, 2024. A total of 145 HIV-positive patients aged ≥18 years were enrolled. Serum free T3 (FT3), free T4 (FT4), thyroid-stimulating hormone (TSH), and CD4 count were measured. Statistical analysis was performed using SPSS version 21. Pearson correlation was used to determine associations between thyroid parameters and CD4 count. A p-value <0.05 was considered statistically significant. **Result:** The mean age was 41.7 ± 12.3 years, with male predominance (64.1%). Thyroid dysfunction was observed in 24.8% of patients. Subclinical hypothyroidism was the most common abnormality (15.9%), followed by sick euthyroid syndrome (5.5%), overt hypothyroidism (2.8%), and hyperthyroidism (0.7%). A significant negative correlation was found between TSH and CD4 count (r = −0.833, p =0.01), while FT3 (r = 0.753, p =0.01) and FT4 (r = 0.534, p =0.01) showed significant positive correlations with CD4 count. **Conclusion:** Thyroid dysfunction, particularly subclinical hypothyroidism, is common among HIV patients. Significant correlations between thyroid hormones and CD4 count suggest that immune status influences thyroid regulation. Routine thyroid screening may aid early detection and management.

INTRODUCTION

HIV infection is a life-threatening disease and a major public health problem in India and worldwide. AIDS was first identified in 1981 in the USA among homosexual men.[1] It has emerged as an unprecedented pandemic cutting across boundaries.[2] Based on the available data, the World Health Organization (WHO) had estimated 38.0 million people living with HIV at the end of 2019. Based on HIV Sentinel Surveillance Report 2019, in India, there were an estimated 23.49 lakh (17.98–30.98 lakh) people living with HIV/AID (PLWHA) in 2019, with an adult (15–49 years) HIV prevalence of 0.22% (0.17%–0.29%).[3] Manipur, a north-eastern state of India, with hardly 0.2% of country's population is contributing nearly 8% of India's total HIV-positive cases. HIV infection rate among the intravenous drug users had increased tremendously from 2% to 3% in 1989 to >50% in 1991 and 64% in 2000.[4]

HIV infection causes a decline in CD4 cell count and weakens the immune system, making the body vulnerable to opportunistic infections.[5] A significant number of PLHIV has increased longevity due to treatment with highly active antiretroviral therapy (HAART).[6] Endocrine changes in the form of thyroid, adrenal, gonadal, bone, and metabolic

dysfunction, have all been reported in both early and late stages of HIV infection.[7] There may be primary endocrine dysfunction as a direct effect of HIV as well as secondary endocrine dysfunction due to indirect effects of cytokines, opportunistic infections and rarely infiltration by a neoplasm. This may be manifested as subtle biochemical and hormonal changes to overt glandular failure. These endocrinopathies can have significant clinical impact, affecting growth and development, preservation of muscle mass, sexual function, fat distribution and quality of life in HIV-infected patients.[8] Thus, their dysfunction of endocrine glands namely, thyroid, adrenals, pituitary, pancreas and gonads results in poor quality of life.[9] Many studies reveal endocrine complications like hypertriglyceridemia, lipodystrophy and lipoatrophy, diabetes mellitus, gonadal dysfunction, and osteoporosis during treatment with ART resembling metabolic syndrome.[10-12] Wide accessibility of highly active antiretroviral therapy (HAART) gave rise to increase life expectancy and hence high incidence of endocrinopathies occurred in HIV-infected patients in the last two decades.[13]

The paucity of data makes it difficult to make general recommendation about hormone replacement therapy in all HIV-infected patient with diminished circulating levels of a particular hormone to reduce morbidity and mortality in HIV-infected patients. Thyroid gland can be infected by HIV virus. Studies reveal that the incidence of dysfunction in thyroid gland is 36%-37% in patients with HIV, a higher level than in the general population and 1-2% have overt thyroid illness.[14]

Thyroid gland dysfunction impairs the quality of life in HIV infected patients. Hypothyroidism results in generalized weakness, intolerance to cold, hoarseness of voice, reduced bowel movements, paresthesia, and pseudomyotonic reflexes. Hyperthyroidism causes irritability, heat intolerance, sweating, palpitations, and loss of weight with increased appetite, increased bowel movements, and tremor. Infection of thyroid gland by HIV changes the course of the disease. As the disease progresses sick Euthyroid syndrome may develop. The most common thyroid abnormalities are subclinical hypothyroidism which is an independent risk factor for atherosclerosis and myocardial ischemia.[15]

The ART drugs used for HIV infection also cause abnormalities in thyroid function.[16] Stavudine drug affects the thyroid hormone production and metabolism resulting in decrease of free Thyroxine (ft4) level.[17] Other than ART, treatment with rifampicin or immunomodulatory drugs have been shown to alter thyroid hormone with clinical effects in HIV patients.[18] Hepatitis B (HBV) and/ hepatitis C virus (HCV) confection also increases the risk of thyroid dysfunction.[19] HCV co-infection is a risk factor for hypothyroidism in a study conducted by beltran et al.[20] Free T3 (FT3) and free t4 (FT4) levels were correlated to disease progression. Protease and integrase inhibitors has no significant influence on thyroid function. Graves' disease can also occur in the course of HIV infection as a part of immune reconstitution.[21]

However there are no clear guidelines for thyroid screening of asymptomatic HIV patients. Non thyroidal illness must be considered as one of the differential diagnosis in altered thyroid function test in patients who have advanced retroviral disease. Also Dolutegravir based HAART (TLD) was started from 2020. There is paucity of information regarding thyroid profile in patients on TLD. Hence this study is being directed to study about the spectrum of thyroid abnormalities in HIV infected persons with varying range of CD4 count.

Objective

1. To assess thyroid function in patients with HIV infection.
2. To correlate thyroid function with CD4 count.

MATERIALS AND METHODS

Study design: Cross -sectional study

Study setting: The study was conducted in Regional Institute of Medical Sciences, Imphal, Manipur, India, in the Department of Medicine in collaboration with the ART CENTRE (Centre of Excellence), RIMS, Imphal.

Study population: HIV- positive patients with or without Antiretroviral therapy (ART) admitted in Medicine ward, attending Medicine OPD or CoE ART Centre, Regional Institute of Medical Sciences, Imphal.

Inclusion Criteria

- Age ≥ 18 years

Exclusion Criteria

- Patients with a known case of thyroid disorder.
- Patients with a history of thyroid surgery.
- Patients who are pregnant.
- Those who refused to participate.

Study duration: The study was conducted from May, 2023 to December, 2024.

Sample size and Sampling: All the HIV- positive patients with or without Antiretroviral therapy (ART) admitted in the Medicine ward, attending Medicine OPD or CoE ART Centre, Regional Institute of Medical Sciences during the study period were eligible for participation in the study.

The sample size for the study was based on a study by Sharma N et al28, who reported the prevalence of thyroid dysfunction to be 23.15% among HIV patients.

The sample size was calculated according to the formula:

Sample size, $N = 1.96^2PQ/L^2$

Taking prevalence as 23.15%. (Sharma N et al28.)

Precision (L) = 7%

Alpha = 1.96

Therefore, N = 145

Based on the formula above, using the mentioned values, the sample size [required] was 145.

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Patients fulfilling the eligibility criteria were recruited by convenient sampling method until the required sample size was reached.

Data source:

a) Primary data were collected using a structured proforma.
b) Secondary data were collected from records provided by the Department of Medicine and CoE ART Centre RIMS, Manipur.

Study variables: Socio-demographic characteristics like age, sex, BMI, ART drug history, duration of ART, types of ART, comorbidities, other drug history, etc., were the independent variables. Outcome variables were the serum thyroid profile, free T3, free T4, TSH and CD4 count.

Study instruments:

i. Record books from the Department of Medicine and CoE ART Centre, RIMS, Manipur.
ii. Pretested predesigned proforma.
iii. Roche Cobas E411 Analyzer for Immunoassay Tests (Disk System) for serum Thyroid profile (free T3, free T4 and TSH).
iv. Automated analyser, Fluorescence-activated Cell Sorter (FACS) for CD4 count as per NACO guidelines.

Data collection: All the HIV patients above 18 years who visited the Medicine OPD or CoE ART Centre, RIMS, IMPHAL during the study period were eligible for the study. The patients were selected by convenience method by the investigator on his duty hours and those who fulfilled the inclusion and exclusion criteria were enrolled in the study. Informed consents were taken from all the participants. The participants were reassured of their anonymity during data collection and the importance of an honest answer was stressed. A detailed structured proforma was used to collect the information. The proforma includes detailed clinical history. The proforma also contains findings of a complete general physical & clinical examination. Further the patients were assessed for Thyroid profile (free T3, free T4 and TSH) and CD4 count at the time of examination. Collected data were checked for completeness and consistency before discharge of the patient, and necessary rectifications were made.

Operational definition:

1. The normal reference ranges of thyroid profile as per Roche Cobas E411 Analyzer for Immunoassay Tests are as follows:48

- TSH: 0.27 to 4.2 mIU/L
- Total T3: 0.8- 2.0 ng/mL
- Total T4: 5.1-14.1 µg/dL
- Free T3: 1.9-5.1 pg/mL
- Free T4: 0.9- 1.7 ng/dL
- Anti-TPO < 35 IU/mL
- Anti- TG < 25 IU/mL

2. Overt Hypothyroidism[49] is defined as evident hypothyroidism characterized by an increased TSH >10mIU and a decreased T4 level.
3. Subclinical Hypothyroidism[49] is defined as an elevated serum thyroid-stimulating hormone level (reference range: 0.27 to 4.20 mIU/L) in the presence of normal serum FT4.
4. Sick Euthyroid Syndrome[49]: decrease in total and free T3 levels (low T3 syndrome) with normal levels of T4 and TSH.
5. Hyperthyroidism[49]: excess total T3, Total T4 above reference range.
6. Subclinical Hyperthyroidism[49]: In this condition, the patient is asymptomatic, with normal serum levels of T3 and FT4 but with low serum TSH (below 0.5 mLU/L).
7. Subacute Thyroiditis: Increased T3 T4 decreased TSH with increased ESR.
8. Human immunodeficiency virus infection: Diagnosed as per NACO guidelines, including both HIV-1 and HIV-2 infection.

Statistical analysis: The collected data were entered and analysed in SPSS (IBM) version 21. Summarizations of data for age, sex, religion, comorbidities, route of infection, etc., were carried out by using descriptive statistics such as mean, standard deviation and percentages. Pearson correlation was done to find association between thyroid profile and CD4 count. Chi square test or fisher exact test was used to compare thyroid profile with intake of ART, gender, etc. A P-value of less than 0.05 was taken as statistically significant.

Ethical issues: Ethical approval was obtained from the Research Ethics Board, RIMS, Imphal, before the beginning of the study. The "Written informed consent" in the format annexed (Appendix-III), was taken from the participants and their participation was completely voluntary and right to refuse to participate in the study was respected. A unique code number was given, and no names were taken to maintain confidentiality. All the information collected for the study was utilized only for the purpose and not disclosed to anyone outside the research team. The reference no. A/206/REB-Comm(SP)/RIMS/2015/752/94/2020.

RESULTS

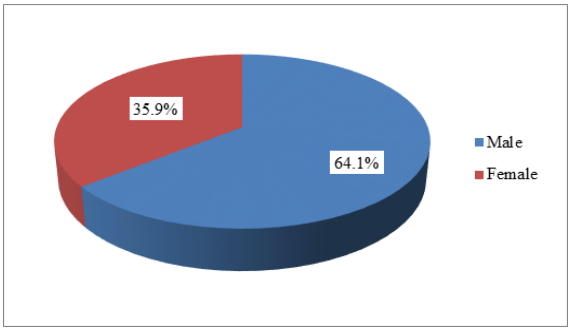

Figure 1: Distribution of patients by gender (N=145)

In total 145 HIV- patients were enrolled in the study during the study period from May 2023 to December 2024. Out of which 93 (64.1%) were males and remaining 52 (35.9%) were females.

Male were predominant in the study population with 64.1%.

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Table 1: Distribution of the patients by mean age among the gender (N=70)

Sl.no.	Gender	Mean age in years	Standard deviation
1.	Male	42.8	12.7
2.	Female	39.7	11.4
3.	Total	41.7	12.3

The mean age of male patients (42.8 ± 12.7 years) was slightly higher than female patients (39.7 ± 11.4 years). The overall mean age was 41.7± 12.3 years.

Table 2: Distribution of the patients by age in years (N=145)

Sl.no.	Age group	No. of participants	Percentage
1.	18-30 years	32	22.1
2.	31-40 years	41	28.3
3.	41-50 years	38	26.2
4.	51-60 years	18	12.4
5.	Above 60 years	16	11.0
6.	Total	145	100

The age group 31 to 40 years has the maximum no. of patients (28.3%). A minimum no. of patients was seen in the group above 60 years (11.0%).

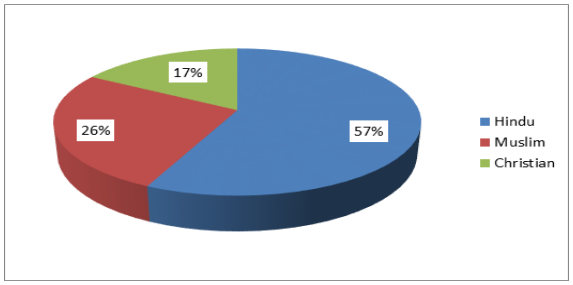

Figure 2: Distribution of the patients by religion (N=145)

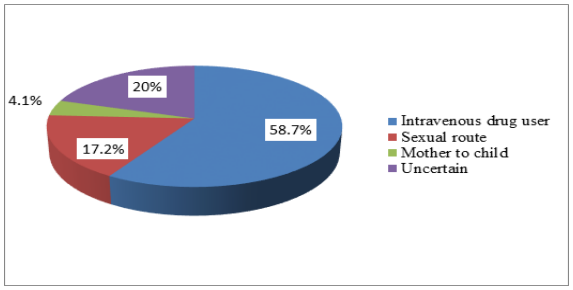

Figure 3: Distribution of the patients by route of infection (N=145)

Eighty-five patients were intravenous drug user which is 58.7% of the total population and was the most common route of infection. Twenty-nine patients were unsure of their route of infection and 25 (17.2%) patients had infection via sexual route. Six patients had their infection through their mother.

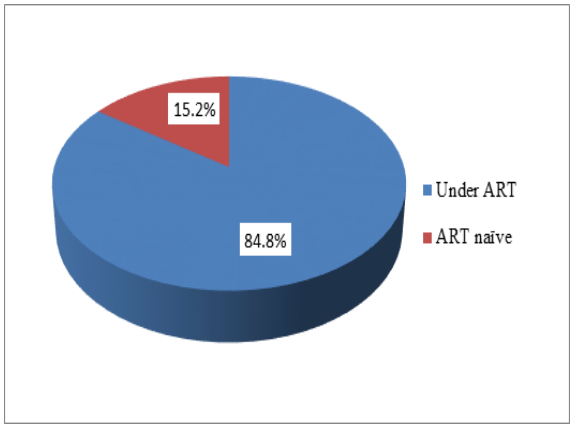

Figure 4: Distribution of the patients by ART status (N=145)

Only 22 patients (15.2%) were newly diagnosed and not taking ART. 123 patients (84.8%) were taking ART from the centre.

Table 4: The Mean duration of ART of the patients (N=123)

Sl.no.	Characteristics	Mean	SD
1.	Duration of ART in months	24.3	16.46

The mean duration of ART was 24.3 ± 16.46 months.

Table 5. Mean thyroid profile and CD4 count of the patients (N=145)

Sl.no.	Thyroid profile	Mean	SD
1.	TSH	2.93	1.63
2.	Free T3	3.04	0.96
3.	Free T4	1.26	0.23
4.	CD4 count	324.85	125.64

The mean serum TSH, FT3, FT4 and CD4 count was 2.93 ± 1.63, 3.04 ± 0.96, 1.26 ± 0.23 and 324.85 ± 125.64, respectively.

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Table 6: Distribution of the patients by Thyroid status (N=145)

Sl.no.	Thyroid status	No. of patients	Percentages (%)
1.	Euthyroid	109	75.2
2.	Subclinical Hypothyroidism	23	15.9
3.	Sick Euthyroid syndrome	8	5.5
4.	Hypothyroidism	4	2.8
5.	Hyperthyroidism	1	0.7

Normal thyroid function was seen in 75.2% of the patients and dysfunction was seen in remaining 24.8% of the patients. The most common thyroid dysfunction was Subclinical Hypothyroidism (15.9%), followed by Sick Euthyroid syndrome (5.5%).
About a quarter (24.8%) of the patients were having thyroid dysfunction in this study.

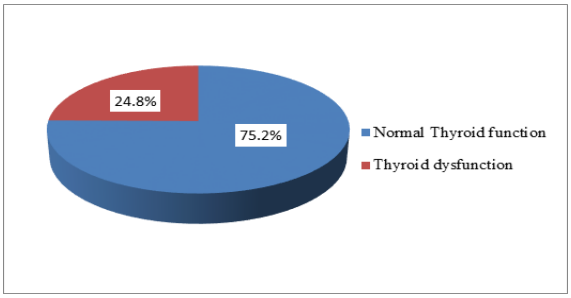

Figure 4: Distribution of the patients by Abnormal Thyroid function (N=145).

Table 7: Association between gender and thyroid dysfunction (N=145)

Gender	No. of patients, n(%)		P value
	Normal Thyroid	Thyroid dysfunction	
Male	74 (79.6)	19 (20.4)	0.076
Female	35 (67.3)	17 (32.7)	

Thyroid dysfunction was seen in 32.7% of the females in comparison to 20.4% of the males. Even though females are more commonly associated with thyroid dysfunction in contrast to the males, the findings were not statistically significant.

Table 8: Association between intake of ART and thyroid dysfunction (N=145)

ART	No. of patients, n (%)		P value
	Normal Thyroid	Thyroid dysfunction	
Yes	95 (77.3)	28 (22.7)	0.076
No	14 (63.6)	8 (36.4)	

Thyroid dysfunction was seen more among the patients not taking ART (36.4%) in comparison to those patients who were under ART (22.7%), but the difference was not significant.

Table 9: Association between intake of ART and Subclinical hypothyroidism (N=132)

ART	No. of patients, n(%)		P value
	Normal Thyroid	Subclinical hypothyroidism	
Yes	95 (87.2)	22 (95.7)	0.218
No	14 (12.8)	1 (4.3)	

Maximum of the patient with Subclinical hypothyroidism took ART (95.7%) than those with normal thyroid function (87.2%). The difference was not significant.

Table 10: Correlation between Serum TSH and CD4 count (N=145)

Characteristics		CD4_count	Serum_TSH
CD4_count	Pearson Correlation	1	-.833**
	Sig. (2-tailed)		.000
	N	145	145
Serum_TSH	Pearson Correlation	-.833**	1
	Sig. (2-tailed)	.000	
	N	145	145
**. Correlation is significant at the 0.01 level (2-tailed).			

A Negative correlation was seen between Serum TSH and CD4 count with pearson correlation of -0.833. The correlation was statistically significant at p value 0.01.

Table 11: Correlation between Serum Free T3 and CD4 count (N=145)

Characteristics		CD4_count	Serum_free T3
CD4 count	Pearson Correlation	1	0.753**
	Sig. (2-tailed)		.000

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	N	145	145
Serum free T3	Pearson Correlation	0.753**	1
	Sig. (2-tailed)	.000	
	N	145	145
**. Correlation is significant at the 0.01 level (2-tailed).			

A Positive correlation was seen between Serum free T3 and CD4 count with pearson correlation of 0.753. The correlation was statistically significant at p value 0.01.

Table 12: Correlation between Serum Free T4 and CD4 count (N=145)

Characteristics		CD4_count	Serum_free T4
CD4 count	Pearson Correlation	1	0.534**
	Sig. (2-tailed)		.000
	N	145	145
Serum free T4	Pearson Correlation	0.534**	1
	Sig. (2-tailed)	.000	
	N	145	145
**. Correlation is significant at the 0.01 level (2-tailed).			

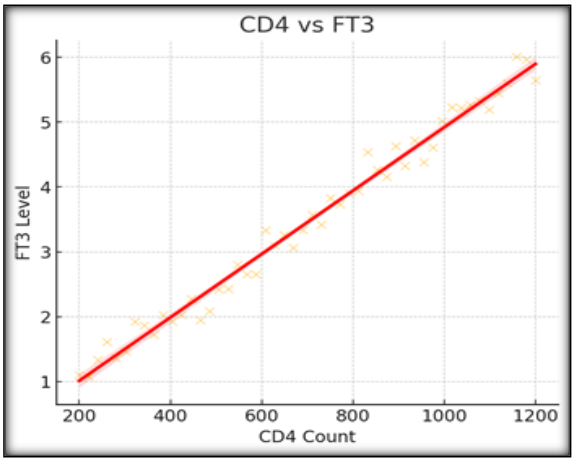
A Positive correlation was seen between Serum free T4 and CD4 count with pearson correlation of 0.534. The correlation was statistically significant at p value 0.01.

Table 13: represents the correlation between the CD4 count and thyroid function levels among the study population by using Pearson correlation coefficient test.

Parameters		FT3	FT4	TSH	CD4
FT3	PEARSON CORRELATION	1	.626**	-.547**	.753**
	SIG	-	.000	.000	.000
FT4	PEARSON CORRELATION	.626**	1	-.471**	.534**
	SIG	.000	-	.000	.000
TSH	PEARSON CORRELATION	-.547**	-.471**	1	-.833**
	SIG	.000	.000	-	.000
CD4	PEARSON CORRELATION	.753**	.534**	-.833**	1
	SIG	.000	.000	.000	-

**. Correlation is significant at the 0.01 level (2-tailed).

The correlation analysis between CD4 count and thyroid function levels reveals significant relationships. A strong positive correlation between CD4 and FT3 (r = 0.753, p = 0.000) and a moderate positive correlation with FT4 (r = 0.534, p = 0.000) indicate that as CD4 levels increase, thyroid hormone levels also tend to rise. Conversely, a strong negative correlation between CD4 and TSH (r = -0.833, p = 0.000) suggests that higher CD4 counts are associated with lower TSH levels. Additionally, thyroid hormones show interrelationships, with FT3 and FT4 positively correlated (r = 0.626, p = 0.000), while both FT3 (r = -0.547, p = 0.000) and FT4 (r = -0.471, p = 0.000) are negatively correlated with TSH. These findings indicate a significant link between immune function (CD4 count) and thyroid regulation, highlighting potential thyroid dysfunction in individuals with altered immune status.



Graph 1 CD4 Vs FT3

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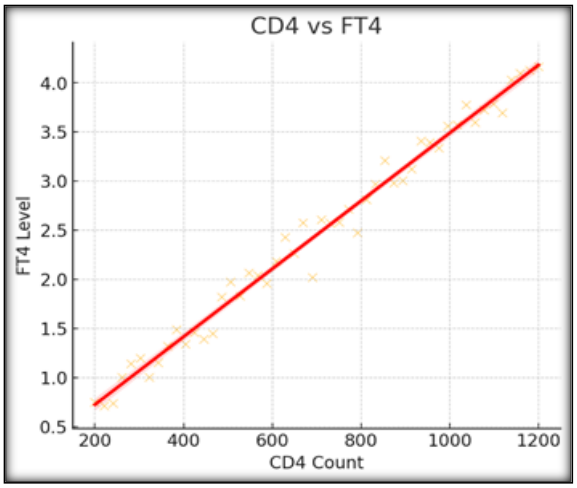
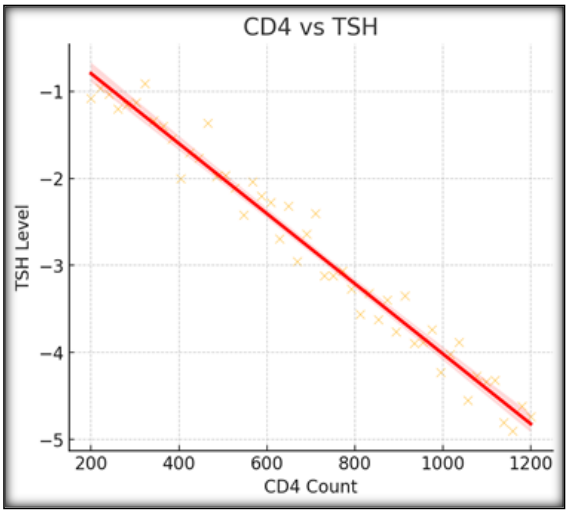


Graph 2 CD4 Vs FT4



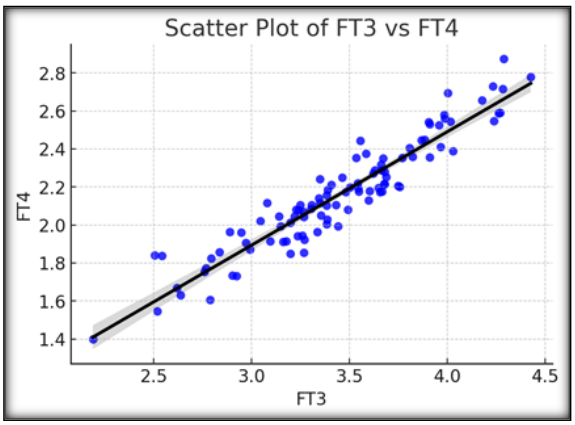
Graph 3 CD4 Vs TSH

Table 14: represents the correlation between the thyroid function levels among the study population by using pearson correlation coefficient test

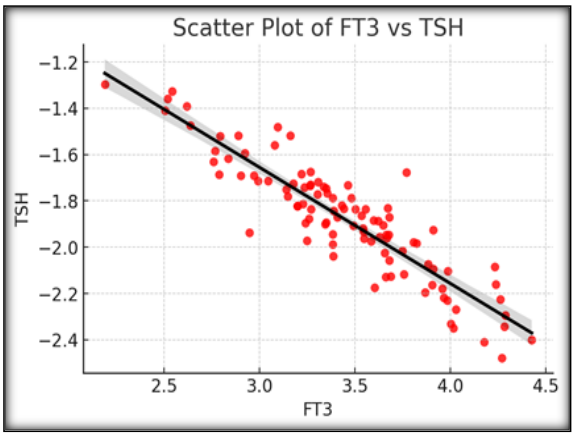
Parameters		FT3	FT4	TSH
FT3	PEARSON CORRELATION	1	.626**	-.547**
	SIG	-	.000	.000
FT4	PEARSON CORRELATION	.626**	1	-.471**
	SIG	.000	-	.000
TSH	PEARSON CORRELATION	-.547**	-.471**	1
	SIG	.000	.000	-

**. Correlation is significant at the 0.01 level (2-tailed).

The correlation analysis between FT3, FT4, and TSH reveals significant relationships among these thyroid function parameters. FT3 and FT4 exhibit a strong positive correlation (r = 0.626, p = 0.000), indicating that as FT3 levels increase, FT4 levels also tend to rise. Conversely, both FT3 and FT4 show a significant negative correlation with TSH (r = -0.547, p = 0.000 for FT3; r = -0.471, p = 0.000 for FT4). This inverse relationship suggests that higher levels of thyroid hormones (FT3 and FT4) are associated with lower TSH levels, consistent with the physiological feedback mechanism of the hypothalamic-pituitary-thyroid (HPT) axis. These findings align with established endocrinological principles, where elevated thyroid hormone levels suppress TSH secretion, while reduced thyroid hormones lead to an increase in TSH production. The statistical significance (p = 0.000) confirms the robustness of these correlations, highlighting the tightly regulated nature of thyroid function.



Graph 4 Scatter Plot Graph FT3 Vs FT4



Graph 5: Scatter Plot Graph FT3 Vs TSH

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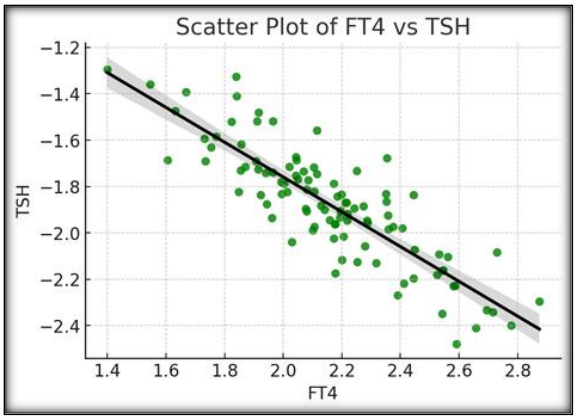

Graph 6: Scatter Plot FT4 Vs TSH

DISCUSSION

In this study, we assessed the thyroid profile of 145 HIV-patients. Out of which 93 (64.1%) were males and the remaining 52 (35.9%) were females. Tripathy SK et al,[7] conducted a similar study among newly diagnosed HIV patients and reported 67.4% male and remaining 32.6% to be female among their study population. Beltran S et al,[20] also reported in their study that 67.4% male dominated their study population of HIV patients. Quirino T et al,[23] also supported this study finding of male preponderance among their study population with 65% in comparison to 35% of female which is similar to this study finding. Thyroid profile among HIV infected children was also studied by Thongam S et al,[25] and reported 56.6% male patients and 43.4% female patients. Ji S et al,[27] reported male predominance of 85.9% among their study population of HIV infected patients. Andries A et al,[35] reported 61% of their study population to be male. Afhami S et al,[43] also reported male preponderance among their study population with 86.2% and remaining 13.8% were females. Kaneria MV et al,[44] also reported 65.3% male study population in their study. Thus majority of the studies reported male patients predominance among their study population of HIV patients which is in line with this study finding.

In the present study, the age group 31 to 40 years has the maximum no. of patients (28.3%). Minimum no. of patients was seen in the group above 60 years (11.0%). In addition to we found the mean age of male patients (42.8 ± 12.7 years) was slightly higher than female patients (39.7 ± 11.4 years). The overall mean age was 41.7± 12.3 years in this study. Tripathy SK et al,[7] reported 37.8 ± 7.8 years to be the mean age of their study population which is more or less similar to this study finding. Beltran S et al,[20] also reported 41.3 ± 10.4 years to be the mean age of their study population. Quirino T et al,[23] also supported this study finding by reporting similar mean age of their study population to be 40.5 ± 8.5 years. Pasupathi P et al,[24] studied among male HIV patients and reported 47 ± 10.2 years as the mean age which is a little higher than this study finding. Ji S et al,[27] also reported a higher mean age of 48.72 ± 10.92 years among their studied HIV patients. Chongtham S et al,[30] reported the mean age of their study population to be 40 ± 8.8 years which is similar to this study finding. Andries A et al,[35] also reported the mean age to be 38 years among their study population. Afhami S et al,[43] reported in their study that the mean age of their study population of HIV patients was 37 ± 8.7 years, which is more or less similar to this study finding. Kaneria MV et al,[44] also reported the mean age of 39 years among their study population which is similar to this study finding. Thus majority of the studies reported their study population to be around 40 years which is in line with this study finding.

Majority of the patients in this study were Hindu (57%) followed by Muslim (26%) and only 17% of the patients were Christian. This may be due to the catchment area of this hospital which has more Hindu population. In this study, comorbidities were assessed and found that hypertension (29.7%) was the most common comorbidities present among the patients followed by diabetes mellitus (12.4%).

In the current study, it was noted that majority of the patients had intravenous drug user (58.7%) as the most common route of infection. Twenty-nine patients were unsure of their route of infection and 25 (17.2%) patients had infection via sexual route. Six patients had their infection through their mother. Ji S et al,[27] conducted their study in China and reported in their study that the most common route of infection for their study population to be MSM (65.1%) followed by sexual transmission (19.1%), unknown source of infection (12.9%), IVDU (1.7%) and blood transmission (1.1%). Afhami S et al,[43] reported in their study that injecting illicit drugs was the common route in 58.5% of their study population, which is similar to this study finding.

In the current study, majority of the patients were taking ART (84.8%) and only 15.2% were newly diagnosed patients. The mean duration of ART was 24.3 ± 16.46 months in this study. Ji S et al,[27] also reported majority of their study population to be on HAART (58.4%) and remaining 41.6% were HAART naïve patients. Further they reported the mean duration of HAART duration to be 7.42 ± 5.2 years. Chongtham S et al,[30] reported the mean duration of ART to be 5.94 ± 2.75 years.

In this study, the mean serum TSH, FT3, FT4 and CD4 count was 2.93 ± 1.63, 3.04 ± 0.96, 1.26 ± 0.23 and 324.85 ± 125.64 respectively. On further analysis of the thyroid hormones it was found that normal thyroid function was seen in 75.2% of the patients and dysfunction was seen in remaining 24.8% of the patients. The most common thyroid dysfunction was Subclinical Hypothyroidism (15.9%) followed by Sick Euthyroid syndrome (5.5%), hypothyroidism in 2.8% and hyperthyroidism in 0.7%. Tripathy SK et al,[7] reported a higher prevalence of thyroid dysfunction among their HIV study population with 60.4%. Beltran S et al,[20] reported 16% of their study population to have hypothyroidism of which 2.6% with overt hypothyroidism, 6.6% with subclinical

ISSN (O): 2687-5365; ISSN (P): 2753-6556

hypothyroidism, and 6.8% with a low FT4 level. Quirino T et al,[23] reported 7.42% subclinical hypothyroidism among their study population which is lesser than this study finding. Ji S et al,[27] reported 33.1% of their study population with thyroid dysfunction which is a little higher than this study finding. They further reported 6.6% with subclinical hypothyroidism, 22.1% with overt hypothyroidism and 3.9% with overt hyperthyroidism. Chongtham S et al,[30] reported 13.6% thyroid dysfunction, out of which 8.9% with subclinical hypothyroidism, 1% with overt hypothyroidism, 2.6% subclinical hyperthyroid cases and 1% overtly hyperthyroid. Andries A et al,[35] studied among MDR TB coinfection with HIV and found that 54% had hypothyroidism after 90 days of treatment. Pommier JD et al,[38] studied HIV infected transgender and found hypothyroidism in 17% of their study population. Noureldeen AF et al,[39] reported 30% of their study population with abnormal thyroid function. Kaneria MV et al.44 reported 44% of their study population with thyroid dysfunction, out of which sick euthyroidism in 25.3%, subclinical hypothyroidism in 13.3%, overt hypothyroidism in 2.6% and isolated low FT4 in 2.6%. Porwal V et al,[49] reported the prevalence of thyroid dysfunction to be 45.7% which is higher than this study finding. Noureldeen AF et al,[39] studied newly diagnosed HIV infected patients and found incidence of thyroid abnormalities ranging from 7% hypothyroidism (subclinical and overt: 6% and 1%, respectively) to hyperthyroidism (2%) and non-thyroidal illness (9%). Thus, varying prevalence of thyroid dysfunction ranging from 13% to 60%.has been reported in various studies among their HIV infected study population. These variations may be due to variation in selection of study population as studies have shown that thyroid dysfunction was significantly more frequent in patients on HAART than in HAART-naive patients,[27] But in this study thyroid dysfunction was comparable between patients under ART and ART naïve patients. Which is also supported by Quirino T et al,[23] who reported subclinical hypothyroidism in both treatment-naive and HAART treated patients with a similar prevalence in their study.

It is possible that the high frequency of thyroid dysfunction among HIV patients is related to advanced acquired immunodeficiency syndrome, which is characterized by the presence of non-thyroidal disease (also known as euthyroid sick syndrome among patients with HIV). Antiretroviral treatment is associated with an increase in the incidence of subclinical hypothyroidism as well as isolated low levels of free thyroxine. Additionally, Graves disease, which is characterized by low levels of thyroid-stimulating hormone and increased levels of thyroxine, may manifest itself during the process of immunological reconstitution.[14]

In this study thyroid dysfunction was seen in 32.7% of the females in comparison to 20.4% of the males. Even though females are more commonly associated with thyroid dysfunction in comparison to the males, the findings were not statistically significant. Tripathy SK et al,[7] reported thyroid dysfunction to be more commonly seen in males (65.5%) than females (50%) which is in contrast to this study finding. Beltran S et al,[20] also reported the prevalence of subclinical hypothyroidism was higher among HIV-infected men than among HIV-infected women. Quirino T et al,[23] reported female (8.71%) patients to have higher thyroid disorder in comparison to male (7.11%) study population which is similar to this study finding. Meena LP et al,[33] also reported the prevalence of 30% subclinical hypothyroidism while 10.6% with overt hypothyroidism among their male HIV infected study population. Sultana I et al.48 reported in their study that euthyroid sick syndrome (25.0%), and subclinical hypothyroidism and primary hypothyroidism (5.0%) were highest in women (15.0%) as compared to 16.0%, 10.0% and 2.0% in men, respectively. The secondary hypothyroidism was comparable among them (10%) and hyperthyroidism was observed in 2.0% men and was absent in women. Thus, few studies reported higher prevalence among males and few studies reported higher among females, this study found a comparable prevalence among male and females.

In this study a significant negative correlation was seen between serum TSH and CD4 count with pearson correlation of -0.833 and a significant positive correlation was seen between Serum free T3 and CD4 count with pearson correlation of 0.753. But no significant association was seen between CD4 count and serum free T4 with pearson correlation of 0.534. Tripathy SK et al,[7] reported no significant correlation between CD4 count and thyroid FT3, FT4 and TSH in their study. Chongtham S et al,[30] also reported no significant correlation between CD4 count and thyroid FT3, FT4 and TSH in their study. Meena LP et al,[33] reported a significant negative correlation between the CD4 counts and serum TSH, which is similar to this study finding. Kaneria MV et al,[44] found positive correlation between FT3 and CD4 count ($r=0.3079$ and $p=0.0072$) and an inverse correlation between TSH levels and CD4 count ($r=0.02561$ and $p = 0.0266$) which is similar to this study finding.

In our study it was shown that 24.8% of the HIV-positive patients had problems with their thyroid tissue. Subclinical hypothyroidism was the most prevalent form of thyroid dysfunction, followed by sick euthyroid syndrome. Direct association was observed between FT3 and CD4 count, and an inverse correlation was observed between TSH and CD4 count indicating an aberrant pattern of thyroid function as the illness advances.

Despite its strengths, our study has some limitations. The sample size, although adequate, may not be fully representative of diverse populations. Additionally, we did not assess longitudinal changes in thyroid profile and CD4 count over time, which could provide deeper insights into disease progression.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Future prospective studies with larger sample sizes and longer follow-up durations are recommended. This study has also emphasized the need for multi-center Randomized Control trials (RCT) to validate correlation of ART and thyroid dysfunction.

The involvement of the thyroid gland is the most prevalent type of endocrine system that is affected by HIV infection. The endocrine system is one of the main systems that this virus affects. In individuals who are HIV positive, it is not uncommon to observe subtle changes in thyroid function. This can be attributed to a number of different factors, including opportunistic infections or tumors that develop in people who are in the symptomatic stage of infection, a dysfunctional immune system, the use of antiretroviral medicines, or a direct consequence of HIV itself.48 In order to further institution of screening and treatment regimens, larger studies are required to investigate the epidemiology of moderate thyroid dysfunction in HIV-infected individuals as well as the many health effects associated with this condition.

CONCLUSION

According to the findings of recent studies, people living with HIV are significantly more likely to have biochemical abnormalities of thyroid function. It was found that the majority of HIV patients were males within the reproductive age group. In this community, the most common mode of infection was through the use of intravenous drugs. Only a small number of individuals in this research were naive to ART. It was shown that 24.8% of the HIV-positive patients had problems with thyroid tissue. Subclinical hypothyroidism was the most prevalent form of thyroid dysfunction observed in HIV-positive individuals, followed by sick euthyroid syndrome as the second most common kind. A direct association was observed between FT3 and CD4 count, and an inverse correlation was observed between TSH and CD4 count, indicating an aberrant pattern of thyroid function as the illness advances. As a result, it is essential for all HIV patients to have routine baseline thyroid profile examinations.

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ISSN (O): 2687-5365; ISSN (P): 2753-6556