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Original Research Article

THYROID DISORDERS AMONG ADOLESCENT GIRLS AND REPRODUCTIVE AGE GROUP WOMEN IN A TERTIARY CARE HOSPITAL IN THE KOLHAN REGION OF JHARKHAND

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ABSTRACT

Background: Thyroid problems affect 14% of adult women and endocrinopathies in reproductive age, affecting 1 in 4,000 live births and 1% to 2% of the paediatric population. Thyroid cancers constitute 6% of paediatric malignancies. Although iodine deficiency problems have declined, they still cause lifelong productivity losses in industrialized nations. Prompt detection and intervention could mitigate long-term metabolic irregularities. The study evaluated thyroid abnormalities in adolescents and reproductive-age women in this region by measuring total triiodothyronine (T3), total thyroxine (T4), and thyroid-stimulating hormone (TSH). **Materials and Methods:** A cross-sectional study was conducted at MGM Medical College, Jamshedpur, involving 309 adolescent and reproductive women aged 12-49. The study obtained informed consent and maintained data confidentiality. Participants were screened for thyroid disorders and their levels were measured using ELISA methods. The study classified subjects based on normal ranges for T3, T4, and TSH tests, with the results analyzed using commercial ELISA kits. **Result:** The study found that 45.3% of individuals had biochemical evidence of thyroid disorder, with 54.7% being euthyroid. Hypothyroid subjects had 22.3% clinical and 3.6% subclinical hypothyroidism. Secondary hyperthyroidism was found in 12.3% of cases. Adolescents and women of reproductive age had 21.6% and 22.4% respectively. Physical activity had a negative correlation with T3 and T4 levels, while BMI had no discernible relationship with T3, T4, or TSH levels. **Conclusion:** Thyroid function problems were detected in 51.4% of adolescents and 44.5% of women, highlighting the persistence of hyperthyroidism, especially secondary hyperthyroidism. The study recommends regular screenings, diagnosis, and treatment for this vulnerable population, and suggests lifestyle modifications like better eating and exercise to help avoid or alleviate thyroid disorders.

INTRODUCTION

Thyroid problems represent the most prevalent endocrine disorders among females, impacting around 14% of adult women, and rank among the most frequent endocrinopathies in women of reproductive age.[1] Congenital hypothyroidism manifests in 1 in 4,000 live births, but acquired hypothyroidism affects 1% to 2% of the paediatric population. Thyroid cancers constitute 6% of paediatric malignancies. Although iodine deficiency problems have declined from 13.1% to 3.2% over the last 25 years, they continue to pose a substantial thyroid issue in industrialised nations, impacting 4.8 million newborns and resulting in lifelong productivity losses in the United States alone.[2]

The National Family Health Survey IV (2015-2016) indicated a 2.2% prevalence of goitre or thyroid disorders among adults aged 15-49, with approximately 2% in females and under 1% in

males. The incidence escalated with age in women (15-19 years: 0.7%; 20-34 years: 1.8%; 35-49 years: 3.4%). The prevalence rose to 2.9% in NFHS-V (2019-2021).[3]

The thyroid gland forms in the first trimester of gestation and comprises two cellular types: thyroid follicular cells and parafollicular cells (C cells). Chest-related hypothyroidism (CH) is a prevalent endocrine condition in Korea, occurring in one out of every 3,981 live births.[4] Thyroid aplasia, a congenital mistake in thyroxine production, is a prevalent condition in children, with thyroid peroxidase deficiency being the most frequent anomaly. Preoperative imaging helps prevent misdiagnosis.[5,6]

Thyroid nodules are few in children but have a higher likelihood of malignancy in individuals referred for assessment. Children with papillary thyroid carcinoma represent 90% or more of paediatric thyroid cancers. Management protocols advocate for fine-needle aspiration (FNA) for nodules smaller than 1 cm and surgical excision for hyper functioning lesions. Treatment is tailored according to staging and risk assessment.[7,8]

The hypothalamic-pituitary-thyroid (HPT) axis governs homeostasis and metabolic processes. Thyrotropin-releasing hormone (TRH) is secreted by the hypothalamus, while thyroid-stimulating hormone (TSH) is produced by the anterior pituitary, both regulating the secretion of TRH and tetraiodothyronine (T4) from the thyroid gland. TSH interacts with LH and FSH, influencing endometrial tissue growth and modulating leptin levels. Thyroid hormones are essential in the female reproductive system, facilitating ovarian activity, embryo implantation, and menstruation. Dysfunction is more common in reproductive disorders such as subfertility, polycystic ovary syndrome (PCOS), and endometrial dysfunctions. Thyroid problems adversely affect ovarian function and pregnancy, influenced by factors such as autoimmune thyroid disease (AITD), low human chorionic gonadotropin (hCG) levels, inadequate iodine consumption, body mass index (BMI), ethnicity, and subclinical hypothyroidism status.[9]

Nonetheless, prompt detection and intervention in thyroid problems might mitigate long-term metabolic irregularities. Specifically, there exists a scarcity of comparable datasets in the state of Jharkhand. We assessed thyroid abnormalities in adolescents and women of reproductive age in this region by measuring total triiodothyronine (T3), total thyroxine (T4), and thyroid-stimulating hormone (TSH).

MATERIALS AND METHODS

A cross-sectional study was conducted in the department of obstetrics & gynaecology, MGM Medical College, Jamshedpur, from April 2024 to March 2025.

The Local Research Advisory Committee and the Institutional Ethics Committee of MGM Medical College, Jamshedpur, approved the research project.

The study recruited 309 adolescent and reproductive women of the age group of 12-49 years. We obtained informed assent (from Parents) and consent from all participants and maintained data confidentiality.

The study excludes individuals not providing consent; those with diabetes, collagen disease, or heart disease with pregnancy; and patients with known thyroid disorders or treatment.

Once we collected a detailed history of age, marital status, and menstrual history, we conducted a general physical examination that included measurements of height, weight, and BMI.

The investigation focused on T3, T4, and TSH. We performed T3, T4, and TSH assays using ELISA methods on the Alere Abbotte Diagnostics system. We analysed serum T3, T4, and TSH using commercial ELISA kits.

We classified the subjects in our study according to the following criteria: The kit instructions from the manufacturer gave normal ranges for the tests done in the lab, which are 0.4-4.2 µIU/ml for TSH, 0.92-2.78 nmol/L for T3, and 4.8-11.6 ng/dl for T4.

Subclinical hypothyroidism: TSH > 4.2 µIU/mL and normal T4, normal T3.

Subclinical hyperthyroidism: TSH < 0.4 µIU/mL and normal T3, normal T4.

Secondary hypothyroidism: T4 <4.8 µg/dL or T3 <0.92 ng/dL and a TSH level that is not appropriately elevated (normal).

Euthyroid Hyperthyroxinemia: T3 >2.78 nmol/L and T4 >11.6 ng/dl and a TSH level that is normal.

Clinical hypothyroidism: TSH > 4.2 µIU/mL and T4 < 4.8 µg/dL , T3 < 0.92 ng/dL

Clinical hyperthyroidism: TSH < 0.4 µIU/mL and T3 > 2.78 nmol/L , T4 > 11.6 ng/dL

The data was analysed using MS Excel & Epi-Info software. We present the quantitative values (age, TSH, T3, and T4) as mean, standard deviation, and range. The prevalence rates of thyroid diseases were presented as numerical counts and percentages. Analysis of T3, T4, and TSH levels in relation to physical activity use Pearson correlation coefficient methodologies.

A p value of <0.05 was taken as significant.

RESULTS

Socio-demographic Characteristics of Study Participants [Table 1]

The study screened a total of 309 subjects using T3, T4, and TSH. We analyzed the results of the screened subjects, which included 37 adolescents and 272 women of reproductive age.

The mean age of the participants was 30.88 ± 9.06 years for the adolescent & reproductive participants.

12% of the participants were adolescents, while 88% were women in reproductive age. 58.3% of

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participants belonged to urban areas. 73.8% were Hindus, 23% were Muslims; and 1.3% was Sikhs. 57.9% live in joint families.

As far as physical activity is concerned, 45.3% had moderate activity, 36.9% had mild activity; and 4.9% had a sedentary lifestyle.

Of the participants, 61.5% had a normal body mass index, 25.2% were overweight, and 7.8% were underweight.

Prevalence of Abnormal thyroid hormone in study participants. [Table 2]

Triiodothyronine (T3) hormone: abnormal T3 was seen in 31 subjects, and the overall prevalence of abnormal TSH was 10%, and the mean value was 1.40 ± .4.

Thyroxine (T4) hormone: abnormal T4 was seen in 123 subjects, and the overall prevalence of abnormal TSH was 39.8% with a mean value of 5.81 ± 3.3.

Thyroid-stimulating hormone (TSH): abnormal TSH was seen in 87 subjects, and the overall prevalence of abnormal TSH was 28.2%, and the mean value was 2.99 ± 2.8.

A comparison line diagram showing the association between age groups and the mean values of T3, T4, and TSH is included in the study population [Figure 1].

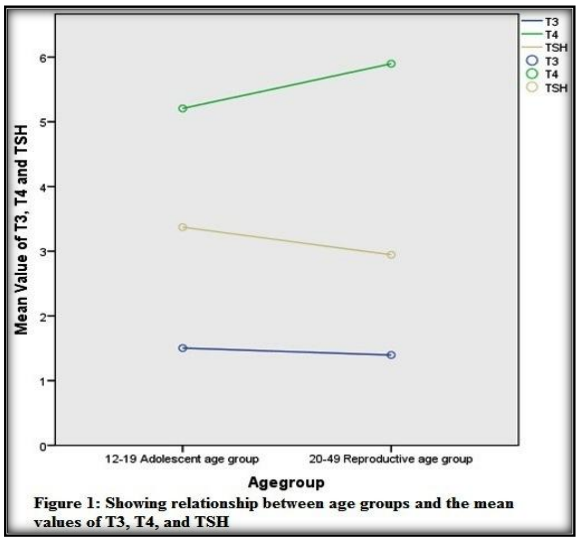

Figure 1: Showing relationship between age groups and the mean values of T3, T4, and TSH

Pattern of Thyroid disorder among Adolescent and Reproductive age Group. [Table 3 & Figure 2]

45.3% had biochemical evidence of thyroid disorder, and 54.7% were euthyroid (normal level).

Out of hypothyroid subjects, 22.3% had clinical and 3.6% had subclinical hypothyroidism. In my study, 12.3% of cases of secondary hyperthyroidism, 4.9% of cases of euthyroid hyperthyroxinaemia and 1.9% of cases of subclinical hyperthyroidism were found.

As far as thyroid disorders in adolescents are concerned, 21.6% had clinical hypothyroidism and secondary hyperthyroidism, while 2.7% were found to have subclinical hyperthyroidism and subclinical hypothyroidism, respectively.

As far as thyroid disorders in women of reproductive age are concerned, 22.4% were found to have clinical hypothyroidism, 12.3% were secondary hyperthyroidism, whereas 3.6% were found to have subclinical hypothyroidism and 1.9% was found to have subclinical hyperthyroidism, respectively.

There was no significant link detected with TSH level, however physical activity had a negative correlation with T3 level ($P < 0.05$) and a positive correlation with T4 level ($P < 0.01$). Similarly, there was no discernible relationship between BMI and T3, T4, or TSH. [Table 4, Figures 3 and 4].

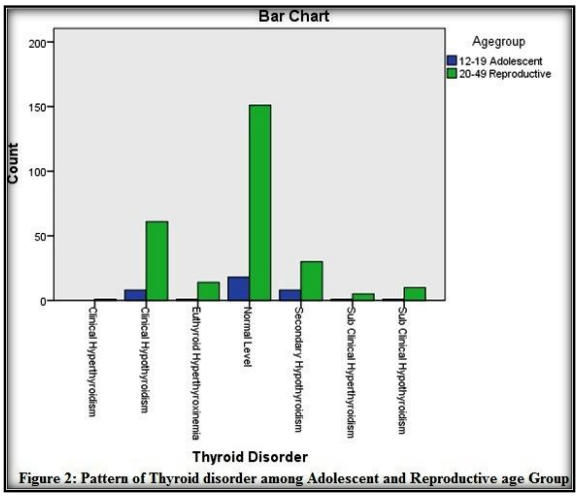

Figure 2: Pattern of Thyroid disorder among Adolescent and Reproductive age Group

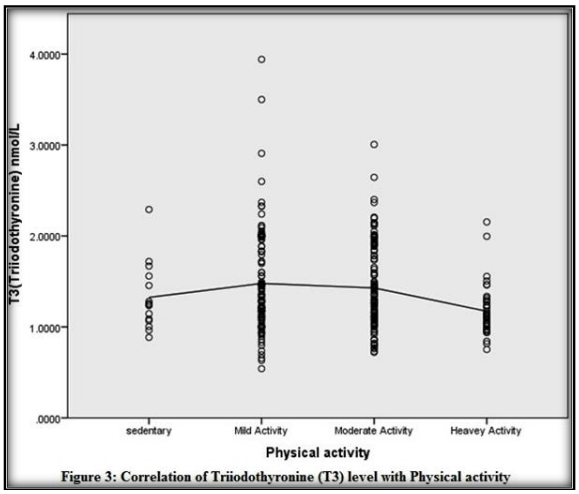

Figure 3: Correlation of Triiodothyronine (T3) level with Physical activity

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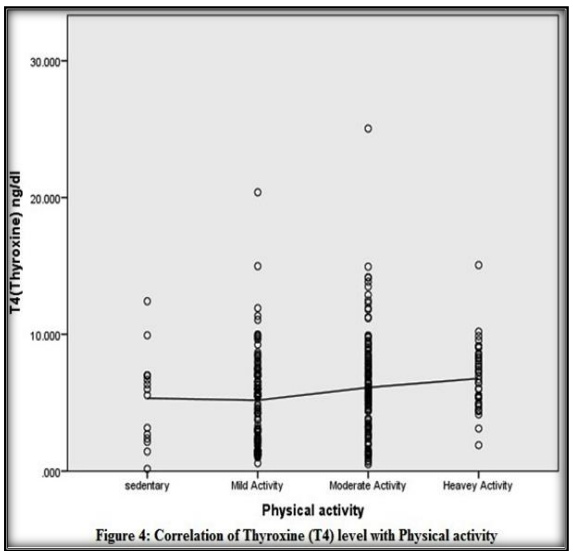

Figure 4: Correlation of Thyroxine (T4) level with Physical activity

Table 1: Distribution of Socio-demographic Characteristics of Study Participants

Variables	**n[%]**	
Age Group		
12-19 (Adolescent)	37[12.0]	**Mean ±** Std. Deviation
20-49 (Reproductive)	272[88.0]	30.88 **±** 9.067
Place of residence		
Urban	180[58.3]	
Rural	129[41.7]	
Religion		
Hindu	228[73.8]	
Muslim	71[23.0]	
Buddha	1[.3]	
Sikh	4[1.3]	
Others	5[1.6]	
Types of family		
Nuclear	130[42.1]	
Joint	179[57.9]	
Physical activity		
Sedentary	15[4.9]	
Mild Activity	114[36.9]	
Moderate Activity	140[45.3]	
Heavy Activity	40[12.9]	
Body Mass Index		
<18.5 Underweight	24[7.8]	
18.5-24.9 Normal	190[61.5]	
25.0-29.00 Overweight	78[25.2]	
>30.0 Obesity	17[5.5]	

Table 2: Prevalence of abnormal thyroid hormone concentration in the study participants.

Variables	**n[%]**	Mean ± **Std. Deviation**
Triiodothyronine (T3) Tests		
Low	27[8.7]	1.40 ± .4
Normal	278[90.0]	
High	4[1.3]	
Thyroxine (T4) Test		
Low	107[34.6]	5.81 ± 3.3
Normal	186[60.2]	
High	16[5.2]	
Thyroid-stimulating hormone (TSH) Test		
Low	7[2.3]	2.99 ± 2.8
Normal	222[71.8]	
High	80[25.9]	

Table 3: Pattern of Thyroid disorder among Adolescent and Reproductive age Group.

Variable	**Adolescent Group (12-19)**	**Reproductive Group (20-49)**	**Total**	**Chi-Square**	**P**
Clinical Hyperthyroidism	0[0.0%]	1[0.4%]	1[0.3%]	4.011	.675
Clinical Hypothyroidism	8[21.6%]	61[22.4%]	69[22.3%]		
Euthyroid Hyperthyroxinemia	1[2.7%]	14[5.1%]	15[4.9%]		

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Normal Level	18[48.6%]	151[55.5%]	169[54.7%]		
Secondary Hyperthyroidism	8[21.6%]	30[11.0%]	38[12.3%]		
Sub Clinical Hyperthyroidism	1[2.7%]	5[1.8%]	6[1.9%]		
Sub Clinical Hypothyroidism	1[2.7%]	10[3.7%]	11[3.6%]		

Table 4: coefficient of correlation between Physical activities with T3, T4 and TSH levels among study participants.

Variables	r	p
T3	-.132*	<0.05
T4	.174**	<0.01
TSH	-.037	.514

*.Correlation was significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).
r value: Pearson's coefficient of correlation
p value: <0.05

DISCUSSION

In 2004, India was classified by the World Health Organisation as having optimal iodine nutrition, likely due to universal salt iodisation and public health initiatives. India has made significant progress in improving iodine nutrition through the National Iodine Deficiency Disorders Control Programme.[10]

Jharkhand, a highly iodine-deficient state in India, is largely due to its geographical features and soil composition, which result in low iodine levels, leading to iodine deficiency disorders (IDD), which can impact thyroid function and lead to various health issues.[11] Thyroid diseases disproportionately impact females, as has long beenn.[12]

In this post-iodisation period, there is a misconception that the better-planned, iodine-rich diets of the adult, non-pregnant female populace in Jharkhand do not induce thyroid issues. This misconception has a negative impact on their health, education, and economy. Although we are located in an iodine-deficient location, our study is the first of its kind to focus on females of reproductive age and adolescents, the majority of whom are consuming foods that are sufficient in iodine.

The National Family Health Survey IV (2015-2016) reported a 2.2% prevalence of goitre or thyroid conditions, while the NFHS-V (2019-2021) reported a 2.9% frequency. Females aged 15-49 had a self-reported prevalence of 2%, while males had less than 1%. The prevalence increased with age, with women having a rate of 3.4% and men having a higher rate.[13]

Segni M,[14] found that thyroid disorders, including hyperthyroidism and hypothyroidism, affect 9-10% of adolescents, with subclinical hypothyroidism being more prevalent.[14]

Lakshminarayana Gopaliah R's study revealed that thyroid function abnormalities are more prevalent in adolescents (10.89%) in India compared to children (7.82%).[15]

Prasad A. et al,[16] revealed that the study indicated a prevalence of thyroid problems in 20.7% of females in the Jharkhand region.

Chakrabarty BK et al,[17] determined that the prevalence rate of thyroid diseases is 19.6%.

Unnikrishnan AG et al,[18] indicated that hypothyroidism is common among adults, with a three-fold greater prevalence in females (15.86% compared to 5.02%) and a two-fold higher frequency in older persons (13.11% compared to 7.53%).

Kajantie E et al,[19] indicated that the global prevalence of hypothyroidism is 5-7 times greater in females, particularly among those with low birth weight and during childhood.

In this investigation, 45.3% had biochemical indicators of thyroid dysfunction, while 54.7% were euthyroid (normal levels). Among hypothyroid individuals, 22.3% had clinical hypothyroidism, while 3.6% presented with subclinical hypothyroidism. In my research, I observed 12.3% instances of secondary hyperthyroidism, 4.9% instances of euthyroid hyperthyroxinaemia, and 1.9% instances of subclinical hyperthyroidism.

Among 37 instances, 19 (51.35%) exhibit all types of thyroid disorders in adolescents. A study by Yelluri S.K,[20] indicated that childhood was observed in over 60% of cases, whereas a comparable study by ShahNA et al,[21] corroborated these findings. Wasniewska M et al,[22] discovered that 52.1% of individuals exhibit euthyroidism, whereas 48% present with an adolescent thyroid disease. Adolescent hypothyroidism is a prevalent condition in India, with over 4% of cases and 18% of subclinical cases.[23] The majority of children with juvenile hypothyroidism have the overt disease, with one-third having a family history of autoimmune thyroid disease and half showinge.[24]

Hypothyroidism in children and teenagers is a multifaceted disorder characterised by nonspecific symptoms such as delayed dental development, fatigue, lethargy, cold sensitivity, constipation, xerosis, brittle hair, facial oedema, and myalgia. Certain children may not display these symptoms, resulting in alternate diagnoses such as constitutional growth delay, hyposomatotropism, malnutrition, paediatric depression, paediatric growth hormone insufficiency, paediatric malabsorption syndromes, short stature, and constipation. In India, around fifty percent of persons with overt adolescent hypothyroidism exhibit goitre; however, the extent of enlargement

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does not correspond with the severity of the disease.[25]

Secondary hyperthyroidism in adolescents is a disorder characterised by the thyroid gland's overproduction of hormones resulting from a dysfunction of the pituitary gland. The thyroid gland is the major source of hyperthyroidism, which is quite uncommon. Hyperthyroidism is predominantly induced by autoimmune thyroid disorders, notably Graves' disease, however it may also arise from non-autoimmune thyroid glands.[26]

Our investigation revealed that 21.6% of adolescents exhibited clinical hypothyroidism and secondary hyperthyroidism, while 2.7% were diagnosed with subclinical hyperthyroidism and subclinical hypothyroidism, respectively. Kilci, F. et al,[27] study revealed that prepubertal patients had a higher rate of clinical hypothyroidism (41.8%) compared to pubertal patients. Wu T et al.28 study reported that subclinical hypothyroidism was found in 1.7% and subclinical hyperthyroidism was found in 2.3% of the adolescents, which was similar to our study.

As far as thyroid disorders in women of reproductive age are concerned, 22.4% were found to have clinical hypothyroidism, 12.3% were secondary hyperthyroidism, whereas 3.6% were found to have subclinical hypothyroidism and 1.9% were found to have subclinical hyperthyroidism, respectively.

Hypothyroidism is a prevalent condition resulting from the thyroid gland's insufficient production of thyroid hormone. This may also arise from dysfunction of the pituitary and hypothalamus. The hypothalamus releases thyrotropin-releasing hormone (TRH), which prompts the pituitary gland to synthesise thyroid-stimulating hormone (TSH). TSH induces the thyroid gland to synthesise and release T4, which possesses a half-life of 7 to 10 days. T3 and T4 inhibit the synthesis of TRH and TSH through negative feedback mechanisms. A reduction in T4 synthesis results in elevated TSH secretion, leading to hypertrophy and hyperplasia of the thyroid parenchyma.[29]

Chandra AK et al,[30] found that hypothyroidism prevalence in 3814 West Bengali subjects was even higher (29%), which was similar to our study. Thyroid disorders in India extend beyond iodine-deficient sub-Himalayan zones, with cyanogenic foods potentially interfering with iodine nutrition. Exposure to industrial and agricultural contaminants is a growing health concern in India.[31] Velayutham K et al,[32] Usha Menon V et al,[33] and Abraham R et al,[34] reported that the prevalence of hypothyroidism (clinical + subclinical) was 13.3% and 11.5% in the study from Kerala and Pondicherry, respectively.

Hyperthyroidism is an autoimmune condition that results in elevated thyroid hormone levels, which occur due to inflammation or destruction of the thyroid follicular cells. Graves' disease triggers this, leading to thyroid gland growth. Toxic Multinodular Goitre (TMNG) is a long-term disease, causing thyroid autonomy. Iodine-Induced Hyperthyroidism is iatrogenic, affecting individuals in iodine-deficient regions, with underlying thyroid nodular disease, or with Graves' disease. Thyroiditis, a common aetiology, results in a transient increase in thyroid hormone due to inflammation or cell destruction.

In the present study, the prevalence of secondary hyperthyroidism was 12.3%, and 1.9% was found to have subclinical hyperthyroidism, respectively. Taylor PN et al,[35] and Chung JH et al,[36] reported that the global prevalence of hyperthyroidism is estimated at 0.2-2.5%. The prevalence of overt hyperthyroidism is approximately 0.2–1.4%. Subclinical hyperthyroidism, defined as low TSH with normal peripheral thyroid hormone, has a prevalence of approximately 0.7-1.4%.

Bhattacharjee, S. et al,[37] reported a prevalence of 27.33% of hyperthyroidism among all cases of thyroid disorders in central India. Lee SY et al,[38] reported that the most common cause of hyperthyroidism is Graves' disease, with a global prevalence of 2% in women. This is similar to our study.

In the concern of physical activities, a negative correlation with T3 level ($P<0.05$) and a positive correlation with T4 level, but no significant correlation was found with TSH level. Tian L et al,[39] found that daily physical activity in American adults significantly impacts thyroid function, including hormone levels and potential thyroid diseases. Klasson CL et al,[40] found that physical activity is linked to lower thyroid hormones in exercise intervention studies, with modest effects on TSH and T4. Physical activity modulates both the circulating TSH and T4 levels and the magnitude of the TSH response to lower T4 levels.

CONCLUSION

This is the first study to ever look at the frequency of thyroid dysfunction in women and adolescent in the Kolhan division of Jharkhand. Given the potential detrimental effects on growth and development, the fact that thyroid function problems were detected in 51.4% of adolescents and 44.5% of women of reproductive age in the research group calls for bigger investigations spanning many centers to determine the prevalence of these diseases on a national scale.

This study highlights the concerning persistence of hyperthyroidism, especially secondary hyperthyroidism, within the affected population. When a pituitary adenoma develops, it can lead to secondary hyperthyroidism, a disorder in which the body's hormone balance is upset because the thyroid generates too much TSH. Based on these results, it is recommended that this vulnerable population have regular screenings for thyroid disease, with further diagnosis and treatment as needed. Modifications to one's lifestyle, such as eating better

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and exercising often, may help avoid or alleviate thyroid disorders.

Limitations: One of the few caveats to our study is that we only surveyed a limited subset of teenagers. Limitations of the present study include compliance with follow-up and long-term treatment, the expense of thyroid screening tests, and medical professionals' understanding.

Recommendations: Misdiagnoses and inappropriate therapies for thyroid problems in teenagers are common. In order to rule out difficulties, we advise anyone dealing with unexplained fatigue, weight gain, infertility, or menstrual problems to get their thyroid profile tested. Problems can be avoided if these flaws are caught early. Thus, we advise that any patient presenting with symptoms such as unexplained weight gain, infertility, irregular periods, or excessive exhaustion undergo a thyroid examination. Complications can be avoided and improved health outcomes can be achieved with this early detection. Multicentric study over this entire geographical region is important to determine the risk factors for thyroid diseases, which are very common among adolescents.

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All authors conceptualised and designed the study. Dr Banita Sahay, Dr Ranju Jha, Dr Rajan Kumar Barnwal, Dr Rohit Jha, Dr Seema Kumari, and Dr Kumar Vimal

Kuber Chandra Setua helped draft the laboratory protocols and reporting. Data entry was performed by Manish Kumar. Dr Rajan Kumar Barnwal & Kumar Vimal performed the statistical analysis. All the authors made contributions toward reviewing, revising, and finalising the manuscript.

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