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Original Article

Prevalence of Thyroid Function Abnormalities and Its Association with Physical Fatigue in First-Year Medical Students

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Abstract

Objective: To estimate prevalence and type of thyroid function abnormalities and explore their associations with physical fatigue in first-year medical students.

Methods: This was a cross-sectional observational study comprising of 200 first-year medical students. Demographic details and history of any significant medical illness was asked and noted. Thyroid function tests were conducted on all participants. The prevalence and type of thyroid function abnormalities were documented in all students, and the presence and severity of physical fatigue were assessed on the basis of physical fatigue score. Participants with any kind of thyroid function abnormality were compared with those with normal thyroid function tests for presence and severity of fatigue.

Results: Among the 200 students, 144 (72%) were males and 56 (28%) were females, resulting in a male-to-female ratio of 1:0.38. Subclinical hypothyroidism was identified in 9% of students (18 cases), while clinical hypothyroidism was present in 7% (14 cases). Additionally, subclinical hyperthyroidism was detected in 1% of students (2 cases), with no cases of clinical hyperthyroidism reported. Female students were found to be having more thyroid function abnormalities as compared to male students and the difference was found to be statistically significant (p=0.0109). Students with abnormal thyroid function tests (34 cases) had a markedly higher mean FSS score (43.22±4.50) as compared to students with euthyroid (16.85±2.70).

Conclusion: Subclinical thyroid abnormalities are prevalent among young individuals, particularly those with physical fatigue. This study revealed a significant link between presence of fatigue and the possibility of thyroid dysfunction.

Keywords: Physical fatigue, subclinical hypothyroidism, thyroid function abnormalities, thyroid function test

Introduction

The thyroid gland plays an important role in regulating the metabolism, growth, and development. Thyroid hormones (T3 and T4) are synthesized in response to the thyroid-stimulating hormone (TSH) released from the anterior pituitary gland.[1] T3 and T4 influence nearly every cell in the body, primarily by modulating the metabolic rate. They increase oxygen consumption and heat production and play a crucial role in protein synthesis and the metabolism of carbohydrates, lipids, and vitamins. Furthermore, thyroid hormones are essential for normal neurological development, bone growth, and cardiovascular function. The delicate balance maintained by these hormones is crucial for health, and even minor deviations can lead to significant physiological

alterations.[2]

Thyroid function abnormalities are common but often remain undiagnosed, particularly in young individuals, due to the subtle nature of their initial manifestations. Hypothyroidism, hyperthyroidism, and subclinical thyroid dysfunctions are the primary categories of thyroid function abnormalities.[3] Among these, subclinical thyroid dysfunction—characterized by abnormal TSH levels with normal T3 and T4 levels—can be particularly insidious. In young individuals, the clinical presentation of thyroid abnormalities may be minimal or entirely absent in the early stages. However, subtle clinical features such as unexplained physical fatigue, mood disturbances, and cognitive impairment might be early indicators of thyroid dysfunction.[4]

The importance of screening for thyroid function abnormalities in young individuals, particularly those presenting with subtle clinical features such as physical fatigue, cannot be overemphasized. Early detection and intervention are crucial in preventing the progression of subclinical conditions to overt thyroid disease, which can have profound effects on a person's overall health and quality of life.[5] Physical fatigue, although common in the general population, could be an early warning sign of thyroid dysfunction. This is particularly relevant in the context of first-year medical students, in whom the stress of academic workload, combined with the physiological changes associated with early adulthood, can mask the early signs of thyroid dysfunction, making targeted screening even more essential.[6]

Early intervention in young individuals with subclinical thyroid function abnormalities is important. The consequences of a delayed diagnosis can be significant as undetected thyroid function abnormalities may increase the risk of long-term complications, including cardiovascular disease, cognitive decline, and metabolic disorders. Moreover, in a population of first-year medical students, untreated thyroid dysfunction can impair academic performance, increase absenteeism, and contribute to mental health issues such as anxiety and depression. Addressing thyroid dysfunction early in its course allows for timely therapeutic intervention which may prevent the development of more severe health issues.[7]

Despite the established importance of thyroid function in overall health and the potential consequences of undiagnosed thyroid abnormalities there is a significant gap in the literature regarding the prevalence of thyroid function abnormalities in young, asymptomatic populations. Most existing studies focus on middle-aged and older adults, with less emphasis on younger individuals who may not exhibit overt symptoms. This study aims to fill this knowledge gap by investigating the prevalence of thyroid function abnormalities in first-year medical students and examining the association between these abnormalities and physical fatigue.

Methods

This was an observational study conducted in the Department of Physiology at a tertiary care medical institute in India. Two hundred medical students were included in this study based on inclusion and exclusion criteria. Since the study was purely observational, no ethical committee clearance was required. The study included first-year medical students who were above 16 years of age and provided written informed consent. Exclusion criteria included students under 16 years, those who refused consent, those on medications known to affect thyroid function (e.g., lithium, amiodarone, sucralfate, rifampicin), and those with significant psychiatric illnesses. Informed written consent was obtained from all participants. The minimum sample size was calculated based on a pilot study on thyroid functions in asymptomatic young individuals, assuming 90% power and a 95% confidence interval; the required sample size was 180 individuals. Therefore, the researcher included 200 first-year medical students in this study. A detailed history of all participants, including age, gender, and any chronic systemic illnesses such as diabetes, hypertension, or bronchial asthma, was collected. The height and weight of each participant were recorded, and BMI was calculated.

Assessment of all participants for the presence and severity of fatigue was conducted using the Fatigue Severity Scale (FSS), which is a nine-item questionnaire designed to assess the impact of fatigue on a person's daily activities and functioning.[8] Each item is rated on a 7-point Likert scale, where 1 indicates strong disagreement with the statement and 7 indicates strong agreement. The minimum possible score on the FSS is 9 (minimal fatigue), and the maximum possible score is 63 (severe fatigue).

Fasting blood samples were collected in the morning for the determination of thyroid function. The method used for the hormone

estimation was the electrochemiluminescence immunoassay method. The normal reference ranges for T3, T4, and TSH were 0.5-2 ng/mL, 4.5–13.2 µg/dL, and 0.39–4.6 mIU/L, respectively. Based on the thyroid function tests and clinical features, students were diagnosed with either subclinical or clinical hypothyroidism or subclinical or clinical hyperthyroidism. The prevalence and type of thyroid function abnormalities were documented for all students. Participants with any thyroid function abnormalities were compared with those who had normal thyroid function tests regarding the presence and severity of fatigue.

Results

The analysis of gender, age, and Body Mass Index (BMI) among the students revealed that there were 144 (72%) males and 56 (28%) females, resulting in a male-to-female ratio of 1:0.38. In terms of age distribution, a significant majority of the students, 91.00% (182 students), were between 16 and 18 years old, while only 18 (9%) students were in the 19-20 age group. Of the students, 112 (56.00%) had a normal BMI (18.5–24.9), whereas 54 (27.00%) were classified as overweight (25.0–29.9). Additionally, 9 students (4.5%) were underweight (BMI < 18.5), 17 students (8.50%) fell into Obesity Class I (BMI 30.0-34.9), 7 students (3.50%) were classified as Obesity Class II (BMI 35.0–39.9), and 1 student (0.5%) was found to have Class III (BMI > 40) obesity (Table 2).

The analysis of thyroid function status among the students revealed that the majority of the students (83%) were euthyroid. Subclinical hypothyroidism was present in 9.00% (18 students), while clinical hypothyroidism was observed in 7.00% (14 students). Two students (1%) were found to have subclinical hyperthyroidism. No students were diagnosed with clinical hyperthyroidism (Fig. 1).

Among the 34 students with thyroid function abnormalities, there were 16 females (8%) and 18 males (9%). However, considering the gender distribution, a higher percentage of females (16 out of 56, 28.57%) were found to have thyroid function abnormalities compared to males (18 out of 144, 12.50%). Female students exhibited more thyroid function abnormalities than male students, and this difference was statistically significant (p 0.0109) (Table 3).

The analysis of thyroid function tests showed that in the euthyroid group, the mean T3 and T4 levels were 1.78±0.83 and 10.26±3.34, respectively, whereas the mean TSH level was 3.96±2.08. In cases of subclinical hypothyroidism, the mean T3 was 1.47±0.79, the mean T4 was 6.54±2.57, and the mean TSH was 12.62±5.52. For clinical hypothyroidism, the mean T3, T4, and TSH levels were found to be 0.32±0.29, 3.84±2.38, and 37.08±12.54, respectively. In the subclinical hyperthyroidism group, the mean T3, T4, and TSH levels were 0.71±0.08, 5.7±0.4, and 0.2 ±0.01, respectively. No student was found to have clinical hyperthyroidism.

The analysis of thyroid function status in relation to fatigue severity revealed a significant difference between students with normal and abnormal thyroid functions.

Table 1 Fatigue Severity Scale For Assessment of Physical Fatigue

Item	Question	Score
1	My motivation decreases when I am fatigued	1 (strongly disagree) to 7 (strongly agree)
2	Exercise contributes to my fatigue.	
3	I am easily fatigued.	
4	Fatigue interferes with my physical functioning.	
5	Fatigue frequently causes problems for me.	
6	My fatigue prevents me from maintaining sustained physical functioning.	
7	Fatigue interferes with carrying out certain duties and responsibilities.	
8	Fatigue is among my three most disabling symptoms.	
9	Fatigue interferes with my work, family, or social life.	

Table 2 Age, Gender, and Body Mass Index of Participants

Age, Gender and Body Mass Index		Number of Students (n=200)	Percentage
Gender Distribution	Males	144	72
	Females	56	28
	Total	200	100
Age Groups	16–18	182	91
	19–20	18	9
	Total	200	100
Body Mass Index	<18.5 (Underweight)	9	4.50
	18.5–24.9 (Normal)	112	56
	25.0–29.9 (Overweight)	54	27
	30.0–34.9 (Obesity Class I)	17	8.50
	35.0–39.0 (Obesity Class II)	7	3.50
	>40 (Obesity III)	1	0.50

Table 3 Thyroid Function Status of Participants

	Male		Female	
	Number of Cases (n=144)	Percentage	Number of Cases (n=56)	Percentage
Euthyroid	126	63	40	20
Subclinical Hypothyroidism	7	3.50	11	5.50
Clinical Hypothyroidism	10	5	4	2
Subclinical Hyperthyroidism	1	0.50	1	0.50
Hyperthyroidism	0	0	0	0
p= 0.0109 (significant)*				

*Chi-square test

Among euthyroid students, who constituted 83% (166 cases), the mean Fatigue Severity Scale (FSS) score was 16.85±2.70. In contrast, students with abnormal thyroid function tests (34 cases) had a markedly higher mean FSS score of 43.22±4.50. This difference was statistically highly significant, with a p-value of less than 0.0001 and a 95% confidence interval ranging from 25.22 to 27.51, indicating a strong association between abnormal thyroid

Table 4 Mean T3, T4, and TSH Levels

Thyroid Function Tests	Mean T3 (ng/mL)	Mean T4 (µg/dL)	Mean TSH (mIU/liter)
Euthyroid	1.78±0.83	10.26±3.34	3.96±2.08
Subclinical Hypothyroidism	1.47±0.79	6.54±2.57	12.62±5.52
Clinical Hypothyroidism	0.32±0.29	3.84± 2.38	37 .08±12.54
Subclinical Hyperthyroidism	0.71±0.08	5.70±0.4	0.20±0.01
Hyperthyroidism	-	-	-

Table 5 Comparison of Fatigue Severity Scale in Euthyroid and Students with Thyroid Function Abnormalities

Thyroid Status of Students	Number of Students	Mean Fatigue Severity Scale
Euthyroid students	166 (83%)	16.85±2.70
Students with abnormal thyroid function tests	34 (17%)	43.22±4.50
p<0.0001 (Highly significant)	95% CI - 25.22 to 27.51	

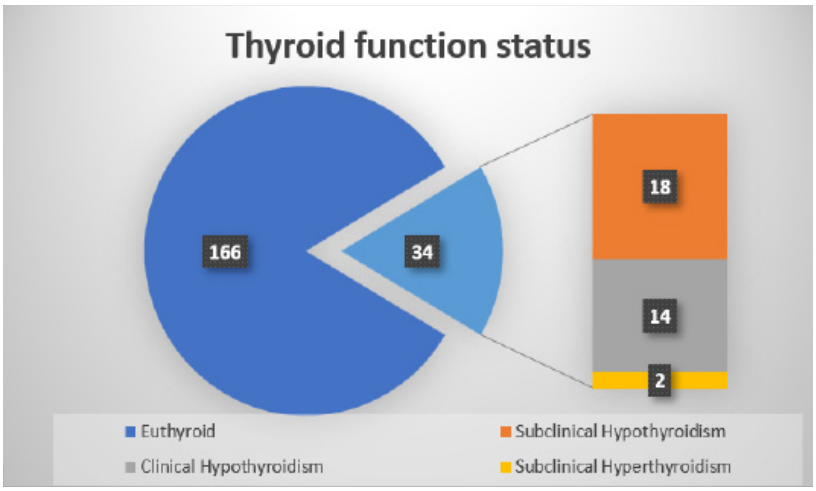

Fig. 1 Thyroid Function Abnormalities

function and increased fatigue severity (Table 5).

Discussion

Thyroid abnormalities are not uncommon in young, seemingly healthy individuals. Subclinical forms of thyroid dysfunction, characterized by biochemical abnormalities without clinical symptoms, are particularly prevalent and can be easily overlooked.[9] These conditions can influence various physiological processes, leading to symptoms such as fatigue, weight gain or loss, and mood disturbances.[10] These signs and symptoms are often ignored by young individuals. The thyroid gland plays a critical role in regulating metabolism and overall homeostasis, making even mild dysfunction potentially significant in affecting an individual's quality of life.[11] In young, healthy individuals, undiagnosed or subclinical thyroid abnormalities can exert insidious but definite effects on physical and cognitive performance.

The majority of the students (83%) were euthyroid. Subclinical hypothyroidism was present in 18 students (9%), while clinical hypothyroidism was observed in 14 students (7%). Two students (4%) were found to have subclinical hyperthyroidism, and no students were diagnosed with overt hyperthyroidism. In a similar study, Iqbal *et al*. assessed thyroid dysfunction and related comorbidities in university students.[12] For this purpose, the authors screened 1,032 students during a two-day medical camp using a questionnaire-based tool. The study found that 7.6% of students had confirmed thyroid disease, with females (10.1%) and individuals aged 15-20 (9.3%) showing higher prevalence rates. Additionally, 23.9% of the participants were identified as high-risk for thyroid dysfunction. Based on these findings, the authors concluded that this screening method effectively identified students at risk for thyroid dysfunction. A similar prevalence of thyroid function abnormalities in young individuals was also reported by authors such as Wanjari *et al*[13] and Delshad *et al*.[14]

Though there were overall more males

with thyroid abnormalities compared to female students, the gender distribution revealed that a higher percentage of females (16 out of 56, 28.57%) had thyroid function abnormalities compared to males (18 out of 144, 12.50%). Unnikrishnan *et al*. conducted a cross-sectional study to investigate the prevalence of hypothyroidism among 5,376 adults across eight cities in India.[15] The overall prevalence was found to be 10.95%, with a striking gender difference. Hypothyroidism affected 15.86% of women, compared to just 5.02% of men, underscoring a significant female predisposition. This disparity was even more pronounced among older women, where the prevalence exceeded 20%. The study also highlighted that 8.02% of the population had subclinical hypothyroidism, with a higher incidence in women. Moreover, 21.85% of participants tested positive for anti-TPO antibodies, further indicating a higher prevalence of autoimmune thyroid disorders in women. These findings suggest that women are more susceptible to hypothyroidism, pointing to a need for increased awareness and targeted screening in this demographic. Similar female preponderance in cases of thyroid disorders was also reported by authors such as Meng *et al.*[16] and Olmos *et al*.[17]

Analysis of the mean fatigue score among euthyroid students showed that the mean Fatigue Severity Scale (FSS) score was 16.85 ± 2.70. In contrast, students with abnormal thyroid function tests (34 cases) had a markedly higher mean FSS score of 43.2± 4.50. This difference was statistically highly significant ($p<0.0001$). Fischer *et al*. conducted a cross-sectional study to investigate the relationship between the hypothalamic-pituitary-thyroid (HPT) axis functioning, fatigue, and early life adversity in women.[18] The study found that lower TSH and higher T4 levels were associated with increased general and physical fatigue, and lower TSH was linked to higher early life adversity. The authors concluded that altered HPT functioning may contribute to fatigue in these patients. Similar correlations between thyroid function abnormalities and physical fatigue have also been reported by authors such as Ruíz-Pacheco *et al*[19]. and Stuber *et al*.[20]

Subclinical thyroid abnormalities are common in young individuals, particularly those who have complaints of generalized fatigue. This study found that students with thyroid function abnormalities had significantly higher Fatigue Severity Scale (FSS) scores compared to those with normal thyroid function. This significant association suggests that fatigue in young individuals may be an indicator of underlying thyroid dysfunction, warranting further clinical evaluation.

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