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Triiodothyronine Variations during Resumption and Examination Periods: A Study among First-Year Medical Students

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Triiodothyronine (T_3) is a thyroid hormone that plays a crucial role in regulating the body's metabolism and maintaining homoestasis. There is limited knowledge of the effect of academic activities on T_3 level among first-year students in various times of their academic journey. This cross-sectional study evaluated Triiodothyronine (T3) levels in first-year students at PAMO University of Medical Sciences (PUMS) during resumption and examination periods. Thirty participants were recruited by random sampling, and blood samples were collected during both times. Serum T3 levels were analyzed using an Enzyme-Linked Immunosorbent Assay (ELISA) with p set at ≤ 0.05. The results showed that T3 levels were significantly higher during examinations (3.39 ± 3.72 nmol/L) compared to resumption (1.81 ± 0.50 nmol/L), with a p-value of 0.024. During resumption, males had T3 levels of 2.02 ± 0.81 nmol/L and females 1.72 ± 0.28 nmol/L, while during examination, T3 levels for males and females were 2.92 ± 0.98 nmol/L and 2.64 ± 0.52 nmol/L, respectively, with no significant gender difference (p = 0.113). Age group comparisons also showed no significant differences in T3 levels during resumption (p = 0.743) or examination (p = 0.89). T3 levels during resumption for the 16-17, 18-19, and 20-21-year age groups were 1.83 ± 0.52 nmol/L, 1.61 ± 0.44 nmol/L, and 1.62 ± 0.00 nmol/L, respectively. During examinations, these levels were 3.52 ± 3.98 nmol/L, 2.60 ± 0.63 nmol/L, and 2.27 ± 0.00 nmol/L, respectively.In conclusion, T3 levels were higher during examinations, with no significant gender or age differences observed.

Keywords: Triiodothyronine; thyroid function; stress; academic performance; medical students.

1. INTRODUCTION

The thyroid gland, an integral part of the endocrine system, plays a critical role in regulating metabolism, growth, and physiological homeostasis (Shahid, et al., 2023). Among its key hormones, triiodothyronine (T3) influences numerous cellular processes, including basal metabolic rate (BMR), cognitive function, and stress responses. T3 exerts its effects by modulating gene expression and enzymatic activity, essential for maintaining bodily functions and responding to physiological challenges (Williams, 2023, Waugh & Grant, 2014).

University education, particularly the first year, marks a period of heightened academic, social, and emotional transitions (Zhao, et al., 2023). Academic activities, demand significant mental effort, structured schedules, and adaptability to rigorous workloads. These activities, including resumption at the start of an academic term and examination periods, often involve changes in sleep patterns, nutritional habits, and physical activity levels, all of which are factors that can influence metabolic and endocrine functions. The need for sustained cognitive focus and physical energy during academic activities may lead to variations in physiological parameters, including thyroid hormone levels (Shahid, et al., 2023, Alcaide Martin & Mayerl, 2023).

The role of T3 in academic performance is of particular interest, given its influence on metabolic rate and cognitive functions (Shahid, et al., 2023, Rakugi, 2023). Previous studies have explored thyroid hormone variations in response to physical and environmental changes (Mohammed, et al., 2023, Vetrani, et al., 2022), but limited research has examined how academic activities specifically affect T3 levels. Understanding this relationship can provide insights into how students adapt physiologically to the demands of academic life and offer a foundation for interventions aimed at optimizing student performance and health.

This study aims to fill this gap by investigating T3 levels during resumption and examinations among first-year medical students. By examining these variations, we aim to elucidate the physiological impact of academic stress, providing a basis for targeted interventions to support student well-being and academic success.

2. METHODOLOGY

2.1 Study Design

This study design was a cross sectional study involving the participation of 30 students of PAMO University of Medical Sciences. Thirty (30) samples (2mls of venous blood) were collected from 100-level students of different departments in PUMS immediately after the resumption and during the examination and

assayed for T3 levels. A statistical comparison was made between the levels of T_3 in students immediately after the resumption and during examination, and in consideration of age and sex.

2.2 Study Area

The research study was conducted in PAMO University of Medical Sciences (PUMS) located at No.1, Tap Road, Elelenwo, Off Aba Expressway, Port Harcourt, Rivers State at a latitude of 4.8598 and longitude of 7.1025.

2.3 Study Population

The study population of interest in this research work was 100 level students of PAMO University of Medical Sciences.

2.4 Eligibility Criteria

The inclusion and exclusion criteria are stated as follows;

2.5 Exclusion Criteria

Students with documented thyroid disorders or other endocrine abnormalities that could influence T3 levels. Individuals undergoing treatment or medication that might interfere with thyroid function. Participants with a history of chronic illnesses or conditions known to affect metabolic processes. Students who experienced significant recent life changes (e.g., surgery or hospitalization) that might impact their physiological baseline.

2.6 Sampling Method

A simple random sampling technique was employed to recruit participants for this study. This was chosen to ensure comprehensive and unbiased representation of the target population.

2.7 Sample Collection

Structured questionnaires were distributed to all participants to collect their information. The identifier was maintained even in blood sample collection to use coherence and easy tracking of participant's data. Blood samples were obtained by venipuncture, drawing 2mls of blood from each participant's cubital vein using sterile disposable syringes. These samples were then placed in plain bottles and left to clot at room temperature for an hour. After clotting, each sample was separated by centrifugation at 3500 revolutions per minute (r.p.m) for 5 minutes using a TDA4 Tabletop Low-Speed Centrifuge, and the serum was collected into plain bottles. The sera were stored frozen at 4-8˚C until the analysis. Before the assay, frozen samples were gently thawed and centrifuged to remove any precipitates.

2.8 Stastistical Analysis

The data generated from this study was analyzed using SPSS (Statistical Package for Social Science) version 23 and statistical significance was defined as a p-value less than or equal to 0.05 at a 95% confidence interval. The levels of triiodothyronine were represented as mean ± standard deviation. A paired t-test was used to compare the levels of triiodothyronine in participants during resumption and examination. An independent t-test was used to compare the levels of triiodothyronine between males and females during resumption and examination. Analysis of variance (ANOVA) was used to compare the levels of triiodothyronine among the different age groups during resumption and examination.

3. RESULTS

Demographic Characteristics of the Participants: This table shows the demographic characteristics of the subjects. Considering gender, 9 (30%) were males while 21 (70%) were females. Considering the age range, 26 (86.7%) were 16 - 17years old, 3 (10%) were 18 – 19 years old, 1 (3.3%) was 20 - 21 years old.

Table 1. Demographic Characteristics of Participants

Characteristics of the Population of test Subjects	Number of Participants	Percentage of the Population (%)
Gender		
Male	9	30
Female	21	70
Age		
16 - 17	26	86.7
18 - 19	3	10
20 - 21	1	3.3

Comparison of T_3 Levels During Resumption and During Examination: This table shows the comparison of Triiodothyronine (T_3) levels during resumption and examination. The serum levels of T_3 in test participants were significantly higher (T – value = 2.39; p = 0.024) during examination (3.39 ± 3.72 nmol/L) than resumption (1.81 ± 0.50 nmol/L).

Table 2. Comparison of the Levels of T_3 during Resumption and Examination

Period	n	T_3 (nmol/L)	T - value	p – value	Inference
Resumption	30	1.81 ± 0.50	2.39	0.024	Significant
Examination	30	3.39 ± 3.72			

Comparison of the Levels of T_3 between Male and Female Participants during Resumption: This table shows the comparison of Triiodothyronine (T_3) between male and female participants during resumption. The serum levels of T_3 between males (2.02 ± 0.81 nmol/L) and females (1.72 ± 0.28 nmol/L) was not statistically significant (T – value =1.16; p = 0.277).

Table 3. Comparison of the Levels of T_3 between Males and Females during Resumption

Gender	n	T_3 (nmol/L)	p - value	T – value	Inference
Male	9	2.02 ± 0.81	0.277	1.16	Non-significant
Female	21	3.39 ± 3.72			

Comparison of the Levels of T_3 between Male and Female Participants during Examination: This table the comparison Triiodothyronine (T_3) between male and female participants during examination. The serum levels of T_3 between males (2.02 ± 0.81 nmol/L) and females (1.72 ± 0.28 nmol/L) was not statistically significant (T – value = 1.036; p = 0.277).

Table 4. Comparison of the Levels of T_3 between Males and Females during Examination

Gender	n	T_3 (nmol/L)	p - value	T – value	Inference
Male	9	5.14 ± 0.98	0.113	1.036	Non-significant
Female	21	2.64 ± 0.52			

Comparison of the Levels of T_3 among the Different Age Groups during Resumption: This table shows the comparison of Triiodothyronine (T_3) among the different age groups during resumption. The serum levels of T_3 in participants between the ages of 16-17 years, 18-19 years, and 20-21 years were 1.83 ± 0.52 nmol/L, 1.61 ± 0.44 nmol/L, and 1.62 ± 0.00 nmol/L, respectively. However, there was no significant difference (F – value = 3.354; p = 0.743) among the age groups of test participants during resumption.

Table 5. Comparison of the Levels of T_3 among Different Age Groups during Resumption

Age	n	T_3 (nmol/L)	F - value	p – value	Inference
16-17 years	26	1.83 ± 0.52	3.354	0.734	Non-significant
18-19 years	3	1.61 ± 0.44			
20-21 years	1	1.62 ± 0.00			

Comparison of the Levels of T_3 among the Different Age Groups during the Examination: This table shows the comparison of Triiodothyronine (T_3) among the different age groups during the examination. The serum levels of T_3 in participants aged 16-17 years, 18-19 years, and 20-21 years were 3.52 ± 3.98 nmol/L, 2.60 ± 0.63 nmol/L, and 2.27 ± 0.00 nmol/L, respectively. However, there was no significant difference (F – value = 0.121; p = 0.88649) among the age groups of test participants during the examination.

Table 6. Comparison of the Levels of T_3 among Different Age Groups during Examination

Age	n	T_3 (nmol/L)	F - value	*p* – value	Inference
16-17 years	26	3.52 ± 3.98	0.121	0.88649	Non-significant
18-19 years	3	2.6 ± 0.63			
20-21 years	1	2.27 ± 0.00			

4. DISCUSSION

Triiodothyronine regulates metabolic processes essential for normal growth and development as well as the regulation of metabolism in adults (Mullur, et al., 2014). It induces effects on practically all nucleated cells in the human body, generally increasing their function and metabolism. It increases Cardiac output, Basal Metabolic Rate, Oxygen consumption, Respiratory rate, and Nervous System activity, while also regulating Reproductive health, Pituitary function, and Renal clearance (Shahid, et al., 2023). Stress during examinations is a significant concern, as this period intensifies the existing academic pressures faced by students. Examinations often heighten anxiety due to the high stakes associated with academic performance, which can impact future opportunities and self-esteem. The stress during this time is compounded by rigorous study schedules, lack of sleep, and fear of failure. This heightened stress can impair cognitive functions, reduce concentration, and negatively affect overall well-being (Koudela-Hamila, et al., 2020). This research study was aimed at evaluating the levels of Triiodothyronine in 100-level students of PUMS during Resumption and Examination.

The results of this study showed that the serum levels of Triiodothyronine in test participants were significantly higher during examinations than at resumption. The observed increase in Triiodothyronine levels in students during exam time compared to the time of resumption could be attributed to several factors. The examination period is often associated with heightened stress levels due to academic pressure and expectations (Koudela-Hamila, et al., 2020). Stress triggers the release of cortisol, which can impact the functioning of the thyroid gland, potentially leading to an increase in Triiodothyronine levels (Healthline, 2024). During intense cognitive activities such as preparation for examination and writing, the body's metabolic rate may increase. This heightened metabolic demand can influence thyroid hormone production and utilization, potentially leading to elevated Triiodothyronine levels (Bennett, et al., 2024). Changes in sleep patterns, including reduced sleep duration or altered circadian rhythms during exam periods, may affect thyroid hormone regulation. Disruptions in sleep patterns can impact the hypothalamic-pituitary-thyroid axis, potentially influencing Triiodothyronine levels (Morgan & Tsai, 2016). Students may undergo dietary modifications during exam periods, such as increased caffeine consumption or changes in meal patterns. These dietary variations can influence thyroid function and subsequently affect Triiodothyronine levels (Duntas, 2023). The level of physical activity may change during exam periods, with some students being less active due to prolonged study hours, while others may use physical activity as a stress-relief mechanism. These variations in physical activity can impact thyroid hormone levels. Therefore, the increased T_3 levels observed in students during exam time compared to resumption could be attributed to a combination of stress response, metabolic demand, sleep patterns, nutritional changes, and physical activity variations during the exam period.

Based on the results of this study, it was reported that the levels of T_3 in males and females during resumption and examination was not statistically significant. The reason for this discrepancy is not fully understood. This was corroborated by the study carried out by (Musa, et al., 2018) which reported no notable difference in T_3 levels between males and females. Following results of this study, it was revealed from this study that there was no variation in T_3 levels across the age groups studied. This implies that age does not have any role on T_3 level but then care must be taken in the interpretation of this result as reports from other studies are not in-tune with this finding. The study by (Taylor, et al., 2023), reported that T_3 level decreases with age.

5. CONCLUSION

The study demonstrated that Triiodothyronine levels were significantly elevated in 100-level students at PUMS during examination periods compared to resumption periods. This increase may be likely driven by the heightened stress and accompanying physiological responses,

including changes in metabolic rate, sleep patterns, diet, and physical activity. No gender differences in T_3 levels were noted in the resumption and their first examination periods. Also, there was no variation in T_3 levels across the age groups studied, potentially due to the limited age range and sample size. This study has therefore, shown that T_3 level was higher during examination than during resumption and there is no gender or age discrimination in the level of T_3 among students in year 1 students of PAMO University of Medical Sciences.

CONSENT

This research included only 100 level students of PUMS, only those willing to provide written consent were included in the study and individuals with no known pre-existing medical conditions or medications which may affect T_3 levels were included to ensure the accuracy of biochemical assessments.

ETHICAL APPROVAL

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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