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ASSOCIATION OF THYROID STIMULATING HORMONES AND CORTISOL LEVELS IN YOUNG ADULTS

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ABSTRACT

Background: Thyroid stimulating hormone (TSH) plays a capacity role in regulating thyroid activity and metabolic homeostasis, and cortisol plays a major role in stress hormone, which regulates physiological reaction to physiological and psychological stress. The two hormones are closely linked with the hypothalamic-pituitary axis and any disruption in one hormone axis can affect the other. According to the recent research, changes in cortisol levels that are caused by stress have the potential to modify thyroid activity, particularly in young adults who experience academic, social, and lifestyle-related stress. Still, there is limited empirical evidence that explains the correlation between TSH and cortisol levels among this group of the population.

Purpose: This study was aimed to define the relationship between the circulating levels of TSH and cortisol amongst young people.

Methodology: all the participants of the study had their venous blood samples taken aseptically and serum obtained by centrifugation. The index of thyroid functions was measured by the levels of serum TSH, triiodothyronine (T3), and thyroxine (T4) and the index of adrenal functions was measured by the means of evening serum cortisol. All the hormonal measurements were done through standardized chemiluminescent immunoassays according to the protocols of the manufacturers. A sandwich immunoassay was used to determine serum TSH and competitive immunoassays were used to determine T3, T4 and cortisol. Strict quality-control measures were put in place in regard to each batch of the analysis to provide accuracy and precision. The level of hormones was also measured within the background of reference ranges.

Findings: 50 young adults (mean age, 24.18 +3.36 years) were recruited into the study; 72 per cent female and 28 per cent male. Thyroid dysfunction had been reported in 54% of the participants, categorized as 31% hypothyroid and 30% cases hyperthyroid. The average serum level TSH concentration was 2.6 ± 1.0 mIU/L and the average evening cortisol level was 13.9 0 -4.93 mg/dL. Afternoon cortisol (>10 mg/dl) was reported in 78 % of the participants indicating a great weight of physiological strain. There were no significant correlations found between cortisol levels and other

variables obtained, i.e. gender, body mass index, anxiety, academic performance, physical activity or perceived stress ($p > 0.05$). However, analysis with the logistic regression indicated significant correlation between TSH and high cortisol rates ($p = 0.02$) with a Nagelkerke R^2 of 0.61, which implies a strong predictive value.
Correlation: The current study has revealed a high level of interdependence between TSH and cortisol levels in young adulthood, indicating a close interaction between the hypothalamic–pituitary-thyroid and the hypothalamic-pituitary-adrenal axes. Elevated cortisol levels are high, which implies that there is a significant stress load in this group. Such outcomes provide an indication of the need to be able to assess endocrinology so that it becomes an integrated approach to which it becomes easy to detect and treat thyroid and stress-pathology in a young age. It would be appropriate to conduct further large-scale, longitudinal studies to explain the causal pathways and the background mechanisms.

Key words: *Thyroid stimulating hormone, cortisol, stress, thyroid functioning, young adults.*

INTRODUCTION

Cortisol and thyroid-stimulating hormone (TSH) serve some of the key functions of the human endocrine and metabolic systems. TSH hormone is produced by the pituitary gland and it plays a vital role in controlling thyroid hormones which subsequently determine energy balance, metabolism and thermoregulation. Cortisol is a glucocorticoid secreted by adrenal glands, which is commonly known as the stress hormone due to its important role in the body when it comes to dealing with stress, inflammatory conditions, and metabolic functions. TSH and cortisol concentrations are especially prone to changes in lifestyle, including diet and physical activity, and quality of sleep in young adults. With the fast-socioeconomic changes in urban centers like Lahore, young adults are now being exposed to stressors that influence the levels of TSH and cortisol. The mechanisms of changes in lifestyle affecting TSH and cortisol are thus necessary in the formulation of specific health-related interventions due to the increase in metabolic disorders at the global and local levels (1).

The dietary habits that are typified by the high consumption of processed food increases the levels of cortisol and may result in hormonal imbalance that is typified by TSH and cortisol. It was found that exercise affected the thyroid activity in a positive way, lowered the concentration of cortisol in body, making the metabolism healthier and alleviating stress. The quality of sleep is another urgent aspect, poor or inconsistency can enhance the release of cortisol, and impairs the process of TSH homeostasis. These lifestyle factors influence TSH balance to a greater extent in young adults as the metabolic and stress effects in this group are all still developing. However, past research has mostly looked at TSH and cortisol as independent variables, little research has been done regarding the interplay between TSH and lifestyle issues in determining the direct relationship between cortisol levels, more so in a relatively young, urbanizing population (2).

Triiodothyronine (T3) and thyroxine (T4) are two different hormones of thyroid gland. The operation of basal metabolic rate is prominent with these hormones. Thyroid gland is an important gland of the endocrine system that unites all hormones excreted by the various glands and the chemical communications along the organism. Thyroid dysfunction may cause hyper secretion or hyposecretion of the hormones hence imbalances of T3 and T4. These imbalances have been associated with such complications as disruption of sleep patterns and cortisol levels. One out of eight women will develop thyroid disease at one time or the other in their life which is subject to growing up and life metabolic issues (3).

A number of experiments have shown that extreme levels of cortisol, which most individuals experience when affected by chronic stress, could potentially inhibit the release of TSH by inhibiting the thyrotropin-releasing hormone (TRH) in the hypothalamus (4).

This process implies that people under stressful conditions over a long period of time are more likely to experience thyroid malfunction, which is evident in subclinical hypothyroidism that is defined by a high level of TSH but normal thyroid hormone levels (5).

On the other hand, there is also a possibility that thyroid malfunctioning affects the production of cortisol. As an illustration, high levels of basal cortisol have been linked to hypothyroidism which is explained by disruptions in the adrenal feedback loops. The clarification of such interrelations is especially essential to young adults, as this group of individuals is often exposed to increased psychosocial pressures that are caused by academic, occupational, and social spheres (6).

TSH and cortisol significantly contribute to physiological homeostasis and it is therefore important to explain the relationship between the two; such knowledge would provide crucial information on the pathophysiology of stress related endocrine conditions. This fact is especially emphasized by the increasing incidence of subclinical hypothyroidism and stress-induced hypercortisolemia in young adults, which implies the need to employ integrative endocrinology mechanisms that would resolve to look simultaneously at both axes in clinical assessment. Longitudinal studies evaluating the effects of changes in TSH and cortisol on health in the long term should be the priority of future research, especially in the case of populations under a risk of increased vulnerability to endocrine dysregulation (7).

There are various determinants of the interaction between TSH and cortisol which include stress, diet, sleep, physical activity and associated environmental exposures. Understanding such interactions is vital in the prevention of endocrine conditions by developing effective preventive measures and the development of curative interventions in such conditions. Due to the widespread stress and resultant hormonal dysfunctions products persistently increasing in a worldwide society, additional studies of the processes involved in the control of TSH and cortisol levels are imperative to ensure that clinical practices and the associated health promotion can be maximized among the young adults.

This is the gap that will be filled in the current study as this paper will analyze the correlation between TSH, lifestyle variables, and the level of cortisol in young adults. The need to conduct research is due to the rising number of stress- and lifestyle-associated disorders and a lack of specific data regarding the impact of these changes in the context of such demographic, in relation to the levels in hormones. The research will help advance the development of preventive measures against the impact of stress on the health risks and metabolic disorders, which is of specific interest in urban population due to the demystification of the role that TSH and lifestyle factors have in influencing cortisol. Moreover, the outcomes can be used in shaping health policies and lifestyle advices that are sensitive to the need of young adults and which can reduce the long-term effect of stress to the health of young adults.

MATERIALS AND METHODS

Study Design and Participants

The present cross-sectional study was carried out to determine association between thyroid stimulating hormone (TSH) and cortisol levels in young adults. 50 healthy participants aged 18-30 years from Riphah International University, Lahore were recruited by using a convenience sampling technique. The study was conducted over a period of six months.

Inclusion and Exclusion Criteria

Healthy subjects aged 18–30 years without a history of thyroid or adrenal disorders were included. Participants taking medications that could potentially affect hormonal levels (e.g. corticosteroids or thyroid hormones) were excluded. pregnant or lactating women, those with endocrine disorders, chronic illnesses or on hormone replacement therapy were also excluded. All participants provided written informed consent.

Data Collection

Data on demographics, medical history and lifestyle factors were collected using a structured questionnaire. Under aseptic conditions, venous blood samples (3–5 mL) were collected and centrifuged at 3000 rpm for 10 minutes to separate serum, which was stored at 2–8°C until analysis.

Biochemical Analysis

Serum TSH levels were measured by chemiluminescent immunoassay, and serum cortisol levels were measured by enzyme linked immunosorbent assay (ELISA). Also, T3 and T4 levels were determined using standard chemiluminescent immunoassay methods.

To account for circadian variation, evening cortisol samples were collected between 4:00 PM and 6:00 PM. All assays were carried out according to the manufacturer's instructions.

Reference Ranges

The reference ranges used were as follows: TSH (0.44–4.0 mIU/L), T3 (0.8–2.0 ng/mL), T4 (5.0–12.0 µg/dL), and evening cortisol (3–10 µg/dL).

Statistical Analysis

The data were analysed using SPSS. Descriptive statistics were computed for all variables. The correlation of TSH and cortisol levels was studied by Pearson correlation analysis. Linear regression analysis was performed to further examine the association. Statistical significance was defined as a $p < 0.05$.

RESULTS

Information provided by a cohort of fifty young adults was studied; 14 of them (28%) were males, and thirty-six of these (72%) were females. The graphical representation of the same is presented in Figure 1.

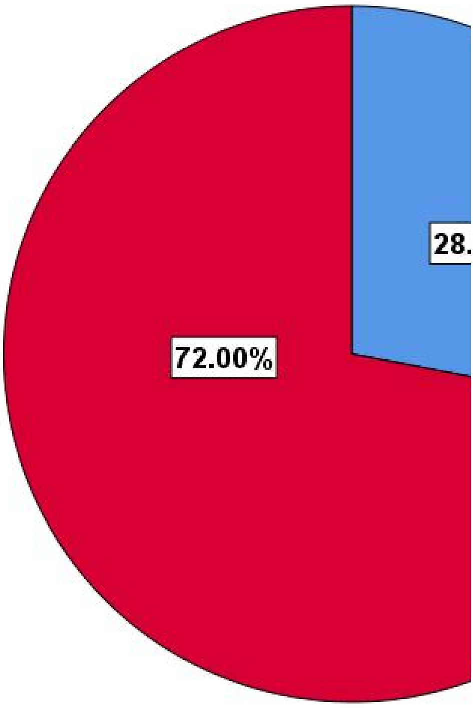

Figure 1 Distribution of genders of participants.

Overall, 18 of the research participants showed euthyroid, 17 broke out with hypothyroidism and 15 broke out with hyperthyroidism as in Figure 02.

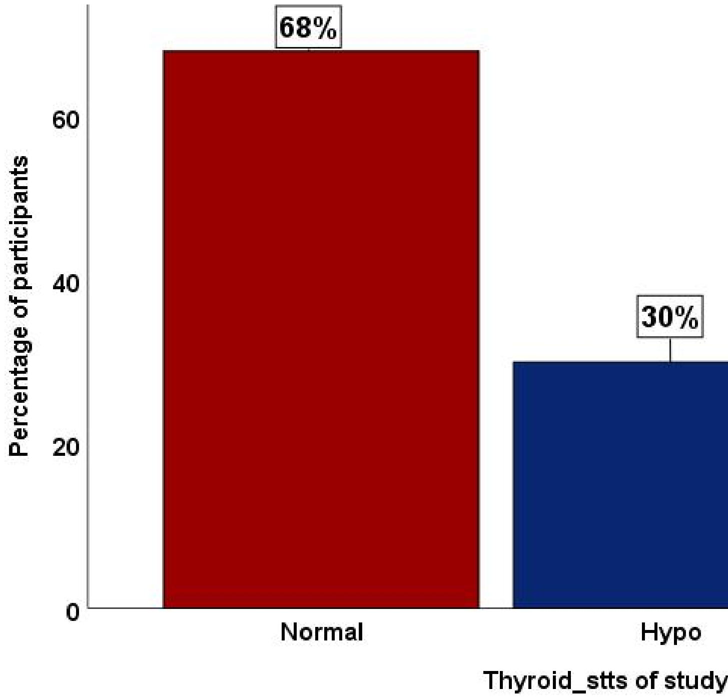

Figure 2 Shows Thyroid status of under study population

The demographic data of participants is shown in Table 01.

Table 1:Demographic Data of study participants.

Variables		Frequency/ Mean ± SD	Mi
Age		24.18 ±3.36	18
Gender	Male	14(28%)	
	Female	36(72%)	
Region	Urban	27(54%)	

	Rural	23(46%)
BMI		23.53 ±2.8
Marrital status	Married	19(38%)
	Unmarried	31(62%)
Working status	Employed	31(62%)
	Unemployed	19(38%)

The participants were also asked about the historical involvement in the different activities; the frequency scales that are related to the topic of the study are also outlined in Table2.

Table 2:Questions asked from study participants.

Variables		**Frequency**	**Percentage**
Smoking Habit	Yes	31	62%
Physical Activity	Low (<30 min weekly)	19	38%
	Moderate(30 to 60 min weekly)	16	32%
	High(60 to 180 min weekly)	15	30%
Stress Level	No	13	26%
	Moderate	22	44%
	High	15	30%
Thyroid disorder	Yes	27	54%
Dietary Habit	Balanced	14	28%
	Bakery Items	16	32%
	Fried Items	20	40%
Anxiety Level	Low	16	32%
	Moderate	18	36%
	High	16	32%
Academic Activity	Below Average	20	40%
	Average	15	30%
	Good	15	30%

Statistical measurement of clinical lab data of participants including TSH,T_3,T_4, and cortisol are shown in table 3.

Table 3: Laboratory parameters of under study participants.

Variables	Mean ± SD	Minimum	Maximum
TSH mIU/L	2.6±1.0	0.62	5.13
T_3 nmol/L	1.2±0.36	0.72	2.18
T_4 mg/dL	8.68 ±1.51	5.60	13.09
Cortisol mg/dl	13.9±4.93	3.41	28.92

In general, 78% of the subjects being studied showed increased cortisol levels in the afternoon as compared to 22 % who showed normal cortisol levels as shown in Figure 03.

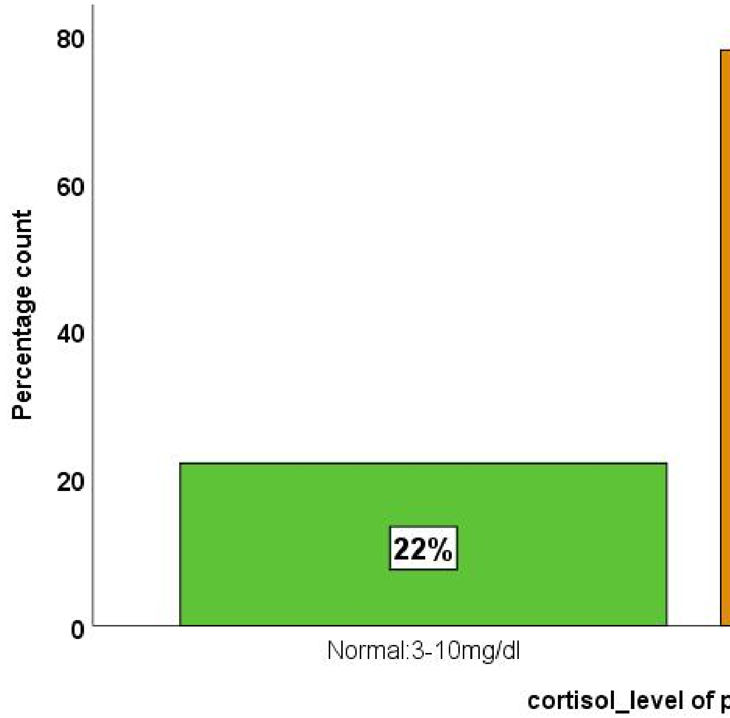

Figure 3 Cortisol level of under study population.

Figure 04 shows the stratification of the thyroid status by sex. Most male cohort contained 8 participants who had euthyroid and 6 who were hypothyroid; comparatively the female cohort contained 26 euthyroid, 9 hypothyroid and 1 hyperthyroid. Although females have a greater number of thyroid disorders, the thyroid status-gender correlation was not found statistically significant (p = 0.407).

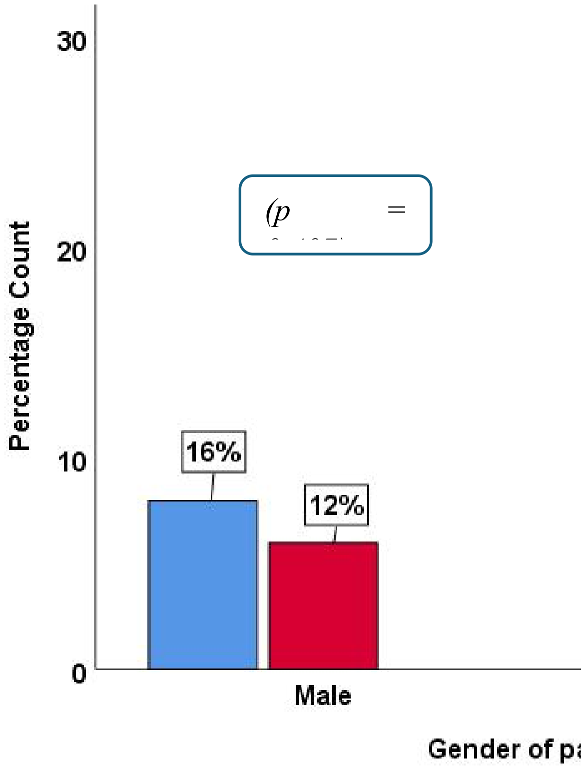

Figure 4 Shows percentages ranges between Thyroid disorder and Gender

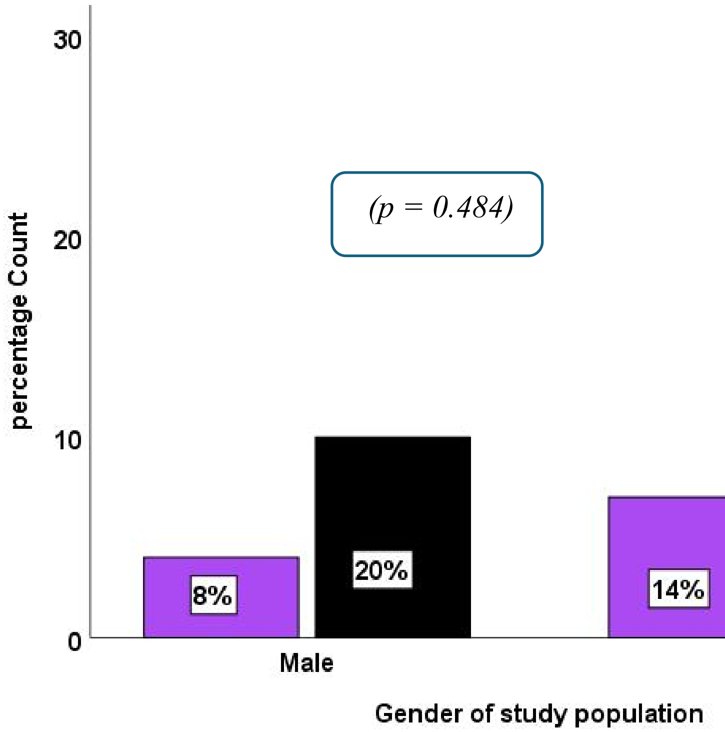

Figure 5 Percentage ranges between Cortisol levels and Gender

The levels of high cortisol were found to be higher in females compared to males, but it was not statistically significant (p = 0.484).

In general, the proportion of participants who had a family history of thyroid disorder was 54% and those who had none was 46%.

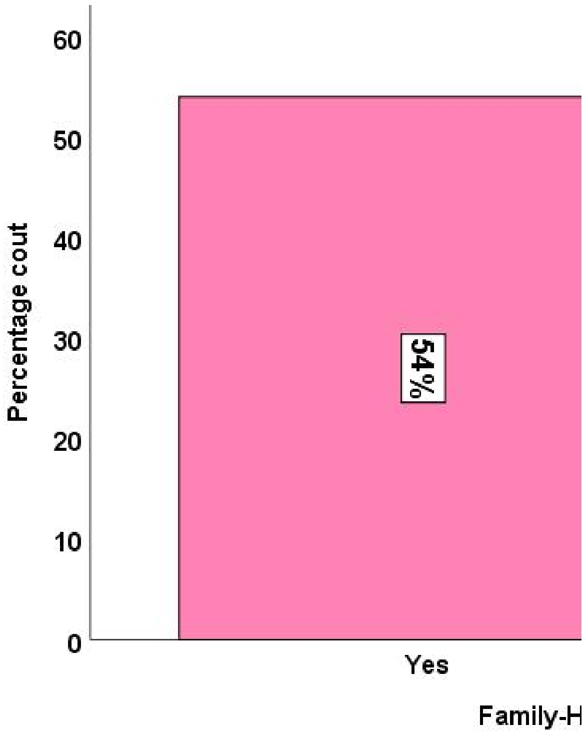

Figure 6 Showing the family history of subjects regarding Thyroid disorder

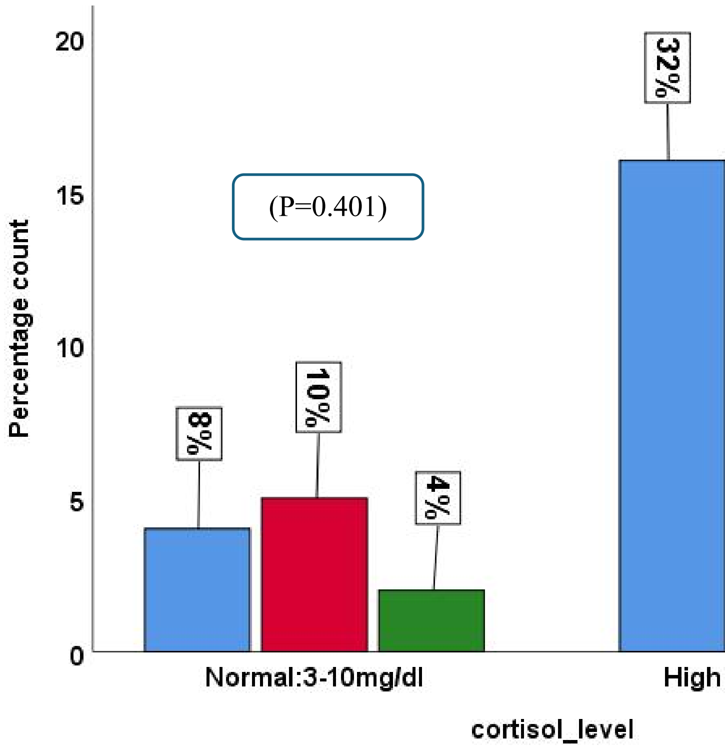

Figure 7 Relationship between cortisol level and academic performance

Figure indicates the cortisol concentrations distribution depending on the academic performance. The greater cortisol levels (>10 mg/dl) were more commonly found without any indication of the academic type. However, there was not statistically significant correlations between cortisol levels and academic achievement (p = 0.401).

Figure 8 demonstrates that a high level of cortisol (>10mg/dl) was highest among the healthy body mass index (BMI) and thereafter in the overweight and underweight groups; the normative levels of cortisol was uncommon among the healthy-BMI and the overweight groups. The mean difference between the cortisol levels and the BMI did not exhibit statistical significance (p = 0.290).

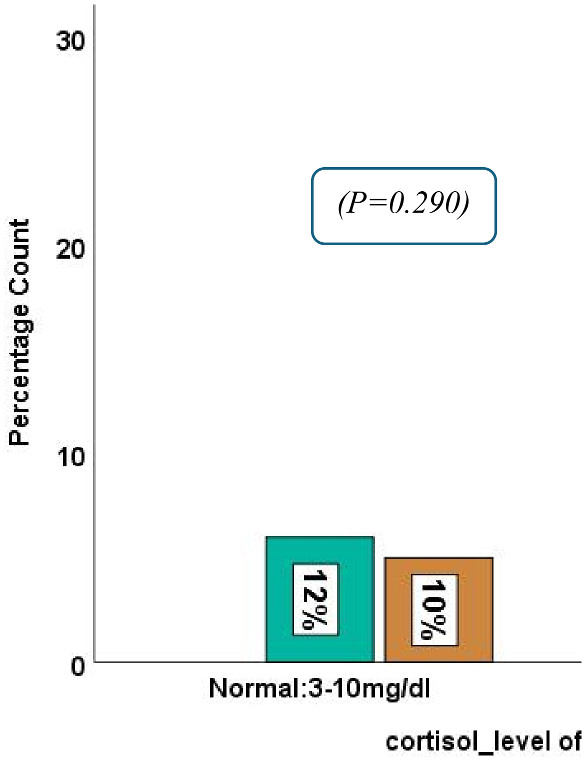

Figure 8 Relationship between cortisol level and BMI

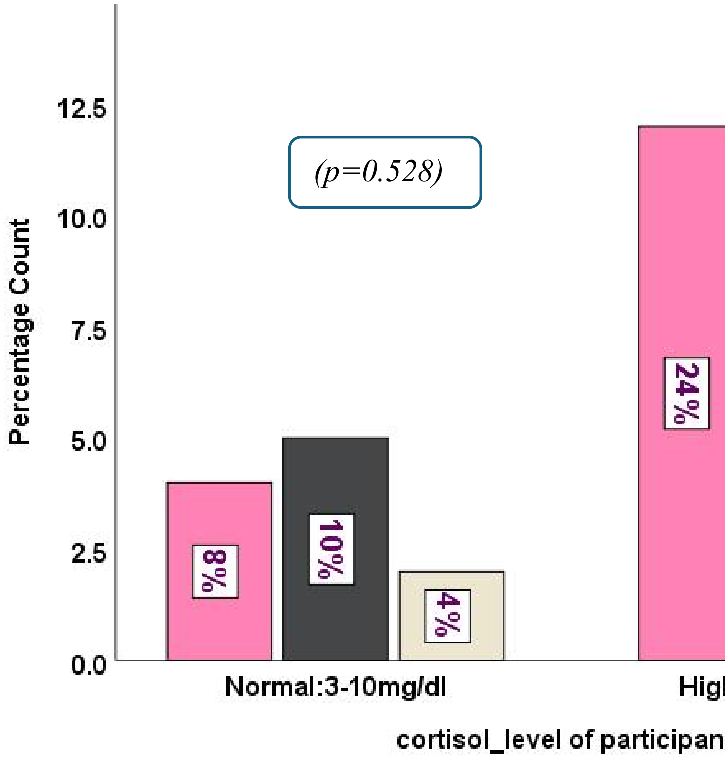

Figure 9 Mean Cortisol level according to perceived anxiety.

The distribution of the cortisol levels against self-reported anxiety levels is shown in figure 9. An increase in cortisol levels (>10 mg⁻ 1 dL) was found in 28 % of the participants reporting high levels of anxiety and 26 % of the participants reporting moderate levels of anxiety, and the proportion of cortisol levels in the range of normalcy (3 -10 mg⁻ 1) was relatively reduced in all levels of anxiety. There was no significant relationship that was observed between the cortisol concentration and body mass index (P = 0.528).

Figure 10 depicts the correlation between the cortisol levels and thyroid between study cohort. High levels of cortisol (>10mg/dl) were most commonly seen in the euthyroid participants (56%), next there were hypothyroid participants (20%), and minorly hyperthyroid participants (2%). Conversely, the euthyroid (12%) and hypothyroid (10%) groups had mostly normal cortisol concentrations (3-10 mg/dl). There was no significant result of cortisol level and body mass index (BMI) (P = 0.411).

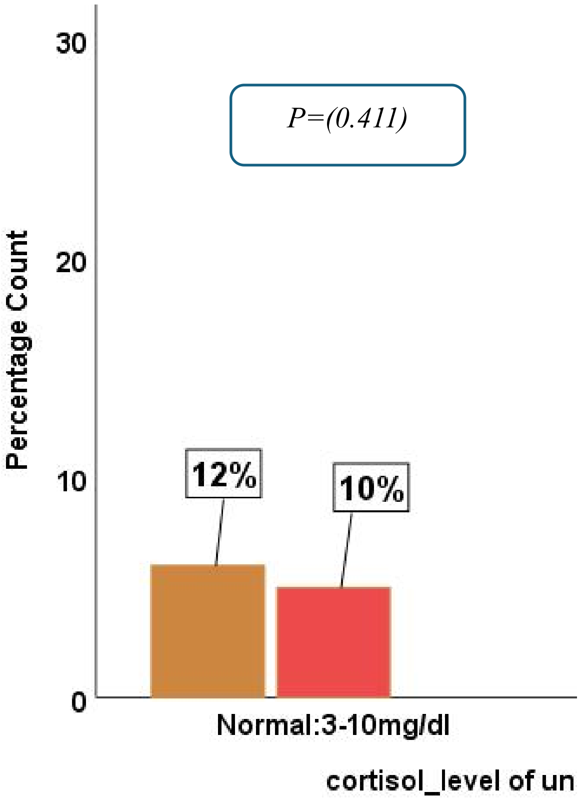

Figure 10 Relationship between Cortisol Level and Thyroid status.

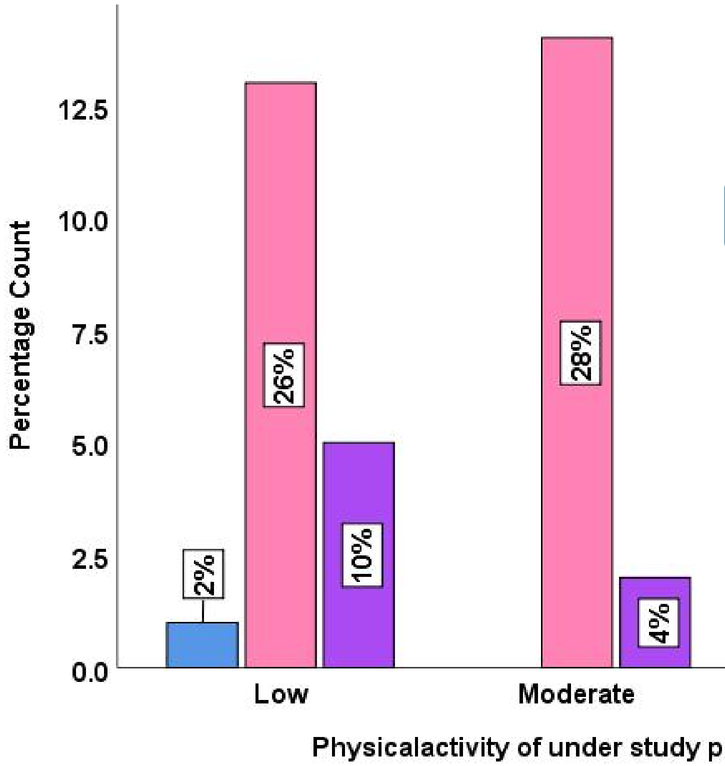

Figure 11 Mean Body Mass Index According to physical Activity Level

Distribution of groups of body mass index (BMI) levels (low, moderate, and high) within the population under study in relation to physical activity (low, moderate, and high). All the activity groups are dominated by people of healthy weight with the biggest proportion in moderate ones with underweight and overweight participants exhibiting lower frequencies. Body mass index and Physical activity, however, do not differ significantly (P = 0.189).

The Logistic regression was carried out, and the Nagelkerke R 2 was 0.61. The level of serum TSH in the study population was significantly correlated (p=0.02) with high levels of cortisol, which was demonstrated in Table.

Table 4:Logistic regression under study participants variable associated with high cortisol level

Variables	Odd ratio (95%CI)
Gender	0.51 (0.33_8.06)
TSH	0.11 (0.01_0.99)
T3	0.48 (0.00_46.8)
T4	0.83 (0.37_1.84)
BMI	14.16 (0.48_417.2)
Physical Activity	0.24 (0.00_7.36)
Sleeping Pattren	1.89 (0.75_4.75)
Anxiety_level	1.28 (0.07_23.81)

Stress Level	2.08 (0.06_
Screen Time	16.05 (0.37

DISCUSSION

The current study was done to evaluate the association between the serum thyroid-stimulating hormone (TSH) and cortisol in a group of young adults, consisting of fifty participants. The median age of the study sample was 24.18 +/-3.36 years, which characterizes a relatively young and demographically homogenous sample. The sample was primarily comprised of female participants 72% of whom is consistent with available epidemiological data suggesting an increased prevalence of thyroid dysfunction and distress-related conditions in women (8).

The present study showed that in the cohort being studied, 54% of the respondents exhibited thyroid dysfunctions of varying severity, 34% were found to have hypothyroid and the remaining 30% were found to have hyperthyroid. It can be contributed by changes in lifestyle, dietary habits, emotional pressure, and genetic disposition since over half of the participants explained that they had a family predisposition to thyroid disorders. Similar findings also have been observed by both regional and international studies which recorded an increase in cases of thyroid abnormality in young adults (9,10).

The overall serum TSH level was 2.6, SD 1.0, miu/L, and this value is within the required reference range; however, it has a significant inter-subject standard deviation. The average cortisol level was 13.9 +/- 4.93 mg/dL and most importantly, 78 percent of the study members displayed high afternoon cortisol levels (>10mg/dl). This finding indicates a significant physiological phenomenal load among the young adult population which could be explained by academic pressures, sleep habits, irregular sleeping, and psychosocial pressures. High levels of cortisol are also well reported among the youngsters and related to academic stress, anxiety, and disturbed sleep patterns (11).

The gender-based analysis showed that females had more prevalence of thyroid disorders and higher levels of cortisol levels compared to males; these studies were not found to be statistically significant. Current literature hypothesizes that the women are prone to the thyroid dysfunction and hypothalamic-pituitary-adrenal HPA axis dys-regulation, and this fact can be accounted by hormonal variation and psychosocial pressing (12, 13).

The inabilities to observe statistically significant differences in the present study could be attributed to the use of a small sample size. Cortisol levels and academic performance, body mass index, anxiety, physical activity, and perceived stress did not show any meaningful correlations. These findings are similar to other studies who have found weak or inconsistent associations between single cortisol assessments and psychosocial or lifestyle factors, especially in cross-sectional designs (11, 14). Secretion of cortisol follows a circadian pattern and is regulated by acute and chronic stressors and maybe not well represented by afternoon sampling.

It is important to note that the log group regression showed that there was a significant association of thyroid-stimulating hormone (TSH) with high cortisol levels (p=0.02) with Nagelkeke R 2 =0.61 indicating the powerful explanatory effect of TSH on high cortisol levels. This observation supports the physiological interaction between the Hypothalamic pituitary Thyroid axis (HPT) and HPA axis. Previous literature has indicated that a rise in cortisol has the capacity of inhibiting the secretion of TSH, but thyroid hormones can alter adrenal responsiveness suggesting a two-way process (15). The immense relationship discovered herein supports the impetration of analyzing both endocrine axes when evaluating maniacal and thyroid diseases in relation to stress.

Altogether, the evidence shows that despite all other demographic and lifestyle factors, which could affect cortisol levels, TSH is a clear predictor of cortisol dysregulation in young adults. These results support the need to have a detailed hormonal evaluation among the individuals with symptoms of stress or thyroid malfunction.

CONCLUSION

The current study creates statistically effective correlation between the level of thyrotropin (TSH) and the levels of cortisol in the circulation of a group of young adults. An exceptionally enormous percentage of the participants showed supra physiological concentration of cortisol in late afternoon sampling period, indicative of extreme neuroendocrine exposure to stress. The results on the coverage of variables including, sex, body mass index, self-reported anxiety, physical activity, and academic achievement, showed that there was no significant association with cortisol but TSH all the time proved to be a powerful predictor of high levels of cortisol concentration. All these findings stress the highly complex physiologic interaction between endocrine and exocrine axes and underline that endocrine balance is essential to maintain metabolism and the psychosocial well-being.

This study provides necessary baseline information on endocrine crosstalk in young adults and suggests that simultaneous measurement of thyroid activity and cortisol release would be a clinically useful test in people who display stress-related effects.

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