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Prevalence and associations of thyroid dysfunction with metabolic markers blood glucose and lipid profile: A cross-sectional study

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Abstract

Thyroid hormone contains two vital hormones. Triiodothyronine (T3) and thyroxine (T4), are necessary for regulating metabolism, including glucose homeostasis, lipid metabolism, and cholesterol synthesis. In this cross-study, a total of 199 patients both males and females included, investigated the interrelation between thyroid function test, lipid profile, and Random blood sugar which were shown to be significant because these are the main factor that affects thyroid hormone and data was analyzed using SPSS version 25. The results suggest that thyroid function plays a role in metabolic health. Furthermore, a significant relationship was identified between TSH and random blood sugar (RBS) that can cause hypoglycemia, indicating a potential link between thyroid function. The mean and standard deviation of T3 is 2.1 ± 2.5ng/ml, T4 3.8 ± 5.9 P mol/L, TSH 5.4 ± 13.3 PIU/ml, RBS 100 ± 45mg/dl which is on the lower limit, TG 200 ± 45mg/dl, Cholesterol 201 ± 25mg/dl are on upper limit can cause dyslipidemia. There is a negative association between TSH and random blood sugar with P< 0.05. These findings have implications for understanding thyroid disorders and their impact on metabolic health.

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Introduction

Thyroid dysfunction is a common endocrine disorder characterized by abnormal production or regulation of thyroid hormones. There are two thyroid hormones, triiodothyronine (T3) and thyroxine (T4) that are essential for controlling metabolism, including glucose homeostasis and lipid metabolism. Thyroid-stimulating hormone (TSH) is released by the pituitary gland and regulates thyroid hormone release (Zuarth-Vázquez *et al*., 2023 & Kube *et al*., 2020). Dyslipidemia, irregular blood glucose levels, and changes in cholesterol profiles can be caused by thyroid hormone imbalances that may increase the risk for diabetes, heart disease, and obesity (Kube *et al*., 2020). Globally, thyroid dysfunction affects millions of people, and its prevalence differs by country and region. Among the general population, approximately 4.6% have hypothyroidism and 1.3% have hyperthyroidism, according to one study. However, these prevalence rates can differ based on geographical location, age, gender, and iodine status (Stagnaro-Green *et al*., 2020). Other studies reported that thyroid dysfunction, particularly hypothyroidism, has been associated with impaired glucose metabolism (Biondi *et al.,* 2010). Insulin resistance, reduced glucose tolerance, and raised fasting blood glucose levels have all been linked to subclinical hypothyroidism, which is characterized by elevated TSH levels with normal T3 and T4 levels.

Moreover, increased levels of triglycerides (TG) and total cholesterol can hypothyroidism. (Stuijver, van Zaane *et al.,* 2012). There is an association between thyroid illness and diabetes mellitus are both prevalent endocrine conditions in the general population 10% of diabetics had thyroid autoimmunity. Higher blood glucose levels may result from increased glucose synthesis and impaired glucose absorption caused by elevated thyroid hormone levels cause hyperthyroidism (Akbar *et al.,* 2006 & Kim *et al*., 2017). Diabetes patients have a much greater frequency of thyroid illness than the overall population. The main is reason is that there is insulin resistances that can cause high TSH levels, although these not statistically significant (Kocaturk *et al.,* 2020).

T3 and T4 levels that are elevated can boost lipolysis (the breakdown of fats) and free fatty acid levels in the blood. Rising thyroid hormone levels can lower cholesterol levels vice versa (S. Attaullah *et al.,* 2016). The study reported that there is no link between thyrotropin levels and the occurrence of meteorological conditions (Ding *et al*., 2021). Dyslipidemia, particularly high levels of triglycerides and total cholesterol, has been linked to hypothyroidism. Increased triglyceride levels have also been connected to subclinical hypothyroidism (Kyriacou *et al.,* 2015 & Langer *et al*., 1997). Blood glucose and dyslipidemia levels are dramatically elevated in females with hypothyroidism which shown that increase in thyroid stimulating hormone (TSH) levels and a considerable fall in thyroxin (T4) levels (Al-Fatlawi *et al.,* 2022).

Therefore, the primary objective of this cross-sectional study is to determine the prevalence of thyroid dysfunction in District Peshawar KPK and investigate its associations with metabolic markers, including blood glucose levels, triglycerides, and cholesterol profiles. We have included patient with age ranges 10-70 year of both genders, excluded who has systemic illness or chronic diseases like cardiovascular diseases, renal dysfunction, liver diseases and Pregnant or lactating women, as hormonal changes during pregnancy can affect thyroid function and metabolic markers.

Material and method

Study design

A cross-sectional observational study is conducted in Tehqeeq clinical Laboratory Peshawar, with total sample size of 100 individual patients from both male and female.

Stastical analysis

Statical analysis of data will be perform using SPSS version 25.

Sample processing

i. Sample collection

A sample will be collect using sterile injection of 5ml and store in heparin or gel top to separate serum after centrifugation.

TFT and lipid profile will be collected in heparin tube or gel top and for. The samples are handled and stored based on the specific requirements for each test

ii. Assessment of thyroid function test & lipid profile

The samples for TFT and lipid profile are collected in heparin tube & gel top and labeled with unique identifiers. Then after that sample is centrifugation and serum are sperate and mix with reagent according manufacture instruction. TSH, T3 and T4 test is setup in biochemistry analyzer after calibration set same as for lipide profile.

iii. Assessment of Blood sugar

The samples for blood sugar are collected in heparin tube and labeled with unique identifiers. Then after that sample is centrifugation and serum are sperate and mix with reagent according manufacture instruction. Biochemistry analyzer setup for RBS and sample is after incubation of 10 minute.

Ethical Approval

Ethical approval is taken from the institutional Ethics Review Board committee of Abasyn University Peshawar with an Approval certificate *(Reference No.* IERC-AUP-2023-009). Ethical principles will be utilized such as to protect the rights, dignity, and safety of all participants. The researcher has applied the following ethical principles, as outlined, respect for personal autonomy, the principle of beneficence and non-maleficence, informed consent, the principle of justice, and privacy and anonymity. Consent was signed by the participants. Code names were used to maintain anonymity.

Result

A total of 199 participate both male and female were included, in which male 30.7% (*n*=61) and female 69.3% (n=138) show in the fig. (1), with minimum age of individual is 16 year and maximum 70 year with mean and standard deviation 34 ± 14, in which majority were between 15 to 30 year 59.3%(*n*=118), 31 to 50 year 25.13% (*n*=50), 51 to 70 year 16.58%(*n*=33) show in the Fig. (2) were study for thyroid function test and metabolic marker.

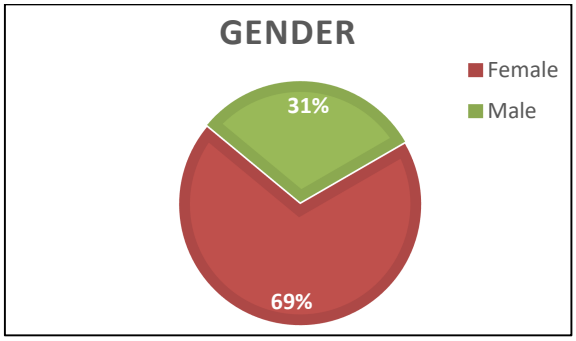

Fig. 1. Gender.

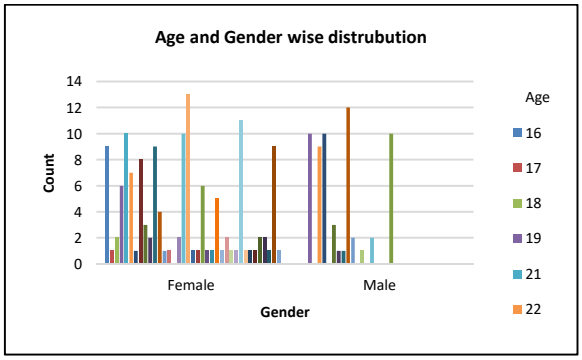

Fig. 2. Age and Gender wise distribution.

The normal range for TSH is 0.38-4.31 PIU/ml, T3 0.79-1.58ng/ml, T4 0.78-1.79 P mol/L. The chi-square test statistics for T3 (Triiodothyronine), T4 (Thyroxine), Thyroid stimulating hormone, Triglyceride, and Cholesterol are all highly significant ($p < 0.001$), suggesting that there are significant relationships among these variables show in the fig. (3).

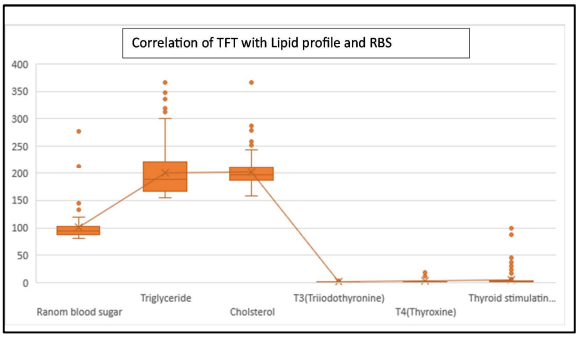

Fig. 3. Correlation of TFT with Lipid profile and RBS.

The mean and standard deviation of T3 is 2.1 ± 2.5, T4 3.8 ± 5.9, TSH 5.4 ± 13.3, RBS 100 ± 45 which is on lower limit side, TG 200 ± 45, Cholesterol 201 ± 25 shows in the table (1). The statically result shows that there are significant changes in lipid profile in hyperthyroidism.

Table 1. Descriptive Statistics of TFT and RBS, Lipid profile.

	Mean	SD	Minimum	Maximum
T_3 (Triiodothyronine)	2.12	2.52	0.07ng/ml	9.27ng/ml
T_4 (Thyroxine)	3.84	5.91	0.01 P mol/L	19.31 P mol/L
Thyroid-stimulating hormone	5.43	13.36	0.01 PIU/ml	100 PIU/ml
Random blood sugar	100.78	24.78	80mg/dl	281mg/dl
Triglyceride	200.44	45.27	154mg/dl	366mg/dl
Cholesterol	201.89	25.27	158mg/dl	366mg/dl

There is a statistical link between TSH and RBS. Significant Pearson Chi-Square (p 0.001) indicates a substantial association. Less significant likelihood ratio (p = 1.000) indicates no connection. There is no linear trend, and the linear-by-linear association is not significant (p = 0.606).

Discussion

In the study, thyroid function tests (TFTs) and metabolic markers were measured in the participants. It was provided the normal ranges for TSH, T3, and T4. Based on chi-square test statistics, significant correlations were found between T3, T4, TSH, triglycerides, and cholesterol (p= 0.001). There was a significant change in lipid profiles in hyperthyroid patients based on the statistical results. Additionally, the chi-square test findings (p 0.05) from the statistical analysis showed a substantial correlation between TSH and random blood sugar (RBS). The study contributes to our comprehension of thyroid diseases and their potential effects on metabolic health by providing insightful information on the link between thyroid function and metabolic markers. The lipid profile can be greatly affected by thyroid dysfunction. All dyslipidemia individuals, as well as all patients who have an unanticipated increase or decrease in their lipid profile, require biochemical evaluation for thyroid dysfunction (Rizos *et al.*, 2011). Ultimately, dyslipidemia, which is one of the main risk factors for atherosclerosis and coronary disease, is increased in both hypothyroid and hyperthyroid individuals. Patients with hypothyroidism had higher total cholesterol, lower HDL cholesterol, and higher levels of VLDL cholesterol. Additionally, hyperthyroidism individuals have higher levels of total and LDL cholesterol as well as lower levels of HDL-C (Kung AW *et al.*, 20115).

The prevalence of thyroid dysfunction in the study was 3.70 percent for overt hypothyroidism, 14.11 percent for subclinical hypothyroidism, 3.35 percent for overt hyperthyroidism, and 4.5 percent for subclinical hyperthyroidism, respectively (Luboshitzky R *et al.*, 2003). Both overt and subclinical hypothyroidisms are accompanied by a rise in triglyceride levels. In the instance of subclinical hypothyroidism, the variance was statistically significant (p=0.000), whereas in the case of overt hypothyroidism, it was only marginally significant (p=0.069). The reduction in lipoprotein lipase activity, which is responsible for eliminating triglyceride-rich lipoprotein, is the factor that causes the rise in triglyceride levels in hypothyroidism (Tan *et al.,* 1998). Overt hyperthyroidism was shown to have lower levels of TC, LDL, and TG, while having higher levels of HDL. However, TC and LDL values were statistically insignificantly elevated non subclinical hyperthyroidism (Duntas *et al.,* 2002). In general, abnormal lipoprotein levels are linked to both overt and subclinical hypothyroidism, which can result in cardiovascular problems. In order to reduce the cardiovascular risk from dyslipidemia, it is vital to test dyslipidemic patients for thyroid abnormalities along with appropriate replacement therapy. It has been shown that the aberrant lipid pattern is totally restored to normal by treatment with thyroxine (Shahnaz Attaullah *et al.,* 2015). According to our research, type 2 diabetes individuals should be screened for thyroid dysfunction since it might cause serious metabolic problems (Shrestha *et al.,* 2011).

Conclusion

One hundred and ninety-nine participants from this study were examined for the relationship between thyroid function tests (TFT), metabolic markers, and lipid profiles. These findings suggest that thyroid function plays a role in metabolic health and lipid metabolism. There was also a significant correlation between TSH and random blood sugar (RBS), indicating a possible link between thyroid function and glucose regulation. These findings enable us to comprehend thyroid disorders and the way they affect metabolic health.

Recommendation

I. Larger-scale research projects with a more varied sample group might aid in testing and extending the results. A deeper examination of these relationships (across various age groups, ethnicities, and geographic areas) would be possible.

II. Long-term prospective studies are needed to examine the temporal relationship between thyroid function and metabolic markers.

III. Need deep research in risk assessment, therapy planning, and management techniques may be aided by monitoring thyroid function in people with metabolic disorders or dyslipidemia.

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Conflict of interests

The authors declare no conflicts of interest.

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