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Lipid levels among euthyroid patients attending a medical college hospital

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Abstract
Background: *Though the relation between thyroid hormones and lipid levels is well established, the effect of thyroid-stimulating hormone (TSH) within the reference range on lipid levels is still unknown.*
Objective: *This study aimed to assess the lipid levels among euthyroid subjects.*
Methods: *This cross-sectional study was conducted in the Department of Pathology, Barind Medical College, Rajshahi for a period of six months. A total of 240 euthyroid participants were included in the final analysis of this study according to inclusion and exclusion criteria. Informed written consent was taken from each participant and ethical issues were followed according to the Declaration of Helsinki. Data collection was conducted through a semi-structured questionnaire. Each participant underwent detailed history taking, physical examination, and laboratory investigations. For data analysis, SPSS V-22 was used. Kruskal-Wallis test was conducted to determine the relation between variables and a p value of <.05 was considered as significant.*
Result: *Mean age of the euthyroid patients was 45.02±13.21 (SD)with slight female predominance (42.1% male and 57.9% female). Elevated triglyceridelevels, abnormalLow-Density Lipoprotein Cholesterol (LDL-C) levels, Low High-Density Lipoprotein Cholesterol (HDL-C)levels were observed in 41.7%, 51.4%, and 49.6% of the participants accordingly. Abnormal cholesterol was observed in 30.5% of participants. No significant relation was observed between serum lipid levels and TSH (p>.05). Linear relation between TSH and lipid levels among male and female participants showed non-significant linear correlation.*
Conclusion: *Abnormal lipid level was quite frequent among euthyroid patients but no significant relation was observed between TSH within reference range and lipid levels.*

Keywords: Euthyroid, Lipid metabolism, Dyslipidemia, TSH, Thyroid dysfunction

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I. Introduction

The significance of thyroid dysfunction on serum lipid levels was first established in 1930 by Mason et al.[1] and later the association between thyroid hormones and lipid levels has been firmly established among patients with thyroid insufficiency.[2] Thyroid hormones are catabolic hormones responsible for the regulation of a variety of metabolic processes and growth along with many other bodily functions.[3,4] Increased levels of serum cholesterol and triglycerides were observed to be associated with hypothyroidism and vice versa.[2] A potential role of thyroid hormones has been observed in the induction of 3 hydroxy 3 methyl glutaryl CoA reductase (HMG-CoA) reductase, low-density lipoprotein receptor (LDLR), lipoprotein lipase, cholesteryl ester transfer protein and apolipoprotein AV, which are responsible for the different metabolic pathways of lipids.[5–8]

Recently, some studies reported the relationship between lipid metabolism and thyroid functioning even among patients without any thyroid disorder.[9–11] This observation has drawn the attention of advanced medical science because it indicates the role of thyroid stimulating hormone (TSH) in lipid metabolism. Pallass et al. and Bakker et al. reported an association between TSH in the upper level of the reference range and high serum cholesterol among euthyroid subjects.[12] On the other hand, Bakker et al. observed a negative association of TSH with low-density lipoprotein-cholesterol (LDL-C) and high-density lipoprotein-cholesterol (HDL-C).[13]

Michalopoulu et al. reported a reduction in serum cholesterol and LDL-C after the administration of oral thyroxine among euthyroid patients with TSH in the upper levels of the reference range.[14]

Lipid abnormalities, including hypertriglyceridaemia, low HDL-C and high LDL-C, are strongly associated with obesity, insulin resistance, atherosclerotic disease and coronary heart disease.[15–18] Ensuring lipid levels in the recommended range among the general population is a primary public health concern. Due to recent trends of excessive fast food and soft drink consumption, sedentary lifestyle, lack of optimum physical activity, lack of regular screening of cardio-metabolic risk factors, maintaining lipid levels in the reference range is challenging in South Asia as well as Bangladesh. If the role of TSH in lipid metabolism could be well established, it would indicate the possibility of utilizing TSH to control lipid levels. Trends in lipid levels and their relationship with thyroid function in the Bangladesh context have yet to be evaluated. Thus, the present study aimed to assess the relationship between lipid profiles and thyroid stimulating hormones among euthyroid individuals.

II. Materials and Methods:

Study design and location: This study was a cross-sectional study that took place in the Department of Pathology, Barind Medical College, Rajshahi. The study period was six months starting from January 2022 to June 2022.

Study population: Euthyroid male and female subjects aged more than or equal to 18 years attending Barind Medical College during the study period were approached for inclusion in this study. A history of any thyroid disorder (hypothyroidism, hyperthyroidism, thyroid carcinoma, thyroid nodules), history of any surgery on the thyroid gland, history of taking thyroid supplementation, anti-thyroid agents, and history of taking lipid-lowering agents such as statins were considered exclusion criteria for study subjects. A total of 285 subjects were selected purposively according to inclusion and exclusion criteria and following informed written consent.

Data collection procedure: A semistructured questionnaire was constructed for data collection. The questionnaire contained two parts: sociodemographic information and laboratory results. Prior to enrollment, all subjects were thoroughly briefed regarding the aim and objective of the study. Following the proper consent procedure, 285 subjects were included as study participants. An interview was held for sociodemographic information. Then, anthropometric measurements weretaken. Height was measured in a standing posture without wearing shoes using a measuring tape. Body weight was measured in light clothing and without shoes by a weight measuring scale. All measurements were carried out three times, and the average measurement was taken. The same instruments were used for all participants to avoid bias.

Venous blood was collected from the participants. All subjects were instructed to fast for at least eight hours prior to blood collection for investigation. Following blood collection, the serum was extracted by centrifugation for 10 minutes at 3000 rpm using a refrigerated centrifuge and stored at -70°C. For measurement of triglycerides (TGs) and high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C), an enzymatic color test was adopted using a Beckman Coulter AU480. Serum total cholesterol (TC) was determined by the enzymatic endpoint method. Serum thyroid stimulating hormone (TSH) and thyroxin (T4) were determined using an automated chemiluminescence immunoassay analyser.

Euthyorid status was defined as a TSH level of 0.34–5.60 μIU/mL and T4 = 0.65–1.74 ng/dL.[19] Subjects with TSH and T4 levels higher and lower than the reference range were excluded from this study. After measurement of TSH and T4, 45 subjects were excluded due to abnormal TSH and T4 levels. Finally, 240 patients were included in the analysis.

Body mass index (BMI) was calculated by the following formula:

BMI= Body weight in $^{kg/height}$ inm^2

Subjects were considered underweight when BMI was <18.5 kg/m^2, where normal weight was considered with a BMI of 18.5–24.9 kg/m^2, overweight was considered with 25.0–29.9 kg/m^2 BMI, and obese was considered with ≥30.0 kg/m^2 BMI.[20]

Lipid levels were classified as follows:

Serum LDL-C:

Optimal- <100 mg/dl

Near Optimal- 100-129 mg/dl

Borderline High- 130-159 mg/dl

High- 160-189 mg/dl

Very High- ≥190 mg/dl

Serum TC:

Desirable: < 200 mg/dl

Borderline High: 200-239 mg/dl

High: ≥240 mg/dl

Serum HDL-C:

Low: <40 mg/dl
Normal: 40-60 mg/dl
High: >60 mg/dl
Serum TG:
Optimal: ≤150 mg/dl
Elevated: >150 mg/dl

Ethical issue: The Declaration of Helsinki was followed in every aspect of this study. Ethical approval for this study was obtained from the Ethical Review Committee (ERC) of Barind Medical College, Rajshahi. Informed written consent was ensured from each participant. Participants' anonymity was maintained with the highest priority.

Statistical analysis: Statistical Package for Social Sciences (SLSS) V-22 was used for statistical analysis. Continuous variables are presented as the mean ± standard deviation. Categorical variables are presented as frequencies and percentages. Normality of the variables was determined by the Shapiro–Wilk test. Differences in serum lipid levels among categories of TSH were determined by the Kruskal–Wallis test. Linear relationships between TSH and lipid levels were determined by Pearson correlation tests and scatter plot diagrams. A p value less than.05 was considered significant.

III. Result

The mean age of the studied participants was 45.02±13.21 (SD) years, and almost half were aged between 31-50 years. A female predominance was observed, with a male:female ratio of 1:1.37. According to body mass index (BMI), nearly two-thirds of the participants had normal nutritional status, where 35.4% were overweight and.7% were obese.

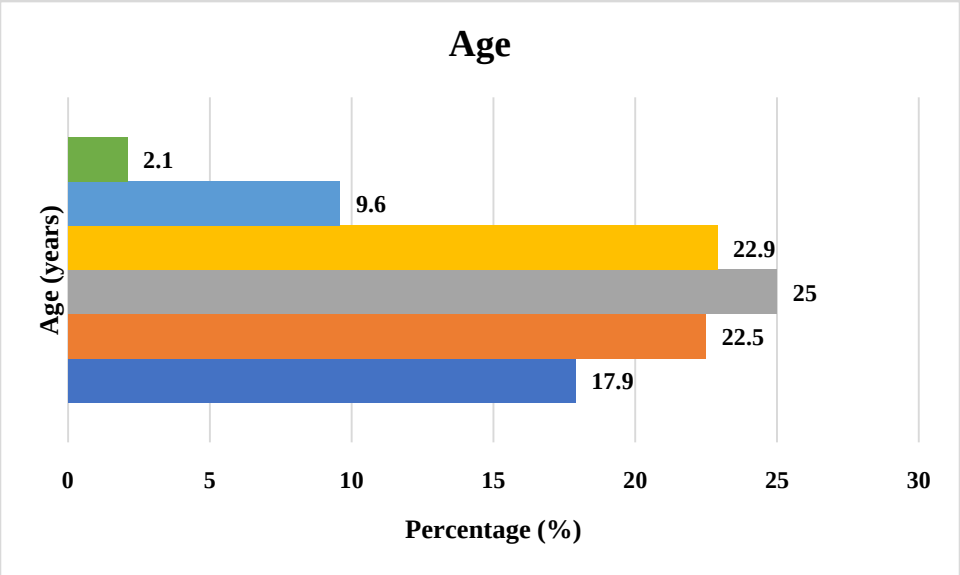

Figure 1: Distribution of the respondents by age (n=240)

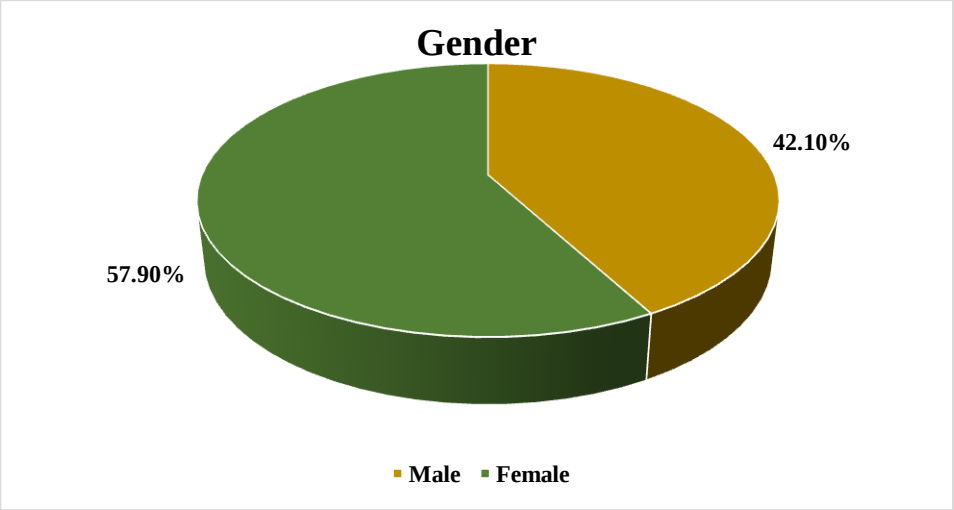

Figure 2: Distribution of the respondents by gender (n=240)

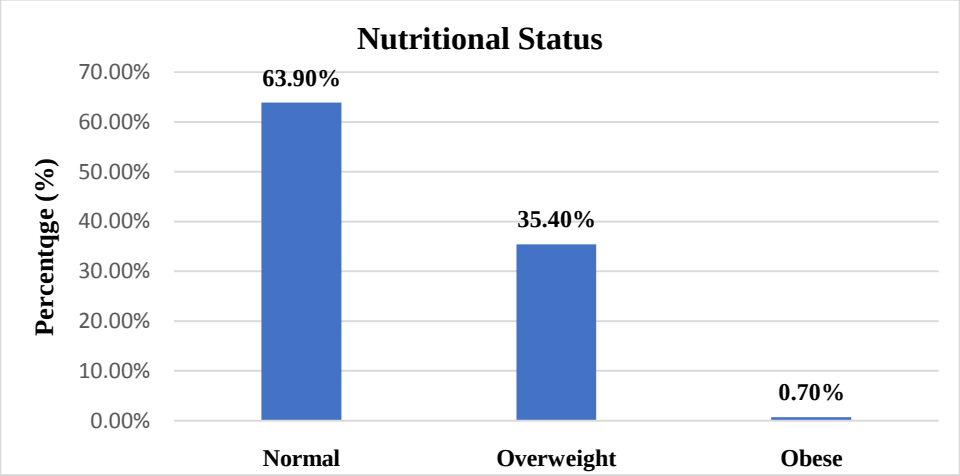

Figure 3: Distribution of the respondents by nutritional status (n=240)

Among serum lipid levels, serum triglyceride levels and serum levels of low-density lipoprotein cholesterol (LDL-C) were higher, and high-density lipoprotein cholesterol (HDL-C) was lower thanthe optimal level in more than half of the participants. Serum cholesterol levels were desirable in more than two-thirds of the patients.

Table 1: Serum lipid profile of study participants (n=240)

	n	%
Serum Level of TG		
Optimal	100	41.7
Elevated	140	58.3
Serum Level of TC		
Desirable	167	69.6
Borderline High	52	21.7
High	21	8.8
Serum Level of LDL-C		
Optimal	119	49.6
Near Optimal	77	32.1
Borderline High	33	13.8
High	6	2.5
Very High	5	2.1
Serum Level of HDL-C		
Low	119	49.6
Normal	107	44.6
High	14	5.8

TG: Triglyceride, TC: Total Cholesterol, LDL: Low-Density Lipoprotein, HDL: High-Density Lipoprotein

Serum lipid levels were statistically similar in all ranges of thyroid-stimulating hormones

Table 2: Geometric mean of serum lipids (mg/dl) according to categories of thyroid stimulating hormone (TSH) among euthyroid participants (n=240)

Lipid profile	TSH categories (mIU/L)											p value*
	.34-.49 n=2	.5-.99 n=24	1-1.49 n=44	1.5-1.99 n=43	2-2.49 n=31	2.5-2.99 n=28	3-3.49 n=18	3.5-3.99 n=18	4-4.49 n=11	4.5-4.99 n=12	5-5.6 n=9	
TG	211± 168.29	208.12 ±156.06	214.40 ±156.06	166.34±74.88	234.70 ±123.98	234.57 ±123.98	158.88±94.73	175.80 ±105.40	240.36 ±150.79	262.41 ±147.60	220.77 ±116.32	.101
TC	173± 66.46	172.87 ±33.64	184.86 ±50.67	180.95±37.08	186.35 ±51.87	191.50 ±57.63	167.33 ±33.26	183.16 ±27.99	174 ±38.50	181.83 ±46.61	161.11 ±39.71	.531
LDL	99± 42.426	94.37 ±26.06	103.02 ±36.35	106 ±31.34	106.32 ±34.16	111 ±37.96	91.83±29.47	111.33 ±33.32	87.90 ±26.02	96.50 ±31.96	83 ±31.68	.323
HDL	31.50 ±9.19	41.29 ±11.48	38.59 ±11.01	38.39 ±9.5	38.30 ±9.5	41.11 ±10.44	45.16 ±10.61	46.50 ±24.05	37.63 ±8.58	38.58 ±8.44	37.55 ±18.47	.502

TG: Triglyceride, TC: Total Cholesterol, LDL: Low-Density Lipoprotein, HDL: High-Density Lipoprotein
*p value was determined by Kruskal–Wallis test

The serum lipid level and thyroid stimulating hormone showed no significant linear correlation in the scatter plot diagram.

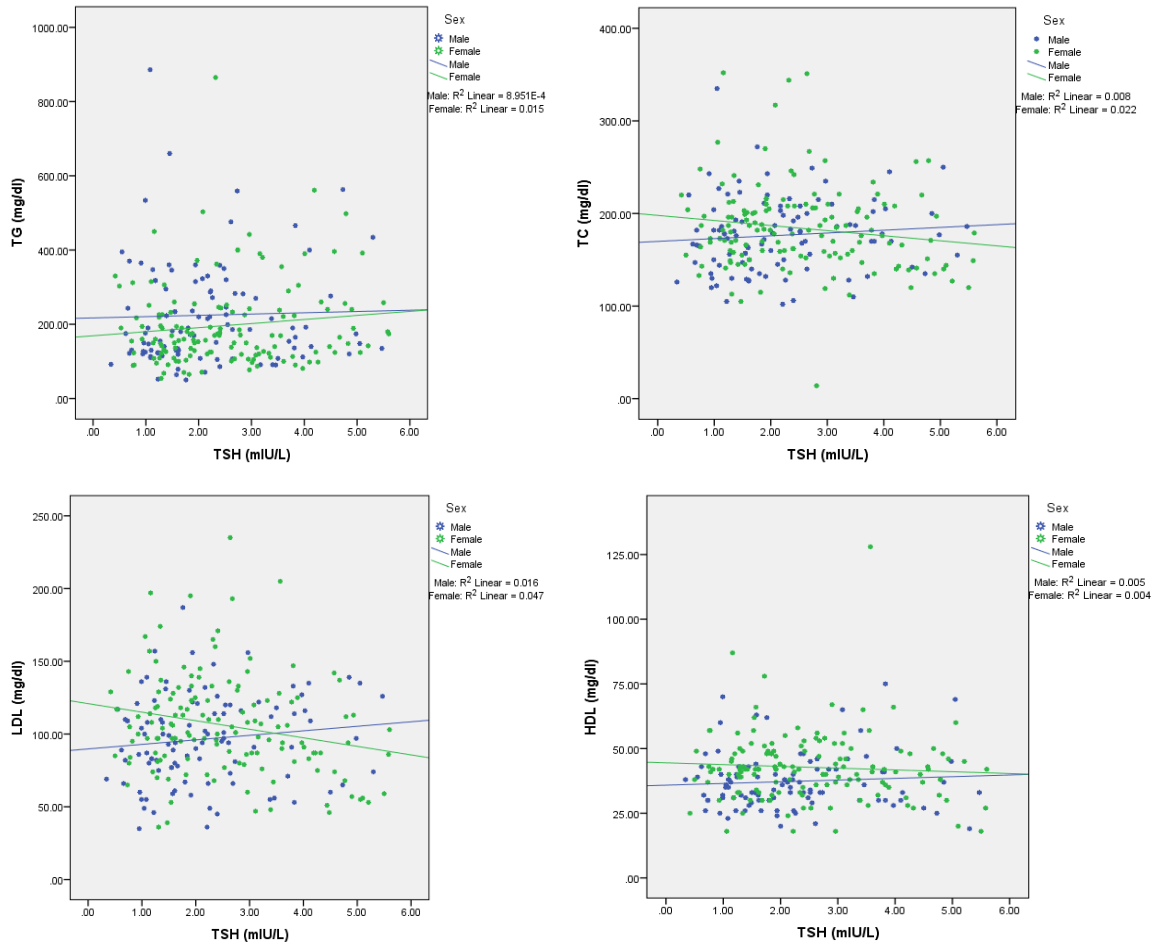

Figure 4: Scatter plot diagram showing the linear relation between thyroid stimulating hormone (TSH) and serum lipid levels (n=240)

IV. Discussion

In the present study, more than half of the euthyroid subjects had abnormal levels of serum triglycerides (TGs), low-density lipoprotein cholesterol (LDL-C) and high-density lipoprotein cholesterol (HDL-C). Abnormal levels of serum cholesterol were observed in less than one-third of the studied participants. Although dyslipidemia is a common feature of thyroid dysfunction,[3] in this study, abnormal lipid levels were quite frequent among euthyroid participants. However,serum lipid levels were statistically similar across the subjects with all ranges of thyroid stimulating hormone (TSH). Unlike our study, Asvold et al. observed an association between TSH and lipid levels among participants with TSH in the reference range.[21] Increased levels of TC, LDL-C, and TG and decreased levels of HDL-C were associated with upper levels of TSH.[21] Another study conducted by Chin et al. among euthyroid men observed significant relationships between TSH and TG levels. They also observed a strong relationship between thyroxin (T4) levels and cholesterol levels.[22] In some previous studies, patients with overt hypothyroidism showed a trend of high TC, TG and LDL-C in comparison to an apparently healthy control population.[23,24] Pearce et al. demonstrated that increased lipid levels decreased to the normal range after supplementation with thyroid hormones.[25] Significant increases in TC and LDL-C were observed in hypothyroid patients compared to participants with normal thyroid function.[26]In contrast, significant decreases in TC, HDL-C and LDL-C were observed in hyperthyroid patients.[27] In Bangladesh, a study was conducted among dyslipidaemic patients where 11.5% had hypothyroidism, 9.5% had subclinical hypothyroidism and 2% overt hypothyroidism.[19] However, the relationship between TSH and the lipid profile among euthyroid patients remains to be studied in a generalized population. However, unlike a few available studies, the present study could not observe any relationship between lipid levels and TSH.

The present study considered participants who attended the studied hospital for health consultation. Among them, 240 participants were selected according to the inclusion and exclusion criteria. Therefore, the

study subjects were not apparently healthy. Moreover, the sample size was also too small to interpret a finding. This study considered only TSH. The combined effect of thyroxin, triiodothyronine and TSH on the lipid profile could be concluded more accurately.

V. Conclusion:

In the present study, a high frequency of abnormal lipid levels was observed, especially serum triglycerides, serum low-density lipoprotein cholesterol and high-density lipoprotein cholesterol. However, no significant relationship between thyroid stimulating hormone (TSH) and lipid levels was noted. A large study with a generalized population is recommended to examine the relationship between TSH within the euthyroid and lipid levels.

Declarations

Ethics approval:

The study was approved by the Ethical Review Committee, Barind Medical College Hospital, Rajshahi. Informed written consent was obtained from all participants following their agreement on participation in this study. The authors declare that the procedures followed the regulations established by the Helsinki Declaration of the World Medical Association.

Consent for publication: Not applicable.

Availability of data and materials: Patient-level data will be available on request from the corresponding author.

Conflict of interest: The authors declare that they have no competing interests.

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