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Correlations of Thyroid Hormones and Lipid Profile in Relation to Body Mass Index

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ABSTRACT

Background: *Thyroid hormones and lipid profile are among the major determinants of greater body weight and these abnormalities are being influenced in higher Body Mass Index (BMI). The studies concerning the impact of overweight/obesity in the levels of thyroid hormones and lipid profile are not conclusive.* ***Objectives:*** *The study is to examine the correlations of thyroid hormone and lipid profile in different grades of BMI.* ***Materials and Methods:*** *This cross-sectional study was conducted in the Department of Physiology, Regional Institute of Medical Sciences, Imphal, and enrolled 600 subjects (either sex) aged 20-65 years. After getting consent from the subjects without a known history of chronic metabolic disorders and women not under the lactation period, blood samples were collected for the estimation of serum levels of leptin, insulin, thyroid hormones, and lipid profiles. The study population was categorized as non-obese (BMI<25 kg/m²) and obese (BMI ≥ 25 kg/m²). Data were presented as mean and standard deviation by calculating significance using student's t-test and for correlations, Pearson's coefficient was used. Significance was p<0.05.* ***Results:*** *In this study, Body Fat percentage (BF%) were increased significantly in obese than non-obese (p<0.01), whereas thyroid hormones (thyroxine (T4), Thyroid Stimulating Hormone (TSH) and lipid profile (Total Cholesterol (TC), Triglycerides (TG), High-Density Lipoprotein (HDL), Low-Density Lipoprotein (LDL) and Very Low-Density Lipoprotein (VLDL) levels were not found significant differences between non-obese and obese groups. BMI had no correlations significantly with thyroid hormones and lipid profile. However, T4 had negative correlations with lipid profile (p<0.05) wherein, TSH levels were found no correlations with lipid profile.* ***Conclusion:*** *Our study found the associations of thyroid hormone and lipid profile without an influence of higher BMI.*

Keywords: Thyroid hormones profile, Lipid profile, Manipur

INTRODUCTION

In general, thyroid hormones and body fat composition are closely related. Thyroid hormones regulate thermogenesis and take an important role in glucose and lipid metabolism, fat oxidation, and food intake [1]. Conversion of T4 to triiodothyronine (T3) is more with increasing de-iodinase activity, interpreting in obese subjects as a defense mechanism could be able to counteract the deposition of fat by more energy expenditure [2]. Thyroid hormone levels were decreased significantly with a reduction of weight [3]. Several studies claimed that lifestyle changes, characterized by improved physical activity and body composition with no concomitant variations of BMI resulting in a reduction of T3 and TSH [4]. A study by Marzullo, et al. suggested that obesity is a risk factor of thyroid autoimmunity which is established as a major cause of obesity and thyroid failure [5]. Some studies also reveal obesity pathogenesis by the role of autoimmune subclinical hypothyroidism [6]. In brown adipose tissue, activation of thyroid hormone-mediated pathways has a significant role in the treatment of obesity [7]. Additionally, thyroid dysfunction is associated with cardiovascular diseases [8-10]. Atherosclerosis and dyslipidemia are reported to be associated with the condition of hypothyroidism [11,12]. Thyroid hormones are required for the regulation of lipid metabolism and their dysfunctions are accompanied by dyslipidemia [13-15]. Further, TSH is correlated with total cholesterol and LDL may be the effect of autoimmune activation involves in lipoprotein secretion [16]. LDL receptors are regulated by thyroid hormones, binding with Thyroid Hormone Responsive Elements (TREs), and controls the sterol regulatory element-binding protein [17,18]. Cholesterol synthesis is enhanced by the expression of hepatic hydroxymethyl glutaryl coenzyme a

reductase where thyroid hormones are involved in this process [19]. A population-based study by Shirasawa, et al. demonstrated a directly related proportion between BMI and LDL level [20]. So far, little data has been found to study regards the influence of thyroid hormones in lipid profile in overweight/obesity. But, the reports show variations with a different population. So, the study is aimed to examine any associations of thyroid hormone and lipid profile in different grades of BMI in the Manipuri population.

MATERIALS AND METHODS

After the approval of the Institutional Ethical Clearance Board (Ethical Approval Code: A/206/REB/Prop(SP)70/46/2019), this study was conducted in the Department of Physiology, Regional Institute of Medical Sciences, Imphal. In this cross-sectional study, we obtained participants' consent and recruited 600 subjects from either sex.

Inclusion Criteria

Individuals who are ready to give consent within the age range of 20-65 years.

Exclusion Criteria

Subjects with a known history of any metabolic disorders like diabetes, cardiovascular diseases, cancer, and thyroid disorders, etc., as well as the women under lactation period, were excluded.

Groupings

Based on universal BMI formulae, study participants were divided into non-obese (BMI<25 kg/m^2) and obese (BMI ≥ 25 kg/m^2) groups.

Sample Collection

Blood samples were withdrawn after 2 hours of breakfast from the participants under aseptic condition. Collected blood was centrifuged in 3000 revolutions per minute for 10 minutes and serum was separated.

Anthropometric Measurements

Age, sex, height, and weight were recorded and BMI was calculated. Height was measured using Portable Stadiometer. Weight and BF% were measured by using Tanita Weighing Machine.

Biochemical Parameters

Serums samples were estimated levels of leptin, insulin, T4, and TSH using ELISA Microplate Reader, Multiskan FC, Thermo scientific and lipid profile levels were determined by using Clinical Biochemistry Analyser Erba EM 200.

Statistical Analysis

Statistical analysis was performed using SPSS software version 26. All data were presented as mean ± Standard Deviations (SD). Student t-test (unpaired) was used to compare the results of different groups. In addition, the Pearson correlation coefficient (r) was used for correlation analysis. P-value<0.05 was considered significant.

RESULTS AND DISCUSSION

Out of 600 subjects, 227 subjects were non-obese and 323 were obese. Table 1 shows the demographic profile and biochemical parameters among non-obese and obese groups. BF% was significantly increased in obese (35.34 ± 7.88) than non-obese (25.81 ± 7.21) group (p<0.01). T4, TSH, TC, TG, HDL, LDL, and VLDL levels were found no significant changes between non-obese and obese groups.

There was no significant correlation of BMI with thyroid hormones and lipid profile (Table 2) wherein, BF% had significant positive correlations with greater BMI. Table 3 shows that T4 was negatively correlated significantly with lipid profile whereas, TSH levels were found no significant correlations with lipid profile levels (Table 4).

Table 1 Demographic profile and biochemical parameters in non-obese and obese

Characteristics	Non-Obese n=277	Obese n=323	p-value
Age (years)	41.44 ±15.20	44.90 ± 12.93	0.112
BMI (kg/m^2)	21.76 ± 2.23	28.19 ± 3.34	0.043*
Body fat%	25.81 ± 7.21	35.34 ± 7.88	0.000**
T4 (µg/dl)	7.97 ± 1.46	8.50 ± 1.93	0.115
TSH (µIU/ml)	2.58 ± 2.30	2.16 ± 1.59	0.083
TC (mg/dl)	191.54 ± 36.34	191.58 ± 43.01	0.260
TG (mg/dl)	149.93 ± 66.70	141.75 ± 63.43	0.920
HDL (mg/dl)	44.26 ± 10.78	44.52 ± 9.20	0.238
LDL (mg/dl)	116.98 ± 31.70	118.18 ± 37.99	0.245
VLDL (mg/dl)	30.11 ± 13.21	28.79 ± 14.14	0.583
*significant at p<0.05, **significant at p<0.01			

Table 2 Correlations of BMI

Parameters	r	p-value
BF%	0.611	0.000**
T4	0.036	0.523
TSH	-0.024	0.669
TC	-0.037	0.536
TG	-0.053	0.376
HDL	-0.004	0.949
LDL	-0.008	0.897
VLDL	-0.091	0.129
*significant at p<0.05, **significant at p<0.01		

Table 3 Correlations of T4

Parameters	r	p-value
TSH	-0.309**	0.000
TC	-0.178**	0.003
TG	-0.190**	0.001
HDL	-0.133*	0.026
LDL	-0.070	0.243
VLDL	-0.251**	0.000
significant at p<0.05, **significant at p<0.01		

Table 4 Correlations of TSH

Parameters	r	p-value
TC	0.052	0.384
TG	0.003	0.962
HDL	0.081	0.180
LDL	-0.010	0.862
VLDL	0.132	0.028

DISCUSSION

In the present study, there were no differences in T4 and TSH levels between non-obese and obese individuals which were supported by the findings of Manji, et al. that may imply that TSH and BMI are not dependent determinants [21]. In a contradictory study of Francis who reported that TSH levels were significantly increased in higher grades of BMI [22]. This study finding is by the study of Kitahara, et al. demonstrated that BMI is not correlated with fT4 and TSH levels [23]. Thus, T4 and TSH may not be having any significant role to control body weight and vice versa. The recent study by Archana, et al. did in the same Manipuri population reported that TSH is not associated with the BMI and concluded that "there is unlikely to be any benefit in maintaining TSH in the lower half of the normal range about weight loss", suggested for lifestyle modification, dietary changes, and exercise [24]. Another study conducted by Solanki, et al. in contrast to this study results in which serum TSH level was increased with increasing BMI, the plausibility of correlation may be direct stimulation in the differentiation of preadipocyte by TSH and leading to adipogenesis [25,26]. A previous study by Pergola, et al. reported an association between thyroid hormone and body weight [27]. Thyroid hormones enhance thermogenesis with raise in the cellular process to produce ATP may be the possible associations of BMI and thyroid hormone [28]. However, the underlying mechanism is inconclusive. Rotondi M, et al. presented the influence of body weight on the thyroid varies accordingly with regards to a lower category of overweight/obese [29]. BMI is in a lower grade (28.19 ± 3.34 kg/m^2) in our finding which might be one reason for showing no correlations between BMI and thyroid hormones. Despite, one more observation shows in our study that maintaining the inverse significant relationships between T4 and TSH level in the obese group which demonstrate the dependent relationships to control thyroid abnormalities.

In the study of Kim, et al. TC and TG were significantly higher in the obese than normal group [30]. TC and TG had positive correlations with BMI but HDL had negative correlations with BMI. One study conducted in the Korean population reveal positive relationships of BMI with TC and LDL [31]. It suggests that dyslipidemia is common among obesity. In contrast, this study finding showed no significant differences in lipid profile between non-obese and obese. It may be related to a dietary lifestyle where green vegetables and fish are mostly consumed, less processed food, and an agrarian lifestyle. The relatively less obese subjects and more overweight in the obese group (3.9% of obesity) could be one reason to explain insignificant differences in TC and TG levels between the groups. But, this also requires detailed studies relating to different BMI statuses to genetic predisposition. Our study is consistent with the reports of Hussain, et al. in which lipid profile and BMI had no significant correlations [32]. The findings of Bayram, et al. demonstrated dyslipidemia prevalence is more with increasing BMI [33]. However, in our study, mean lipid profile levels were within normal ranges and no significant differences between the non-obese and obese groups. It infers that BMI may not be a relative determinant of lipid profile. Hence, for determining the dyslipidemia occurrence among the Manipuri population in different BMI, other possible factors like lifestyle, dietary, genetics linkage could be better looked into. Adipose tissue and thyroid are organs that produce adipocytokines and thyroid hormones, respectively, which play a central role in body metabolism [34]. In the present study, T4 was negatively correlated with serum TC, TG, HDL LDL, and VLDL which was by the findings of Essam H Jiffri, which signifies that T4 increases the lipid profile decreases and vice versa [35]. Moreover, Roos, et al. reported that free T4 was negatively associated significantly with TG, HDL-cholesterol [13]. One reason may be thyroid hormone which is involved in hydroxymethyl glutaryl coenzyme A reductase expression in the liver, which increases cholesterol synthesis [36]. This study was inconsistent with the study of Garduno-Garcia, that T4 was positively correlated significantly with HDL [10]. We found that TSH had no significant correlations with lipid profile in the present study. Previous studies were supported in our findings that TSH was not associated with lipid parameters (TC, TG, HDL, and LDL) suggesting the results were not consistent with the well-known relationship of subclinical hypothyroidism and greater levels of TC and LDL [37-39]. In contrast, another study by Amer, et al. stated that TSH had positive significant correlations with TC, TG, and LDL [40]. Further, Shekhar, et al. reported that TSH was associated with TC and LDL in hypothyroid patients [41]. In addition, TSH had a positive association significantly with TC and TG which was reported by Garduno-Garcia [10]. A study conducted by Asvold, et al. also stated that there were positive correlations between TSH and TC, TG, LDL, and negative correlations were observed between TSH and HDL [42].

Interestingly, some of the studies have reported that variations in the levels of TSH and thyroid hormones but within normal ranges can alter the body weight and subsequently influence lipid profile [43]. The present study demonstrated

T4 and lipid profile levels are still within the normal ranges. But, it shows correlations to each other, implies that T4 and lipid profile are dependent determinants independent of BMI.

Our study is limited to poor sample size and needs to study in larger population size for the interlinking mechanisms of thyroid and lipid profile in different BMI. However, interrelationships between thyroid and lipid profile about BMI without disease conditions have been established.

CONCLUSION

In our study, thyroid hormones and lipid profiles show no correlations with different grades of BMI. However, there was an association between thyroid hormones and lipid profile within normal ranges without an effect of BMI. So, we conclude that controlling dietary and lifestyle changes may be the better choice to control abnormalities of thyroid hormones and lipid profile instead of maintaining body weight in this Manipuri population.

DECLARATIONS

Conflicts of Interest

The authors declared no potential conflicts of interest concerning the research, authorship, and/or publication of this article.

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