INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :6.514(2020); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:10, ISSUE:1(2), January :2021
Online Copy Available: www.ijmer.in

BODY FAT DISTRIBUTION, BLOOD PRESSURE AND LIPID PROFILE IN NEWLY DIAGNOSED HYPOTHYROID AND HYPERTHYROID INDIVIDUALS

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Abstract
Background: In this study, we have assessed the changes in blood pressure, body fat distribution and lipid profile in newly in newly diagnosed hypo-thyroid and hyper-thyroid individuals of North India.
Methodology: This study was carried out in newly diagnosed hypo-thyroid and hyper-thyroid females. Each group consisted of 45 individuals. They were controls, Newly diagnosed hypo-thyroid and hyper-thyroid subjects. fT3, fT4 and TSH were analyzed using commercially available chemiluminescence assay kits, Lipid profile was assessed by using enzymatic method, fat distribution by bio impedance assay.
Results: Body mass index was high in hypothyroid subjects. Heart rate was significantly low in hypothyroid subjects and high in hyperthyroid subjects. Total body fat % and visceral fat % were high in hypothyroid subjects when compared to hyperthyroid subjects. Significant difference were found in total cholesterol, high density lipoproteins, triglycerides, low density lipoproteins, very low density lipoproteins.
Conclusion: even in newly diagnosed thyroid disorders both hypo and hyper thyroidism, there was an effect on body fat distribution, lipid profile, heart rate and blood pressure. Further, it is important to evaluate all these parameters immediately after diagnosing any thyroid disease which help to prevent further damage on cardiovascular system.

Key words: Hypo-Thyroidism, Hyper-Thyroidism, Bio Impedance Assay, Visceral Fat, Subcutaneous Fat.

Introduction

Thyroid dysfunctions became most common across the globe. Hypothyroidism representing 5–15% and hyperthyroidism 0.3 to 0.6%. (1). The rate of thyroid dysfunctions has expanded extensively and as of now, the concern of thyroid problems. Thyroid hormones are the significant controllers of the level of metabolism directly affects sympatho-vagal balance (2). Cardio-vascular system is one of the most incessant, severe genuine clinical indications of thyroid dysfunctions (3).

Hyperthyroidism leads to increased metabolism linked with higher sympathetic activity. Hormones of thyroid gland as facilitates catecholamine functions. However, hyperthyroidism is portrayed by both increased as well as decreased modulation parasympathetic activity on cardiovascular system (4), the level of inhibition of parasympathetic activity in hyper-thyroidism has not been appropriately reported. As per recent reports, significant inhibition of vagal activity proportionate to activation of sympathetic activity in hyper-thyroidism (5).

The impacts of hyper-thyroidism on cardiovascular system are changes in haemodyamics like reduced resistance of systemic circulation, higher cardiac output, pulse, blood volume, circulatory strain and hindered cardiovascular contractility. These progressions bring about ventricular stretch & pressure over-load, which leads to increased BNP levels in this condition. 0 Late consideration has been attracted to the connection of BNP and hyper-thyroidism. Reports propose that plasma BNP and NT-proBNP levels are increased in hyper-thyroidism. This condition is expansion is mostly because of hyper-thyroidism-induced dysfunction of left ventricle. Likewise, hormones of the thyroid may up-regulate BNP discharge from myocytes of both atria and ventricules (6).

Hypo-thyroidism influences somewhere in the range of 4% and 10% population. and the sub-clinical hypo-thyroidism prevalence is accounted as as high as 10% in different studies (7), (8). Hypo-thyroidism is analyzed when lower level of thyroid hormones brings about raised degrees of thyroid stimulating hormone (TSH), while sub-clinical hypo-thyroidism is declared when TSH levels are raised over the maximum furthest reaches of the reference ranges with typical level of hormones of thyroid gland. Hypo-thyroidism produces significant cardio-vascular impacts.

Central or abdominal fat accumulation has been demonstrated to be an important predictor for high morbidity and mortality from various life style diseases like diabetes and cardio-vascular diseases (9), (10). Abdominal obesity is one of the components of the group of metabolic abnormalities collectivelycalled as the metabolic syndrome (MS). It is unclear whether the visceral the subcutaneous component of abdominal fat is more deleterious from the metabolic point of view. It has been shown that cardiometabolic risk factors increase as a function of visceral fat accumulation (11).

The information regarding the effect of hyo-thyroidism and hyper-thyroidism on heart rate, blood pressure, body fat distribution and lipid profile in newly diagnosed North Indians is less.

Therefore, in this study, we have assessed the changes in blood pressure, body fat distribution and lipid profile in newly in newly diagnosed hypo-thyroid and hyper-thyroid individuals of North India.

Materials and Methods*:* This is cross sectional study was carried out in newly diagnosed hypo-thyroid and hyper-thyroid females with age matched controls. After getting clearance from institute ethics committee, written informed consent was obtained from all participants. All experiments were performed at research laboratory in the **Department of Physiology and Biochemistry, Santhosh Medical College, Bareilly**. Hypo and hyper thyroid subjects were recruited from Medicine and Endocrinology out patient departments. Controls were age matched students and residents. They were divided into three groups. Each group consisted of 45 individuals. Group 1: controls, Group 2: Newly diagnosed Hypo-thyroid subjects, Group: Newly Diagnosed Hyper-thyroid subjects.

Inclusion criteria: Age: 18 – 35 years, in hypothyroid group, female patients newly diagnosed as primary hypothyroidism, before initiation of the treatment were included. Likewise, newly diagnosed female patients with primary hyperthyroidism, before initiation of the treatment was taken in hyperthyroid group. For control group, subjects with age matched apparently healthy individuals were recruited.

Exclusion criteria: Patients, who were already on treatment for thyroid disorders, known cases of diabetes mellitus, hypertension, heart diseases, autonomic failure or endocrine disorders and those were on any chronic medications were excluded from the study. Height, weight, body mass index were recorded before blood collection. Blood samples were collected after 10 hours of fasting. 5ml of blood was collected and allowed to clot. Serum was separated and stored in refrigerator to estimate the fT3, fT4 and TSH were analyzed using commercially available chemilluminesence assay kits (Maglumi, UK, Gentaur, Belgium). Lipid profile was done by enzymatic method. Body fat distribution was measured by using body fat analyzer working under the principle of bioelectrical impedance analysis (BIA) method.

Results: The baseline and anthropometric parameters of controls, hypothyroid and hyperthyroid subjects were depicted in Table 1. There was no significant difference in age, height and pulse pressure between the groups. Weight ($p<0.000$), Body mass index ($p<0.000$), heart rate ($p<0.000$), systolic blood pressure ($p<0.000$), diastolic blood pressure ($p<0.000$), mean arterial pressure ($p<0.000$), rate pressure product ($p<0.000$) were significantly different between the groups.

Further, body weight of hypothyroid subjects ($p < 0.05$) was significantly high and significantly low in hyperthyroid subjects ($p < 0.05$). Body mass index ($p < 0.05$) was high in hypothyroid subjects and slightly high in hyperthyroid subjects. Heart rate was significantly low in ($p < 0.05$) hypothyroid subjects and high in hyperthyroid subjects ($p < 0.05$) when compared to controls. Further, within groups analysis showed the significantly higher heart rate was seen in hyperthyroid subjects ($p < 0.05$) when compared to hypothyroid subjects.

Systolic blood pressure, diastolic blood pressure and mean arterial pressure were significantly high in ($p < 0.05$) hypothyroid subjects and high in hyperthyroid subjects ($p < 0.05$) when compared to controls. Further, within groups analysis showed the significantly higher Systolic blood pressure, diastolic blood pressure and mean arterial pressure seen in hyperthyroid subjects ($p < 0.05$) when compared to hypothyroid subjects. Rate pressure product was significantly low in ($p < 0.05$) hypothyroid subjects and high in hyperthyroid subjects ($p < 0.05$) when compared to controls. Further, within groups analysis showed the significantly higher rate pressure product was seen in hyperthyroid subjects ($p < 0.05$) when compared to hypothyroid subjects

As shown in Table 2, Tri-iodothyronine ($p < 0.000$), thyroxine ($p < 0.000$), thyroid stimulating hormone ($p < 0.000$), total body fat % ($p < 0.000$), visceral fat % ($p < 0.000$) were significantly different between the groups. Further, tri-iodothyronine, thyroxine levels were significantly low ($p < 0.05$) in hypothyroid group, high ($p < 0.05$) in hyperthyroid subjects when compared to controls. Between group analysis showed that tri-iodothyronine ($p < 0.05$), thyroxine ($p < 0.05$) were significantly high in hyperthyroid subjects when compared to hypothyroid subjects. Thyroid stimulating hormone was significantly high in hypothyroid group ($p < 0.05$) when compared to hyperthyroid subjects. Total body fat % ($p < 0.000$) and visceral fat % ($p < 0.000$) was significantly different between the groups. However total body fat % and visceral fat % ($p < 0.05$) were high ($p < 0.05$) in hypothyroid subjects when compared to hyperthyroid subjects.

Table 3 shows the between and within group differences of lipid profile. Significant difference were found in total cholesterol ($p <0.000$), high density lipoproteins ($p <0.000$), triglycerides ($p <0.000$), low density lipoproteins ($p <0.000$), very low density

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lipoproteins (p <0.000). Within group differences showed that total cholesterol (p<0.05) and low-density lipoproteins (p<0.05) were significantly high in hypothyroid subjects when compared to hyperthyroid subjects.

Table 1: Baseline characteristics of controls, hypothyroid and hyperthyroid subjects.

Sl.No	Parameter	Control group (n= 45)	Hypothyroid (n= 45)	Hyperthyroid (n= 45)	P value (ANOVA)
1	Age(yrs)	22.00 ± 3.32	20.69 ± 2.36	20.35 ± 2.27	0.100
2	Height (cm)	165.08 ± 5.27	163.87 ± 6.86	164.88 ± 4.92	0.566
3	Weight(kg)	60.60 ± 6.38	65.58 ± 10.03*	59.34 ± 5.08$^{\#}$	0.000
4	BMI (Kg/m^2)	22.25 ± 2.32	24.38 ± 3.12*	22.81 ± 2.64$^{\#}$	0.000
5	WHR	0.83 ± 0.05	0.88 ± 0.06*	0.81 ± 0.06$^{\#}$	0.000
6	HR (bpm)	82.40 ± 2.78	74.55 ± 3.26*	87.14 ± 6.00$^{@\#}$	0.000
7	SBP (mmHg)	114.00 ± 4.98	120.80 ± 5.91*	122.67 ± 3.70$^{@\#}$	0.000
8	DBP(mmHg)	75.42 ± 2.28	81.60 ± 6.38*	84.40 ± 3.80$^{@\#}$	0.000
9	PP(mmHg)	38.58 ± 4.54	39.20 ± 1.88	38.27 ± 6.13	0.611
10	MAP(mmHg)	88.28 ± 2.66	94.66 ± 6.16*	97.15 ± 2.41$^{@\#}$	0.000
11	RPP	9391.37 ± 477.58	9006.57 ± 596.35*	10695 ± 626.34$^{@\#}$	0.000

Data expressed as Mean ± SD. BMI: Body Mass Index, SBP: Systolic Blood Pressure, DBP: Diastolic Blood Pressure, PP: Pulse Pressure, RPP: Rate Pressure Product, HR: Heart Rate.
*Controls Vs. Hypothyroid subjects; p < 0.05.
@ Controls Vs. Hyperthyroids; p< 0.05.
# Hypothyroids Vs. Hyperthyroids; p< 0.05.

Table 2: Body fat distribution and thyroid function tests of controls, hypothyroid and hyperthyroid subjects.

Sl.no	Parameter	Control group (n= 45)	Hypothyroid (n= 45)	Hyperthyroid (n= 45)	P value (ANOVA)
1	fT3 (pmol/L)	5.17 ± 0.82	2.40 ± 0.59*	11.13 ± 2.25$^{@\#}$	0.000
2	fT4 (pmol/L)	12.29 ± 2.28	2.24 ± 1.45*	28.31 ± 3.90$^{@\#}$	0.000
3	TSH (uU/L)	2.27 ± 0.67	10.51 ± 2.79*	0.18 ± 0.09$^{@\#}$	0.000
4	Total BODY FAT (%)	28.20 ± 2.12	31.08 ± 2.03*	24.22 ± 1.95$^{@\#}$	0.000
5	VISCERAL FAT (%)	5.76 ± 0.93	7.44 ± 1.76*	6.31 ± 0.99$^{\#}$	0.000

fT3: Tri-iodothyronine, fT4: Thyroxine, TSH: Thyroid releasing hormone.

Data expressed as Mean ± SD.
*Controls Vs. Hypothyroid subjects; p < 0.05.
@ Controls Vs. Hyperthyroids; p< 0.05.
# Hypothyroids Vs. Hyperthyroids; p< 0.05.

Discussion: This study was carried out to evaluate the body composition, newly diagnosed hypo and hyper thyroid individuals. Our study is unique that, as far as we are aware this is one of very few studies to report body composition changes of newly diagnosed hypo and hyperthyroid individuals in North India.

There was no significant difference in age, height and pulse pressure between the groups. But, Weight, Body mass index, heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure and rate pressure product were significantly different between the groups.

Further, body weight of hypothyroid subjects was significantly high and significantly low in hyperthyroid subjects. Body mass index was high in hypothyroid subjects and slightly high in hyperthyroid subjects.

Our study results substantiates previous study reported by Nyrnes A et al., they compared BMI and TSH levels in 6,164 adults from 1995 to 2001. In this study, higher BMI was associated with higher TSH (TSH is higher in hypothyroidism), and increases in BMI throughout the six-year period was positively correlated with increases in TSH (12). Another study by Bastemir et al., also found a strong correlation with BMI (13)

Further, our observations are in accordance with the general assumption of an association between thyroid function, weight, and adipose tissue. Hypothyroidism is associated with a decrease in metabolic rate (14) and affects both lipid and carbohydrate metabolism (15). There are receptors expressed for TSH as well as thyroid hormones in adipose tissue (16).

Thyroid hormones are involved in both lipogenesis and lipolysis (17), an effect that possibly is mediated by affecting local noradrenaline levels and/or adrenergic post receptor signaling (18).

Heart rate was significantly low in hypothyroid subjects and high in hyperthyroid subjects when compared to controls. Further, within groups analysis showed the significantly higher heart rate was seen in hyperthyroid subjects when compared to hypothyroid subjects.

Systolic blood pressure, diastolic blood pressure and mean arterial pressure were significantly high in hypothyroid subjects and high in hyperthyroid subjects when compared to controls. Further, within groups analysis showed the significantly higher Systolic blood pressure, diastolic blood pressure and mean arterial pressure seen in hyperthyroid subjects when compared to hypothyroid subjects. Rate pressure product was significantly low in hypothyroid subjects and high in hyperthyroid subjects when compared to controls. Further, within groups analysis showed the significantly higher rate pressure product was seen in hyperthyroid subjects when compared to hypothyroid subjects.

This lends support to earlier reported information that hyperthyroidism causes reduction in diastolic blood pressure due to peripheral vasodilation and with increased systolic blood pressure. Increased diastolic blood pressure was reported to be common in hypothyroidism (19) and has been reported in several studies in individuals with hypothyroidism (20), (21), (22), (23).

In our study, Tri-iodothyronine, thyroxine, thyroid stimulating hormone, total body fat % and visceral fat % were significantly different between the groups. Further, tri-iodothyronine, thyroxine levels were significantly low in hypothyroid group, high in hyperthyroid subjects when compared to controls. Between group analysis showed that tri-iodothyronine, thyroxine were significantly high in hyperthyroid subjects when compared to hypothyroid subjects. Thyroid stimulating hormone was significantly high in hypothyroid group when compared to hyperthyroid subjects. Total body fat % and visceral fat % were significantly different between the groups. However total body fat % and visceral fat % were high in hypothyroid subjects when compared to hyperthyroid subjects.

Results of our study are consistent with available information that, thyroid hormones regulate metabolism of the whole human body - triiodothyronine (T3) is necessary to maintain the energy requirements of various cells and tissues, to balance their anabolism and catabolism, and regulate body weight (24)(21). An abnormal amount of T3 disturbs a number of metabolic processes. shortage of T3 in hypothyroidism reduces basic metabolic rate and thermogenesis, inhibits catabolism and gains total body weight (25) excess of T3 in hyperthyroidism reverses these processes. Specific therapy of hypo- (26), (27) and hyperthyroidism (28), (29), (30) restores a proper body mass.

Our results corroborate with Yahaya et al., reported as hyperthyroidism was associated with decrease total cholesterol, high density lipoprotein cholesterol, low density lipoprotein cholesterol and slightly increased triglycerides (31). We found significant difference in total cholesterol, high density lipoproteins, triglycerides, low density lipoproteins, very low-density lipoproteins. Within group differences showed that total cholesterol and low-density lipoproteins were significantly high in hypothyroid subjects when compared to hyperthyroid subjects.

Conclusion: Based on our results, it is concluded that, even in newly diagnosed thyroid disorders both hypo and hyper thyroidism, there was an effect on body fat distribution, lipid profile, heart rate and blood pressure. Further, it is important to evaluate all these parameters immediately after diagnosing any thyroid disease which help to prevent further damage on cardiovascular system.

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