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Original Research Paper

Gender, Age and Race Related Thyroid Hormones Profile of Normal Healthy Subjects in Northern Area, Bangladesh

Physics

KEYWORDS : hormones profile, gender, age, race, healthy individuals

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ABSTRACT

The present study was designed to investigate the effect of gender, age and race on the concentration of thyroxine (T4), triiodothyronine (T3) and thyroid stimulating hormone (TSH) levels on normal healthy individuals. In total, 1425 assays were performed in 475 normal healthy subjects visited the RIA laboratory of the INMAS, Rajshahi for T4, T3 and TSH tests during October 2014 to April 2015. The thyroids of all the individuals were in clinically normal condition. Serum T4 and T3 were analyzed by RIA method using BF002 and BF001 Radioimmunoassay kits, whereas serum TSH was estimated by IRMA method using BF003/BF028 TSH Immuunoradiomatricassy Kits supplied by Beijing North Institute of Biotechnology Co. Ltd., Beijing. The current study demonstrated a significant effect of age, gender and race on the levels T4, T3 and TSH.

INTRODUCTION

The thyroid is the largest endocrine gland located immediately below the larynx on either side of and anterior to the trachea [1, 2]. It is the master gland to control the body metabolism, growth, development and maintenance of the internal environment. Biologically active two principal thyroid hormones, thyroxine (T4) and triiodothyronine (T3) together with thyroid stimulating hormone (TSH) stimulate enzymes that are involved in glucose oxidation. These hormones increase the basal metabolic rate (BMR) and body heat production. Extreme excess of thyroid secretion cause the BMR to raise 60-100% above the normal. Complete lack of thyroid secretion can cause BMR to fall 40-50% below the normal [3]. These hormones also play a great role to promote growth and development of human brain [4-8]. Thyroid secretes 93% of thyroxin (T4) and 7% tri-iodothyronin (T3), T3 is almost 10 times more active than T4 and produced mainly by the conversion of T4 in the peripheral tissues. The normal range of total plasma T4 level is 65–156 ηmol/L, plasma T3 level is 0.8–2.7 ηmol/L, and TSH level is 0.5–5.0 μIU/L [9-11].

Thyroid needs iodine for the synthesis of T4 and T3. The requirements of iodine depend on many factors, which include growth, body weight, gender, age, climate, geographical region, nutritional status, etc. With the advancement of age, there is gradual decrease in body functions affecting cardiovascular, respiratory, renal, nervous as well as endocrine and metabolic systems [12]. These changes may alter hormone production, metabolism, biological activities, target tissue response to hormones and rhythms in the body such as the menstrual cycle. In old age brain has diminished homeostatic reserve and is vulnerable to disturbances in the internal milieu [13].

It has been studied that T4 concentration in neonates gradually decreases, reaching towards the normal at the end of first year. Serum T3 remains higher through early adolescences [14]. Higher frequencies of thyroid problems are noted in people above 40 yrs of age [15]. Compared to non-pregnant women, the serum T3 and T4 levels may rise to twice in pregnant women. During the first trimester, a decrease of TSH concentration occurs, and the decrease is greater in twin pregnancy [16]. Sex has also an effect on the concentration of thyroid hormones [17]. It has reported that greater frequency of thyroid problems in females than males [18]. The concentration of hormones decreases with age in both sexes but the drop is more in female than males [14]. Race is also an important factor that affects on the normal serum levels. Alteration in nutritional status, whether short term or long term and whether as the result of over feeding or under feeding or merely a change in substrate mix, affects different aspects of thyroid hormones economy, especially peripheral hormones metabolism [19].

A lot of research has been done in abroad to estimate the effect of various parameters on the thyroid gland but no such published data, except only one [20], has yet been available on this aspect in our country. In view of this, the present study has been designed to study the thyroid hormone profile in the relation of gender, age and race of normal healthy subjects in Northern Area of Bangladesh. It is expected that the findings of this study would help the physician for early detection and better management of thyroid dysfunction also to develop awareness among the general people.

MATERIALS AND METHODS

Study Subjects

This cross sectional descriptive study was conducted at the Institute of Nuclear Medicine and Allied Sciences (INMAS), Rajshahi affiliated with the Atomic Energy Commission (AEC), Bangladesh. In total, 1425 assays were performed in 475 normal healthy subjects visited the RIA laboratory of the INMAS, Rajshahi for T4, T3 and TSH tests during October 2014 to April 2015. The thyroids of all the individuals were in clinically normal condition. Among the individuals 237 were men and 238 women, with ages ranging from 5 days to 80 years. The total subjects were classified into four groups according to their age: infants (0-1 year), children (>1-15 years), adult (>15-40 years) and old age (>40 years). The subjects were from six different districts of Northern Area of Bangladesh. Out of the total subjects 83, 84, 85, 78, 78 and 67 individuals were referred to the laboratory, respectively, from Rajshahi, Chapainababgonj, Natore, Naogaon, Pabna and Kushtia districts.

Collection of Blood Sample

Venous blood samples were collected from non-fasting subjects through disposable syringes of suitable volume. The samples were transferred into properly labeled sterilized test tubes and were left for 60 minutes at room temperature for coagulation. The coagulated blood samples were then centrifuged at 3500 rpm for 20 minutes. Serum were sepa-

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rated and transferred into sterile plastic tubes that were approximately labeled for the required test, and the date of sample collection. The samples were analyzed either on the same working day or stored at -20^{0}C until analyzed.

Assay Procedures

Serum T4 and T3 were analyzed by RIA method using BF002 and BF001 Radioimmunoassay kits, whereas serum TSH was estimated by IRMA method using BF003/BF028 TSH Immuunoradiomatricassy Kits supplied by Beijing North Institute of Biotechnology Co. Ltd., Beijing. All the kits were provided with standards, tracer antibody in case of T4 and T3, antibody coated tubes in case of TSH. Assay tubes were labeled as standards, non-specific binding, total count, patient samples and quality control in duplicate. A Gamma counter Model LB 2111 NaI borehole-type scintillation detector manufactured by BERTHOLD TECHNOLOGIES, Germany was used for counting the assay tubes. Finally, hormone concentrations were measured using 4-parameter computer programs (LBIS immunoassay software package).

Data Analysis

All the data collected were entered and analyzed in Statistical Package of Social Sciences version 20. The relationships between serum concentrations of T4, T3 and TSH and various age groups and race were determined using one way ANOVA. Association of hormone levels with sex was determined by independent sample t-test. Statistical significance level was fixed at $p < 0.05$. The graphs were constructed using Microsoft Excel program.

RESULTS

The effect of gender on the concentration of serum T4, T3 and TSH is presented in Table 1. The T4, T3 and TSH levels in both males and females were in normal range. The present observation shows that there was a significant difference in the concentration of T4, T3 and TSH. All hormone levels were higher in females than males. However, no statistical significant difference has been found by gender among the hormone levels at $p<0.05$.

TABLE – 1
THYROID PROFILE WITH RESPECTTO GENDER

Gender	N	T4 (nmol/L)	T3 (nmol/L)	TSH (mIU/L)
Male	237	109.93± 25.80	2.27± 0.54	2.23± 1.39
Female	238	113.77± 27.19	2.29± 0.60	2.35± 1.50
P value		0.115	0.663	0.375

All 475 subjects were classified into different age groups. Table 2 shows the T4, T3 and TSH values in different age groups. The present data revealed that the difference for means of T4 and T3 between different age groups was insignificant, but mean TSH value was significantly different at $p<0.05$. On comparing the different thyroid hormone levels in different age groups higher mean values of both T4 and T3 were found in infant. Mean T4 value remains nearly unaffected during next of life, but mean T3 respectively followed by children, adult and old age groups. On contrary, mean TSH value was found to be elevated in children then followed by infant, adult and old age groups.

TABLE – 2
THYROID PROFILE IN DIFFERENT AGE GROUPS

Age Group	N	T4 (nmol/L)	T3 (nmol/L)	TSH (mIU/L)
Infant	10	122.55± 30.99	2.43± 0.62	2.5± 1.96
Children	108	111.03± 26.68	2.31± 0.55	2.7± 1.53
Adult	202	110.75± 26.65	2.30± 0.57	2.20± 1.37
Old Age	155	113.16± 26.09	2.23± 0.58	2.11± 1.41
F value		0.816	0.778	4.21
P value		0.486	0.506	0.006

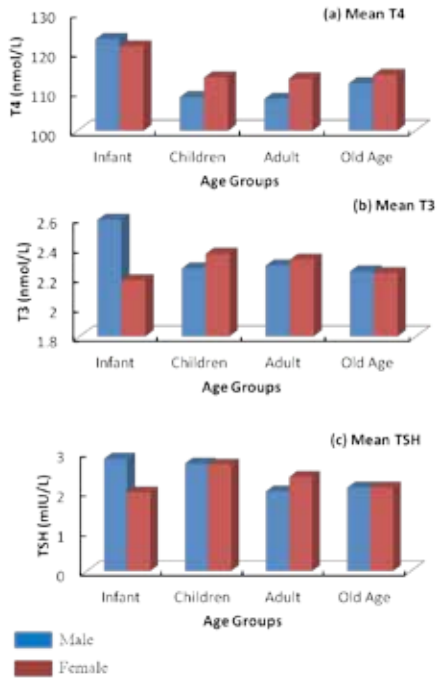

Figure 1: distribution of T4, T3 and TSH values in different age groups both for males and females

Fig. 1 compares the levels of serum T4, T3 and TSH in males and females of different age groups and it is revealed that there was no significant difference in serum T4 levels between male and female infant. The mean concentration of T3 and TSH in male infant was more than that in female infant. In all other age group, serum T4, T3 and TSH levels were found to be slightly higher in females than in males though this difference was statistically insignificant.

TABLE – 3
THYROID PROFILE AS A FUNTION OF RACE

District	N	T4 (nmol/L)	T3 (nmol/L)	TSH (mIU/L)
Rajshahi	83	108.39± 23.30	2.40± 0.56	2.8± 1.34
Chapain-ababgonj	84	112.56± 29.22	2.22± 0.57	2.1± 1.44
Natore	85	114.60± 25.96	2.26± 0.55	2.27± 1.39
Naogaon	78	108.11± 26.94	2.24± 0.59	2.19± 1.54
Pabna	78	111.58± 27.49	2.31± 0.55	2.39± 1.45
Kushtia	67	116.43± 25.77	2.27± 0.58	1.95± 1.41
F value		1.188	1.015	3.399
P value		0.314	0.408	0.005

The concentration of serum T4, T3 and TSH levels in individuals belonging to the different districts in Northern Area of Bangladesh is given in Table 3. The results revealed that T4 values higher for Kushtia and Natore and lower for Rajshahi, Chapainabagonj and Naogaon districts. T3 levels higher for Rashahi district and nearly same in all other districts. The TSH levels, on the other hand, higher for Rajshahi district followed by Pabna, Natore, Naogaon, Chapainababgonj and Kushtia districts.

DISCUSSION

The variations in the mean values of the concerned hormones with gender suggests that a small change within the normal range can be seen in serum T4, T3 and TSH in both genders with a slightly higher level in females than males. This observation is in accordance with the studies done by others [21-25]. However, somewhat contradictory results were reported by some others who concluded that level of T4 and T3 was higher in males than females [14, 21, 26, 27]. They further concluded that T3 and TSH levels are not influenced by gender [14, 23, 28, 29]. The observed values for T3 and TSH reveal that these values deviate from the reference values measured for the RIA laboratory, INMAS, Rajshahi as the ranges for both T3 and TSH have slightly expanded. The reference values of T3 and TSH are 1.96±0.54 nmol/L and 2.06±1.08 μIU/L, respectively [30] and are thus different from the current observations. But in the case of T4, the observed value is very much similar to the reference value (113.21±27.62 nmol/L).

Concentration of T4, T3 and TSH dropped with increasing age in both sexes. The drop was more in males than females and thus resulting in higher concentration of these hormones in females. This result provides a clue that females will develop thyroid problems easily. Higher frequencies of thyroid problems in females may be attributed to stress, multiple pregnancies and lactation. Due to particular family set up in Bangladesh, females are more exposed to nutritional deficiencies that cause health problems including thyroid disorders.

On comparing the different thyroid hormone levels in different age groups (Table 2), the present study observed that, the mean concentration of both T4 and T3 was significantly higher in infant than the other age groups. The increase in the level of both T4 and T3 in the early stage is due to the increased metabolic activity during infancy and childhood. Mean T4 value was observed nearly constant until the adult and slightly increased in older age group. On contrary, mean T3 levels were decreased with increasing age. This pattern of effect is also in agreement with the findings by others [28, 29, 31, 32]. The higher concentration of T4 and lower of T3 in old age group may be due to primary retardation of processes for hormone metabolism within the cell which is associated with aging process [33, 34], increased degradation rate of thyroid hormones in old age [35], age related decline of hepatic 52-deiodinase activity that may reduce peripheral conversion of T4 to T3 which leads to higher level of T4 but lower level of T3 [36]. The present study elucidate that the normal reference level of TSH was higher in children followed by infants, adult and old age groups. The decreasing prevalence of TSH with increasing age is also supported by [37-39]. This might be due to increased pituitary sensitivity to circulating thyroid hormones in elderly subjects. TSH secretion by the pituitary gland has been shown to decrease in advancing age.

The serum thyroid hormones and TSH levels on the basis of different age groups both for males and females are shown in Fig. 1. The present observation found increased T4 levels in both male and female infant and then remain nearly constant throughout the life in female but slightly increased in old age for male.

The effect of race on the concentration of thyroid hormones and TSH is presented in Table 3. There is a general pattern of increase and decrease in these hormones. According to that pattern, when thyroid hormones are less, then TSH hormone is high and vice versa. This pattern was, however, observed in T4 and TSH, but not in T3 and TSH. The difference in the observed serum levels among different districts may be due to the difference in their food habit, race and socio-economic conditions of peoples belonging to the above mentioned areas of the province.

CONCLUSIONS

In the present study, a cross sectional descriptive study on the concentration of serum T4, T3 and TSH levels over normal healthy individuals from different districts of Northern Area of Bangladesh was presented. It was aimed to see the impact of gender, age and race on the T4, T3 and TSH levels. To summarize our observations, the serum thyroid hormones and TSH levels were found to be higher in females than males. This change is, however, not statistically significant. On comparing the different thyroid hormone levels in different age groups showed that serum T3 levels were higher in children and declined progressively with age while serum T4 levels declined slightly only in elderly age group. On contrary, mean TSH levels was found to be significantly changed with age ($P = 0.000$). It was found to be elevated in children and then declined with age. There was also a significant difference in the mean serum T4, T3 and TSH values among the different districts in Northern Area of Bangladesh. It is, therefore, concluded from the present study that the gender, age and race all have an appreciable effect on the levels T4, T3 and TSH. Therefore, in view of the age-related thyroid status, it becomes imperative that this variability in the thyroid status has to be borne in mind during evaluation and treatment of thyroid disorders.

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