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Evaluation of Body Mass Index in The Normal Individuals Compared with Hypothyroid Patients

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A B S T R A C T

The thyroid is an endocrinal, butterfly-shaped, and biggest gland in the neck which makes and stores hormones that help in the regulation of blood pressure, heart rate, and body temperature and also help in the regulation of growth and rate of chemical reactions (metabolism) in the body. Hypothyroidism is associated with decreased thermogenesis, decreased metabolic rate, and has also been shown to correlate with a higher body mass index (BMI) and a higher prevalence of obesity. The present study was undertaken to evaluate the BMI at the time of diagnosis in hypothyroid patients and compare with that of normal individuals. A Case control study was conducted at Dinajpur Medical College Hospital, Dinajpur Bangladesh from January 2020 to December 2021. Out of 150 hypothyroid subjects 133 were females and 17 were males. Out of 150 normal individuals 70 were females and 30 were males. All subjects were in the age group of 20-40 years. Height is measured with Harpenden stadiometer, & weight is measured with standard weighing machine. BMI was calculated, data of T3, T4 & TSH levels were collected & compared between normal and hypothyroid subjects. It was found that hypothyroid subjects had a higher body mass index than the normal individuals. Hence maintenance of thyroid hormones at normal level and regular monitoring of BMI in Hypothyroid patients will help in early detection and prevention of obesity and its related complications in future. Hence maintenance of thyroid hormones at normal level and regular monitoring of BMI in Hypothyroid patients will help in early detection and prevention of obesity and its related complications in future. Awareness of weight reduction and regular physical exercise are to be advised to patients with hypothyroidism.

Keywords: BMI, T_4, T_3, TSH

INTRODUCTION

The thyroid is an endocrinal, butterfly-shaped, and biggest gland in the neck which makes and stores hormones that help in the regulation of blood pressure, heart rate, and body temperature and also help in the regulation of growth and rate of chemical reactions (metabolism) in the body. The thyroid gland made up from follicular cells which produce two major hormones of the thyroid gland-T3 (triiodothyronine) and T4 (tetraiodothyronine or thyroxine) and few parafollicular cells (C-cells) produces hormone called “Calcitonin” which helps in the regulation of calcium homeostasis [1-3]. Hypothyroidism is associated with decreased thermogenesis, decreased metabolic rate, and has also been shown to correlate with a higher body mass index (BMI) and a higher prevalence of obesity. Hypothyroidism is an insidious condition in which the thyroid gland does not synthesize enough thyroid hormones to meet metabolic requirement of the body which is associated with subtle and nonspecific symptoms with significant morbidity [4]. Iodine deficiency is the

most common cause of hypothyroidism worldwide. The relationship between thyroid function and body weight in euthyroid individuals has been given a great medical concern. Various researchers have studied the effect of the thyroid hormones on body mass index (BMI), and it has been demonstrated that overt thyroid dysfunction affects body weight. Clinical hypothyroidism causes an increase in body weight, while hyperthyroidism reduces it [5]. However, variations in thyroid function exist also between individuals with thyroid hormones levels within the reference (physiologic) range [6]. These slight differences within the normal thyroid function may have important implications for the regulation of body weight and thus the prevalence of obesity. Previous studies have revealed that the effects of obesity on the endocrine system are multifaceted, although that is seldom noted. Obesity can affect thyroid function and the release of gonadotropin releasing hormone (GnRH), alter the luteinizing hormone pulse amplitude [7], decrease growth hormone levels, and increase cortisol levels. Thyroid function is closely related to obesity and obesity-related metabolic disease. Therefore, increasing attention is being focused on the effects of obesity on thyroid function. Several studies have explored alterations in thyroid function associated with differences in body mass index (BMI) in individuals who are euthyroid [8-12]. The results, however, have been rather inconsistent. Most of these studies have had small sample sizes and concentrated on the effects of thyroid function on BMI. Hypothyroidism is the leading cause of several complications, the commonest being overweight and obesity. The present study was undertaken to evaluate the BMI at the time of diagnosis in hypothyroid patients and compare with that of normal individuals. Below table shows BMI and its classification.

MATERIALS AND METHODS

A Case control study was conducted at Dinajpur Medical College Hospital, Dinajpur Bangladesh from January 2020 to December 2021. Out of 150 hypothyroid subjects 133 were females and 17 were males. Out of 150 normal individuals 70 were females and 30 were males. BMI was calculated, data of T3, T4 & TSH levels were collected & compared between normal and hypothyroid subjects. All subjects were in the age group of 20-40 years. Height is measured with Harpenden stadiometer, & weight is measured with standard weighing machine. Participant should stand erect with chest straight and chin facing forward, bare foot & heels touching the wall. Participant should wear lightweight clothes. The information provided by the participant will be kept confidential and the Participation is voluntary.

Inclusion Criteria

- Patients of hypothyroidism at the time of diagnosis in the age group of 20 to 40 years.
- 150 healthy volunteers are taken as controls.

Exclusion Criteria

- Immunologically-compromised patients
- Patients with Diabetes Mellitus, Hypertension
- Chronic liver disease
- Chronic renal disease
- Patients taking any drugs altering serum TSH levels (somatostatin, opiates, dopamine, glucocorticoids, bromocriptin etc.)
- Pregnant and lactating female

BMI was calculated as body weight (Kilograms) divided by height squared (Meters). Data of T3, T4 & TSH levels were collected & compared between normal and hypothyroid subjects. Mean values of T_3, T_4, TSH, BMI was calculated. These values were compared between normal subjects and hypothyroid patients. P value was calculated. $P< 0.001$ was considered significant.

Hypothyroidism can have serious health consequences at all the stages of the life cycle.

BMI	CLASSIFICATION
<18.5	Underweight
18.5-24.9	Normal
25.0-29.9	Overweight
30.0-34.9	Obesity (Class I)
35.0-39.9	Obesity (Class II)
>40	Extreme Obesity (Class III)

Normal Thyroid Profile (According to Williams Text book of Endocrinology 11th Edition):

TSH value 0.4 – 4. 2 mU/l

T_3 value 70 - 190 ng/dl

T_4 value 5 -11 micro grams/dl

RESULTS

Out of 150 hypothyroid subjects 133 were females and 17 were males. Out of 150 normal individuals 70 were females and 30 were males. According to WHO classification the BMI value between 18.5 and 24.9 is considered as normal weight. BMI value between 25 and 29.9 is considered as overweight. BMI value of 30 and above is considered as obesity. It shows BMI in normal and hypothyroid male and female subjects. MI is more in hypothyroid subjects as compared to normal subjects.It shows TSH is more in hypothyroid subjects as compared to normal subjects. Table-1 shows that BMI is more in hypothyroid males and females as compared to normal subjects, and this is statistically significant ($p<0.001$). Hypothyroid patients were found to be overweight.

Table-1: Showing BMI & Thyroid profiles of study population

Parameter	Normal males (Mean value)	Hypothyroid males	p-value	Normal females (Mean value)	Hypothyroid females	p-value
BMI (kg/mt^2)	22.2063032	27.10361061	0.0008	22.36539541	28.48236955	0.0006
TSH (mU/l)	2.4259375	25.33076923	0.0003	2.414285714	28.56	0.0004
T_4(ṁcg/dl)	8.0625	5.661538462	0.02	8.354285714	6.196666667	0.0002
T_3(ng/dl)	129.1875	112.8461538	0.015	128.5	106.0751111	0.012

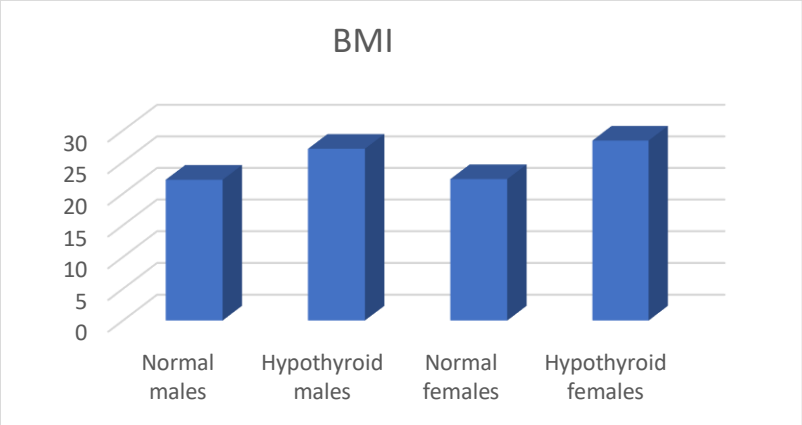

Fig-1: Depicting BMI in study population

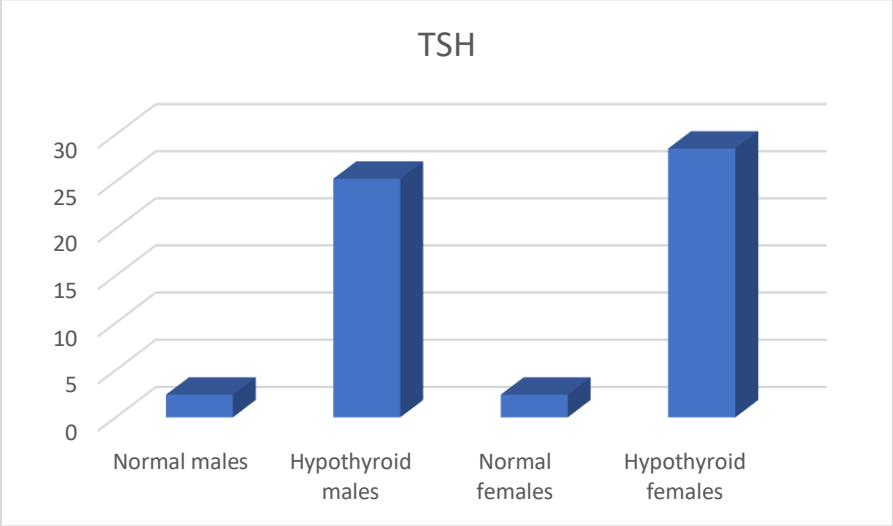

Fig-2: Figure depicting TSH in study population

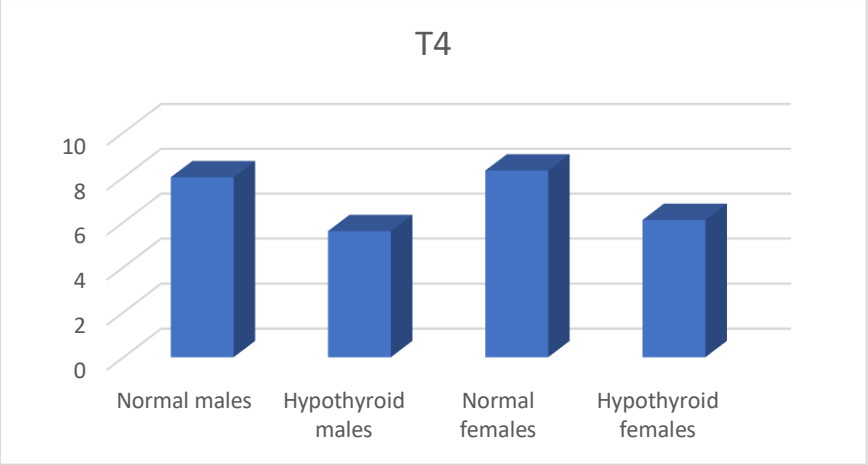

Fig-3: Figure depicting T_4 in study population

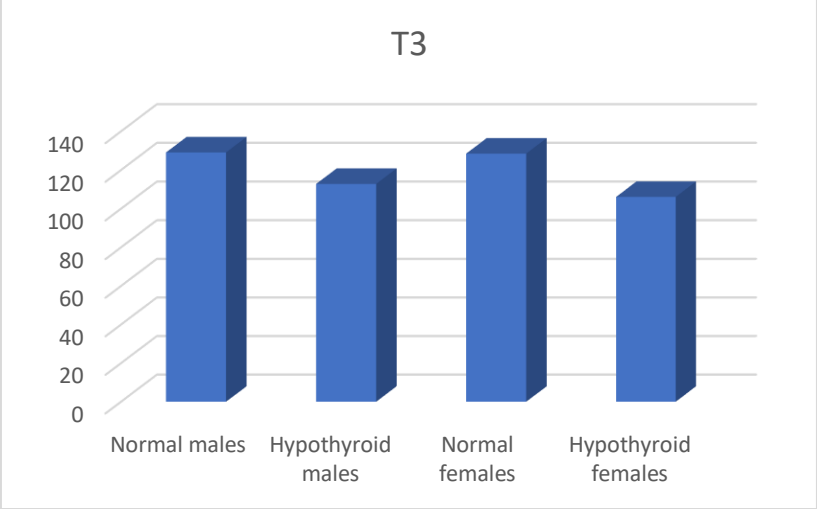

Fig-4: Figure depicting T_3 in study population

DISCUSSION

Thyroid hormone induces changes in physical activity and in turn in the body mass [13]. BMI is a simple index of weight for height that is commonly used to quantify the amount of tissue mass (Muscle, fat and bone) of an individual and categorize as underweight, normal weight, overweight or obese based on that value. BMI provides the most useful population level measure of overweight and obesity as it is same for both sexes and all ages. Thyroid Hormones stimulate oxygen consumption of most of the body cells, helps in regulation of lipid and carbohydrate metabolism and are necessary for normal growth and maturation [14]. Thyroid hormone mobilizes lipids rapidly from the fat tissue which reduces the fat stores of the body and it increases free fatty acid concentration in plasma and accelerates the oxidation of free fatty acid by the cells. Although the optimal values for thyrotropin (TSH), T4 and T3 are not firmly established, there is a modern trend towards the narrowing of the reference normal range, especially for TSH [15]. In 2003, the American Association of Clinical Endocrinologists (AACE) defined the boundaries of the normal thyroid function and proposed the treatment of thyroid dysfunction when the serum TSH levels are off the narrow limits of 0.3–3.0 mIU/L [16]. Thyroid hormone increases the number of LDL receptors on liver cells leading to rapid removal of LDL from plasma by the liver. Reduced thyroid hormones greatly increase the plasma concentration of cholesterol, phospholipids, triglycerides and excessive deposition of fat in the liver [17]. Recently, several clinical studies evaluated the issue of hormonal changes associated with obesity. Thyroid hormone is indeed an important determinant of energy expenditure and contributes to appetite regulation. On the other hand, secretory products from the adipose tissue act on the CNS to inform on the quantity of energy stores, and this may have an impact on the activity of the hypothalamus–pituitary–thyroid axis [18]. Hypothyroidism causes a weight increase together with a decrease in basal metabolic rate and thermogenesis. Moreover, it has also been reported that there is an inverse correlation between free thyroxine (fT_4) values and body mass index (BMI), even when fT_4 values remain in the normal range [19] BMI has been negatively associated with serum free T4

(FT_4), and fat accumulation has been associated with lower FT4 and higher TSH levels among slightly overweight euthyroid individuals, thereby resulting in a positive correlation between TSH and the progressive increase in weight with time. The alterations in body weight associated with hypothyroidism may reflect both the accumulation of body fat, due to decreased REE and reduced physical activity, and the increased water content of the body, consequent to a reduced capacity of excreting free water. Hypothyroid subjects also have increased amounts of glycosaminoglycans that are responsible for the greater water-binding capacity, a condition that results in the typical ‘‘myxedema’’ of hypothyroidism [20,21]. Restoration of euthyroidism is followed by an increase in Resting Energy Expenditure (REE) and even small variations in serum TSH, induced by L-T4 substitution, are associated with opposite changes in REE. However, in spite of adequate substitution with L-T4, hypothyroid patients may experience only a modest and/or transient loss of weight during hormone treatment. Excretion of excess body water, rather than reduction in fat mass, accounts for this change of body weight [22,23]. In this study an attempt has been made to compare the BMI between hypothyroid subjects and normal individuals to emphasize the relation between BMI and TSH. A significant correlation was found between BMI and TSH. Most of the Hypothyroid subjects in the present study fall under the category of overweight. However, this parallel increase in BMI due to weight gain along with increase in TSH may further lead to complications of overt hypothyroidism if left untreated. Obesity itself could produce various metabolic disorders in coming future. Hence maintenance of thyroid hormones at normal level and regular monitoring of BMI in Hypothyroid patients will help in early detection and prevention of Obesity and its related complications in future. Awareness of weight reduction and regular physical exercise are to be advised to patients with hypothyroidism.

CONCLUSION

Hypothyroidism is the most common thyroid disorder associated with low level of thyroid hormones. Hypothyroidism is the leading cause of several complications such as Dyslipidemia, Obesity and Cardiovascular diseases. Central obesity is related to many endocrine disorders including thyroid dysfunction. BMI is commonly used to quantify the amount of tissue mass which includes Muscles, Fat and Bone of an individual. BMI provides the most useful population level measure of overweight and obesity as it is same for both sexes and all ages. This study suggests that Hypothyroidism influences body weight and BMI of the patients significantly.

Conflict of Interest: None.
Source of Fund: Nil.

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