Detection of Prevalence &Characterization of Thyroid Disorder Patients in Dhaka: A Survey Based Study

A Dissertation submitted to BRAC University in partial fulfillmentof the requirements for the degree of Master of Science in Biotechnology

Submitted by

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DECLARATION

I hereby declare that, this thesis, entitled **"Detection of Prevalence & Characterization of Thyroid Disorder Patients in Dhaka: A Survey Based Study"** is based on my own work and it contains no material previously published or written by another person and not accepted for the award of any other degree of university or other institute of higher education.

This research work was carried out in the institute The Thyroid Center, Green Road, Dhaka under the supervision of Dr. Mohammad Rafiqul Islam, Associate Professor, Department of Mathematics and Natural Sciences, BRAC University, Mohakhali, Dhaka.

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CERTIFICATE

This is to certify that Md. Shafiul Alam has completed the thesis entitled **"Detection of Prevalence & Characterization of Thyroid Disorder Patients in Dhaka: A Survey Based Study"** as a partial fulfillment of the requirements for the degree of Master of Science in Biotechnology thesis part by the BRAC University Dhaka, Bangladesh.

His work is original and the work is up to my satisfaction.

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List of Abbreviations

T3	Triiodothyronine
T4	Thyroxine
MIT	Mono-iodinated tyrosine
DIT	Di-iodinated tyrosine
TBG	Thyroxin Binding Globulin
TSH	Thyroid Stimulating Hormone, Thyrotropin
TH	Thyroid Hormone
TRH	Thyrotropin Releasing Hormone
IDD	Iodine Deficiency Disorder
USI	Universal Salt Iodization
CIDD	Control of Iodine Deficiency Disorder
AITD	Autoimmune Thyroid Disease
LATS	Long-acting Thyroid Stimulating Antibodies
FNA	Fine Needle Aspiration Biopsy
FT4	Free T4
FT4I, FTI	Free T4 Index
Tg	Thyroglobulin
RAIU	Radioactive Iodine Uptake
CVD	Cardiovascular Disease
BMI	Body Mass Index
T1DM	Type 1 Diabetes Mellitus
T2DM	Type 2 Diabetes Mellitus
IHD	Ischemic Heart Disease
MHC	Major Histo Compatibility
XCI	X-chromosome Inactivation

Abstract

Thyroid disorder is being considered as the most widespread endocrine dysfunction globally. Almost 200 million people around the world are suffering from some form of Thyroid Disorder. The pattern of thyroid disease may vary in different parts of the world and also in different regions of the same country. The objective of this study is to identify the prevalence, determine a critical age range for onset of thyroid disorder & characterizing the patients of thyroid disorder in Dhaka, Bangladesh by analyzing different cofactors on a survey based study. The survey was carried out in an institution specialized in diagnosis & treatment of thyroid disorder patients. The name of the institution is 'The Thyroid Center' situated in Green Road, Dhaka. A total of 186 subjects were taken under this study for investigating their cases who were registered patients at the institute. All the subjects went through the same assessment procedure by measuring height & weight and reviewing medical history by filling up the provided questionnaire.The prevalence of thyroid disorder was observed in women (71%) than men (29%). Most of the subjects was of the age range of 30-40 years (34%). This specific age range was found predominant within both male & female subjects. After calculating the Body Mass Index of the subjects, it was found that the largest percentage of it lies within the overweight limit (49%). Autoimmune Thyroid Disorder has been found to be most occurred (93%) thyroid dysfunction among all the types. Moreover, hypothyroidism is found to me prevalent (80%) than hyperthyroidism in general. But male subjects are more likely to have hyperthyroidism (63%) & female subjects are found to be more prone to have hypothyroidism (98%). Most of the subjects under the study were diagnosed within 1 year (66%). 66% of the subjects did not have any other diseases & 84% of them do not have any habitual acts. Among the subjects 14% of them had maternal family history of thyroid disease, 12% had paternal history & 74% had no history of thyroid disorder in their family. The evidence from the study presented that, the occurrence of Autoimmune Thyroid Disorder has been increasing at an alarming rate & the critical age range for onset of Thyroid Disorder is 30-40 years for both male & female individual.

Keywords:

Thyroid Disorder, Autoimmune Thyroid Disorder, Hypothyroidism, Hyperthyroidism, Critical Age range, Body Mass Index (BMI)

1. Introduction

When we are asked to name any critical organs, most likely the heart, lungs or brain immediately jumps to our minds, but just because the thyroid does not get to the top it does not mean it is not as important. In fact, this little butterfly-shaped part of the endocrine system is essential to everyday health.

The word thyroid gland is Greek, and translated to mean “shield gland”. (Malik et al., 2015)It is so named because of its resemblance to the classical shield (thureos) used by the ancient Greeks. (Encyclopedia.com, 2016)

In many ways, it acts like a shield by protecting our bodies from losing functional balance. (Healthbytesnyc.com, 2016)

Located in the junction between the head and the body, the thyroid gland may be envisioned as a meeting point between psyche and soma. Somatic diseases within the thyroid have major impact on the psyche of the patient and vice versa. (Watt, 2008)

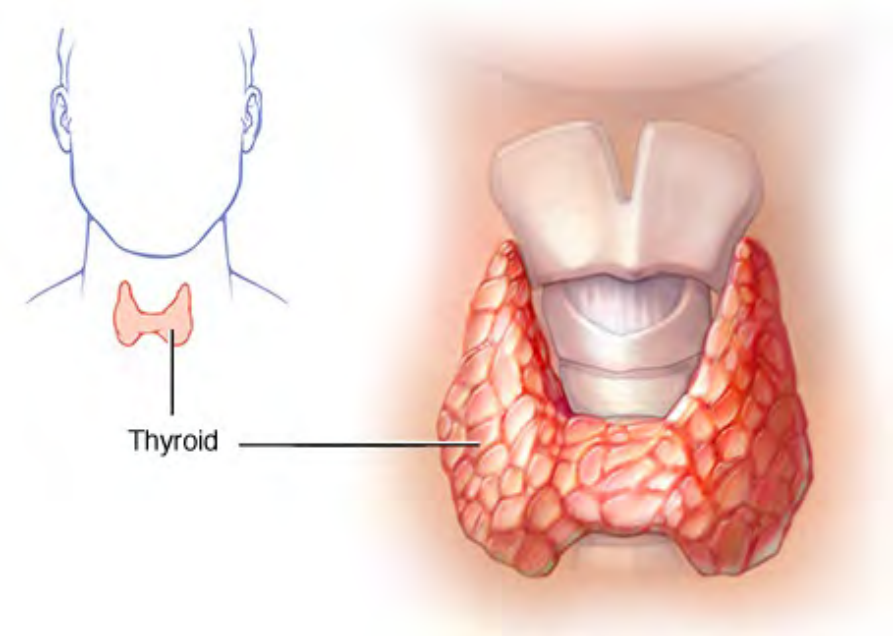


Fig. 01: Thyroid Gland

Diseases related to the thyroid gland are very common, affecting individuals of all ages, mainly women. Thyroid hormones target all cells/organs in the body, mainly as a promoter of metabolism, and under- or overproduction of hormones therefore affects a broad range of human functions. (Watt, 2008)

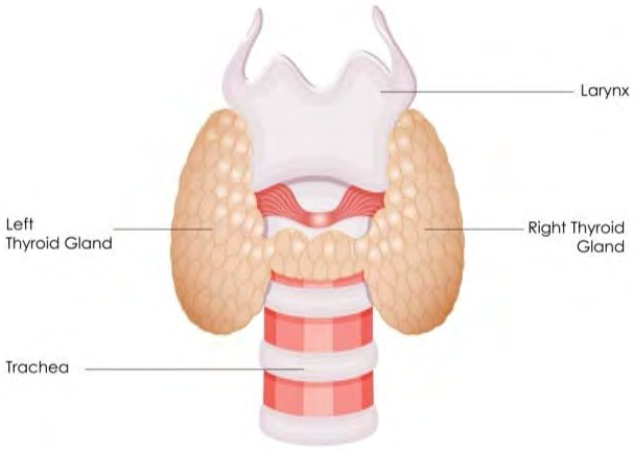


Fig. 02: Thyroid Gland

About 200 million people around the world have some form of Thyroid disease. Thyroid disorders for the most part are treatable; however untreated thyroid disease can produce serious results in other parts of body. Improved public awareness and understanding of thyroid disorders will enable patients and their families to cope more effectively with the course of thyroid illness. (BS, D.S.)

It is believed that, thyroid diseases are only prevalent to women of age more than 50. But the current rise in thyroid disorder patients both male & female, who are of different age ranges, is very alarming. The goal of this study is to identify the prevalence, determine a critical age range for onset of thyroid disorder & characterizing the occurrence of thyroid disorder in Bangladesh by analyzing different cofactors on a survey based study. Still it is obvious that, further studies in order to have a more comprehensive analysis of epidemiological aspect is highly required for better awareness and control of this endocrine disorder.

2. Literature Review

2.1 Thyroid Gland Overview

2.1.1 Development of Thyroid Gland

The thyroid gland is the first of the body's endocrine glands to develop, on approximately the 24th day of gestation. The thyroid originates from two main structures: the primitive pharynx and the neural crest. The rudimentary lateral thyroid develops from neural crest cells, while the median thyroid, which forms the bulk of the gland, arises from the primitive pharynx.

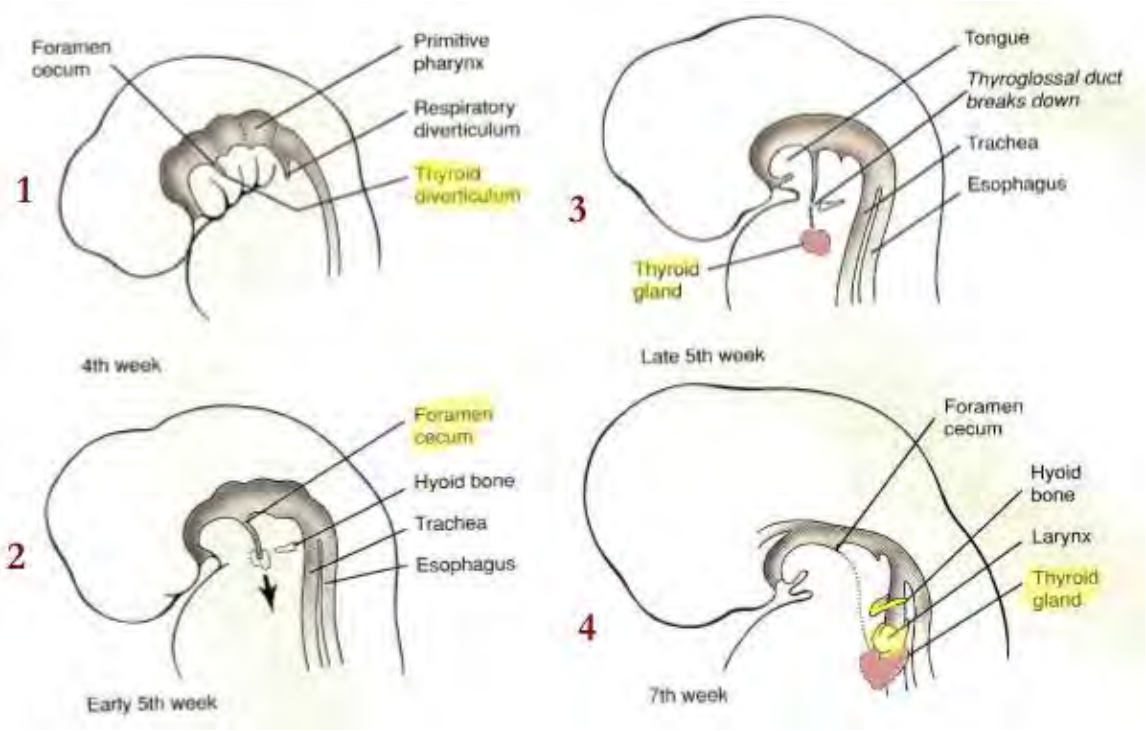


Fig. 03: Development stages of Thyroid Gland

The thyroid gland forms as a proliferation of endodermal epithelial cells on the median surface of the developing pharyngeal floor. The site of this development lies between 2 key structures, the tuberculumimpar and the copula, and is known as the foramen cecum. The thyroid initially arises caudal to the tuberculumimpar, which is also known as the median tongue bud. This embryonic swelling develops from the first pharyngeal arch and occurs midline on the floor of the developing pharynx, eventually helping form the tongue as the two lateral lingual swellings overgrow it.

The foramen cecum begins rostral to the copula, also known as the hypobranchial eminence. This median embryologic swelling consists of mesoderm that arises from the second pharyngeal pouch (although the third and fourth pouches are also involved). The thyroid gland, therefore, originates from between the first and second pouches.

The initial thyroid precursor, the thyroid primordium, starts as a simple midline thickening and develops to form the thyroid diverticulum. This structure is initially hollow, although it later solidifies and becomes bilobed. The stem usually has a lumen, the thyroglossalduct that does not descend into the lateral lobes. The 2 lobes are located on either side of the midline and are connected via an isthmus. (Zapanta, P. E.)

The butterfly-shaped endocrine gland is normally located in the lower front of the neck. The thyroid's job is to make thyroid hormones, which are secreted into the blood and then carried to every tissue in the body. Thyroid hormone helps the body use energy, stay warm and keep the brain, heart, muscles, and other organs working as they should. (American Thyroid Association, 2016)

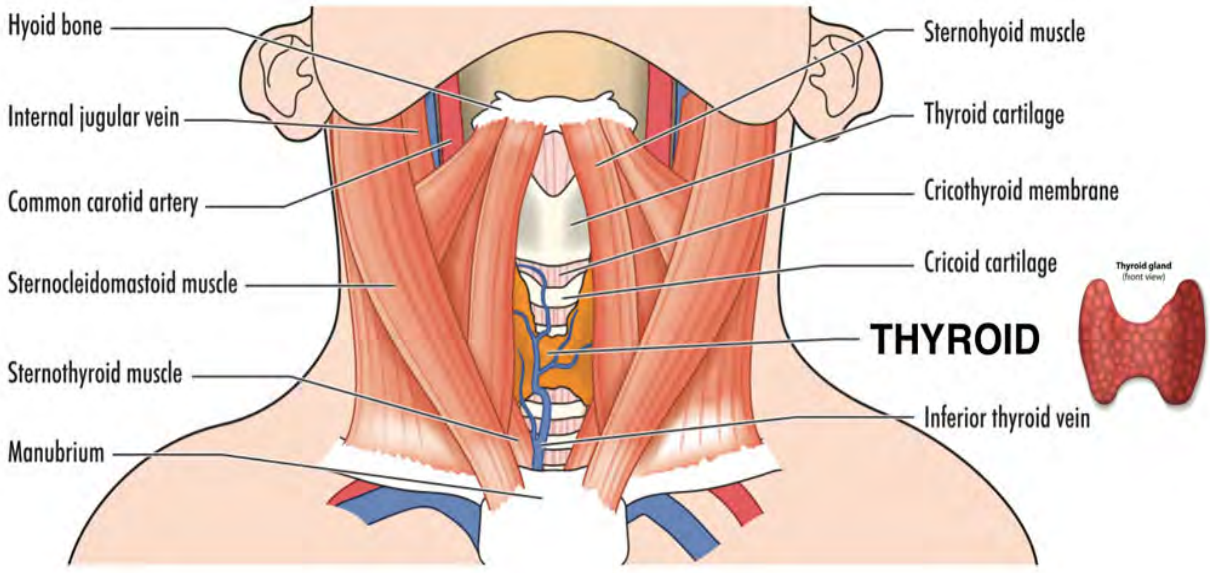


Fig. 04: Position of Thyroid Gland

2.1.2 Anatomy of Thyroid Gland

The adult gland comprises a bi-lobular structure, which weighs between 15 and 20 grams, and connected by a 2-centimeter–wide isthmus that is located anterior to the laryngeal cartilages. The isthmus varies greatly in position and size, making its palpation difficult in certain patients. The gland, however, is palpable in most healthy adults. The internal anatomy of the thyroid gland consists of follicles that contain a mucinous colloid where the protein thyroglobulin is found. Thyroglobulin is the basic building block for the two main hormones produced by the thyroid: triiodothyronine, or T3, and thyroxine, or T4. (Pinto and Glick, 2002)

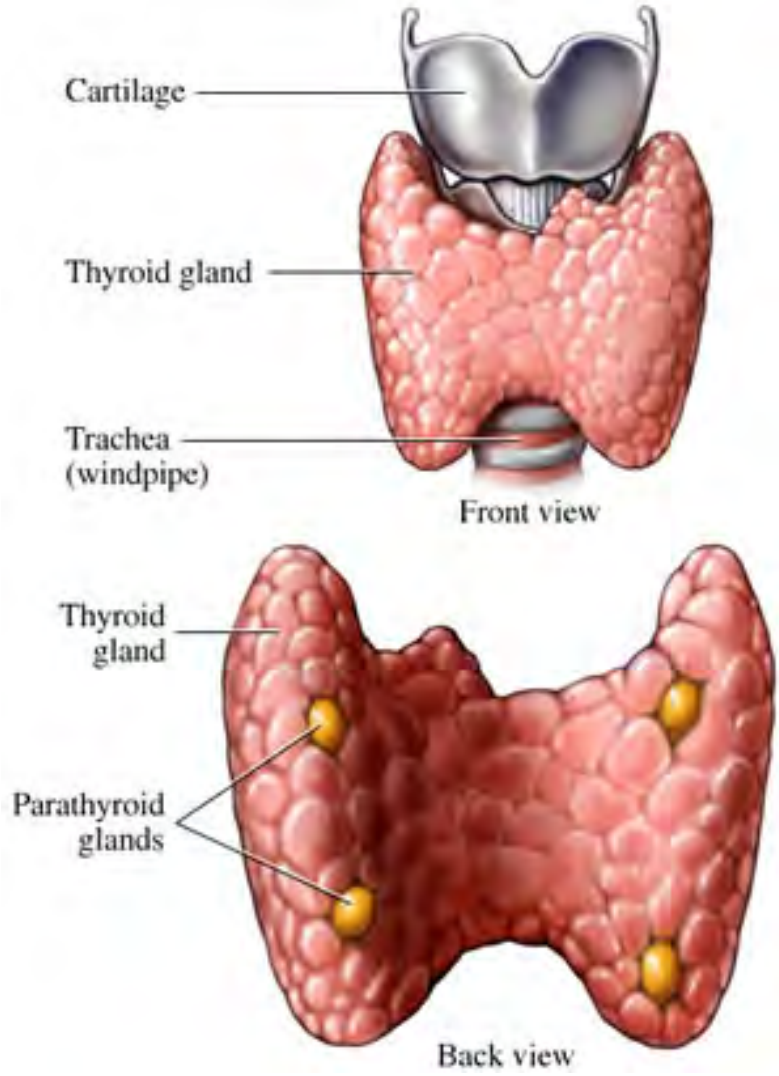


Fig. 05: Front & Back view of Thyroid Gland

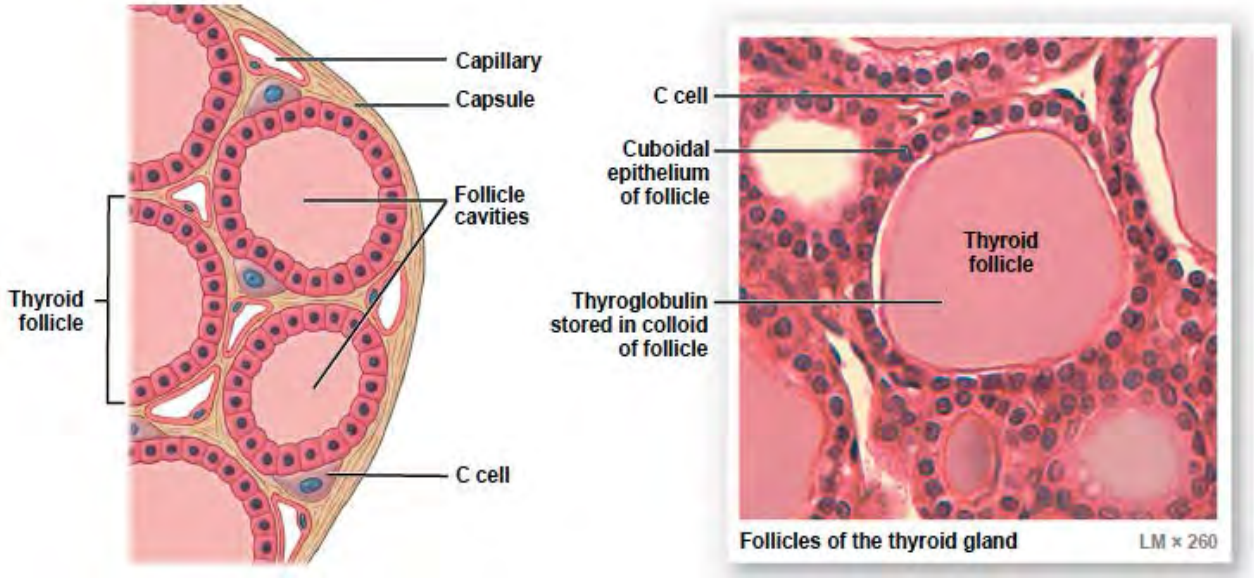


Fig. 06: Anatomy of Thyroid Gland

2.2 Thyroid Hormones & their Pathway of Synthesis

The major thyroid hormone secreted by the thyroid gland is thyroxine, also called T4 because it contains four iodine atoms. To exert its effects, T4 is converted to triiodothyronine (T3) by the removal of an iodine atom. This occurs mainly in the liver and in certain tissues where T3 acts, such as in the brain. (American Thyroid Association, 2016)

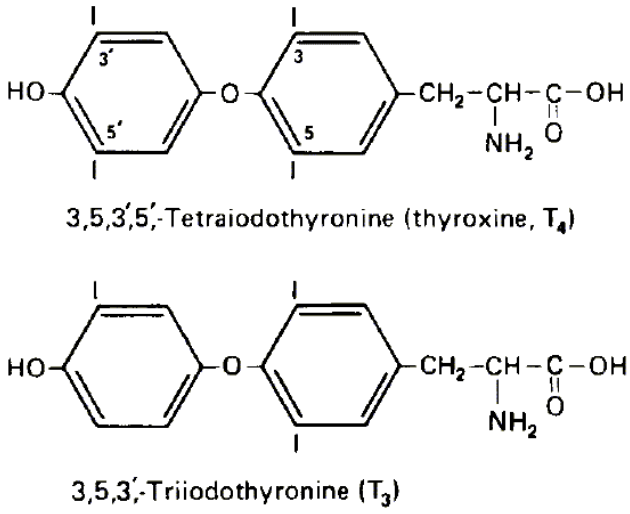


Fig. 07: Structure of Thyroid Hormones

Triiodothyronine is about four times as potent as thyroxine, but it is present in the blood in much smaller quantities and persists for a much shorter time than thyroxin.(Nowak, 2009)

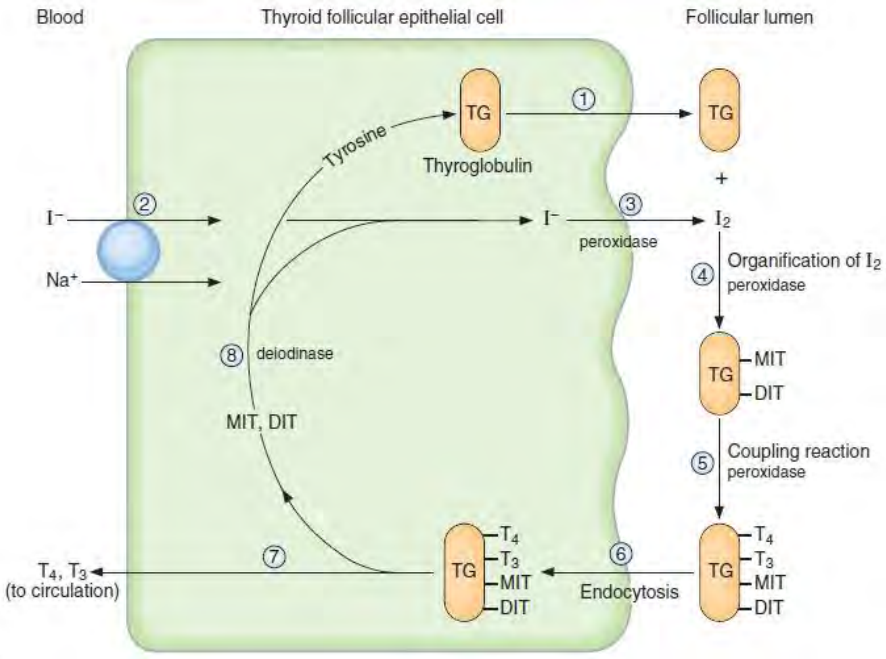


Fig. 08: Thyroid Hormone production Pathway

The first step in the synthesis of thyroid hormones is the organification of iodine. Iodide is taken up, converted to iodine, and then condensed onto tyrosine residues which reside along the polypeptide backbone of a protein molecule called thyroglobulin. This reaction results in either a mono-iodinated tyrosine (MIT) or di-iodinated tyrosine (DIT) being incorporated into thyroglobulin. This newly formed iodothyroglobulin forms one of the most important constituents of the colloid material, present in the follicle of the thyroid unit.

The other synthetic reaction, that is closely linked to organification, is a coupling reaction, where iodotyrosine molecules are coupled together. If two di-iodotyrosine molecules couple together, the result is the formation of thyroxin (T4). If a di-iodotyrosine and a mono-iodotyrosine are coupled together, the result is the formation of tri-iodothyronine (T3).

From the perspective of the formation of thyroid hormone, the major coupling reaction is the di-iodotyrosine coupling to produce T4. Although T3 is more biologically active than T4, the major production of T3 actually occurs outside of the thyroid gland. The majority of T3 is

produced by peripheral conversion from T4 in a deiodination reaction involving a specific enzyme which removes one iodine from the outer ring of T4.

The T3 and T4 released from the thyroid by proteolysis reach the bloodstream where they are bound to thyroid hormone binding proteins. The major thyroid hormone binding protein is thyroxin binding globulin (TBG) which accounts for about 75% of the bound hormone.(Thyroid Hormone Synthesis, University of Connecticut Health Center)

2.3 Regulation of Thyroid Hormone

The amount of T4 produced by the thyroid gland is controlled by another hormone, which is made in the pituitary gland located at the base of the brain, called thyroid stimulating hormone (TSH). The amount of TSH that the pituitary sends into the blood stream depends on the amount of T4 that the pituitary sees. If the pituitary sees very little T4, then it produces more TSH to tell the thyroid gland to produce more T4. Once the T4 in the blood stream goes above a certain level, the pituitary's production of TSH is shut off. (American Thyroid Association, 2016)

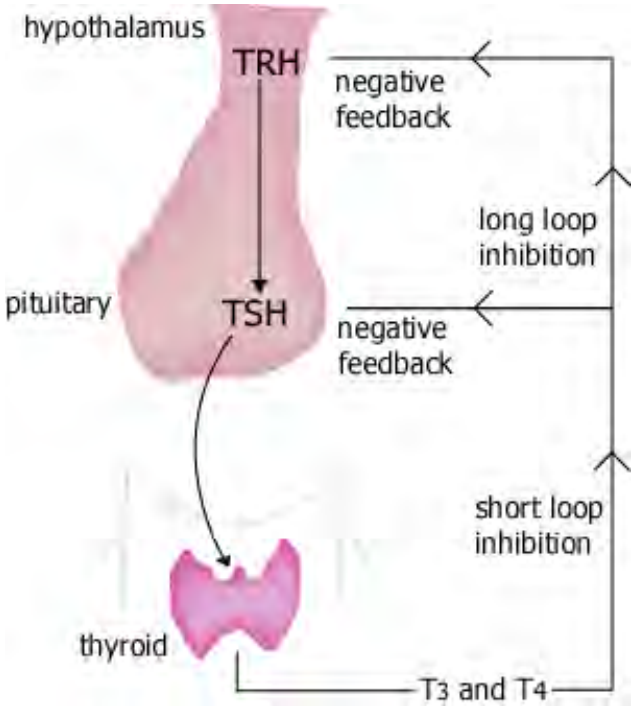


Fig. 09: Regulation pathway of Thyroid Hormone secretion

2.4 Function of Thyroid Hormone

The thyroid gland regulates a wide range of physiological functions in the body including growth, metabolism and energy homeostasis, via the secretion of thyroid hormone (TH). (National Medicines Information Centre, 2014)

Thyroid hormones influence the growth and maturation of tissue, energy metabolism, and turnover of both cells and nutrients. (Pinto and Glick, 2002)

T3 is the main metabolic effector, with a 10-fold greater affinity over T4 or nuclear thyroid receptor proteins. The action of this hormone at amolecular level includes the activation of genetic material (mainly transcription and formation of messenger ribonucleic acid) and translation to proteins coding for multiple hormonal and constituent tissues such as growth hormone; thyrotropin-releasing hormone, or TRH; malicenzyme; myosin; and the calcium pump complex of the sarcoplasmic reticulum. Tissue-specificthyroid receptors have been described as (alpha) and (beta). Alpha-receptors are found in myocardial cells, and Beta receptors are responsible for hormone hemostasis and feedback mechanism. (Pinto and Glick, 2002)

Thyroid hormones:

- Control the rate at which calories are burned. This affects weight loss or weight gain.
- Can slow down or speed up the heartbeat.
- Can raise or lower body temperature.
- Affect how fast food moves through the digestive tract.
- Control the way muscles contract. (TUFTS Healthplan, 2014)

A deficiency of either T4 or T3 can affect adversely the growth and development of the infant and will decrease metabolic function in the adult. An overproduction or excess availability of thyroid hormones can cause serious and life threatening complications if not discovered and managed in time. (Pinto and Glick, 2002)

2.5 Global Situation of Thyroid Disease

Thyroid dysfunction has been considered as one of the most common endocrine disorder in clinical practice throughout the world. Its increasing prevalence had led to the screening of general population in different parts of the world in order to investigate causes for rising incidence. (Nusrath et al., 2015)

Clinical abnormalities in thyroid function are estimated to affect >5% of individuals during their lifetime. (National Medicines Information Centre, 2014)

Up to 5 percent of the U.S. female population has alterations in thyroid function, and up to 6 percent may have clinically detectable thyroid nodules on palpation. An estimated 15 percent of the general population has abnormalities of thyroid anatomy on physical examination, and an unknown percentage of these do not complete a diagnostic evaluation. It has been suggested that the number of people affected may be twice as many as the undetected cases. (Pinto and Glick, 2002)

2.6 Thyroid Disorder in Bangladesh

Thyroid disorder is one of the major health problems in Bangladesh. (Paul et al., 2006)Between 1981 and 1987, a program to administer injected iodated oil was implemented in districts with high rates of Iodine Deficiency Disorder (IDD). Universal Salt Iodization (USI) was then found to be more practical. In 1989, the Government of Bangladesh passed a law making it mandatory for all edible salt to be iodized. Fortification of salt with iodine was initiated in 1990 to meet the urgent need for a cost-effective and sustainable intervention for the Control of Iodine Deficiency Disorder (CIDD). This activity, initiated after careful trials, also complied with a global recommendation for USI. (Unicef.org, 2016)

Later, a study in 1996 reveled a 44% of household was already consuming iodized salts in Bangladesh. (Xu et al., 1999)

There are several institution based studies on thyroid disorders in different parts of the country and studies showed that the problem of thyroid is mainly in the northern part of our country and along the belt of Jamunariver. The pattern of thyroid disease may vary in different parts of the world and also in different regions of the same country. It is thought that the thyroid disorder is less common in southern part of our country but a small hospital based study done at Nuclear Medicine Centre, Khulna shows that the incidence of various thyroid diseases is also high in this zone. (Paul et al., 2006)

Chronic autoimmune disease (atrophic autoimmune thyroiditis and Hashimoto's thyroiditis) is one of the etiological factors for thyroid disorders in this southern zone. (Paul et al., 2006)

At the beginning of the twenty first century hypothyroidism, Graves' disease, postpartum thyroiditis and thyroid malignancies are common thyroid disorders in Bangladesh while iodine deficiency disorders are still persisting in low prevalence. It is believed that around 10% of the Bangladeshi people suffer from clinically evident thyroid disorders. Recently subclinical hypo and hyperthyroidisms are included as thyroid disorders adding another 10% population to be dysthyroidtotalling 20% of the population suffering from any type of thyroid disorders. (Maj, 2014)

Thyroid diseases are related to genetic and environmental factors. In 1993 national survey, urinary iodine and prevalence of goitre were studied among all age groups in Bangladesh. It was revealed that total goiter rate was about 15% and more than 69% of the population had iodine deficiency. But this survey neith~rcorrelated the hormonal dysfunction nor the autoimmunity of thyroid with goitre prevalence and iodine deficiency. However, regulating bodies of the country introduced compulsory iodization of table salt since 1993. (Hasanat et al., 2003)

A study in 2011 also stated that, Subclinical hypothyroidism in rural school-going children is common than the urban school going children, due to less iodine intake. (Begum et al., 2011)

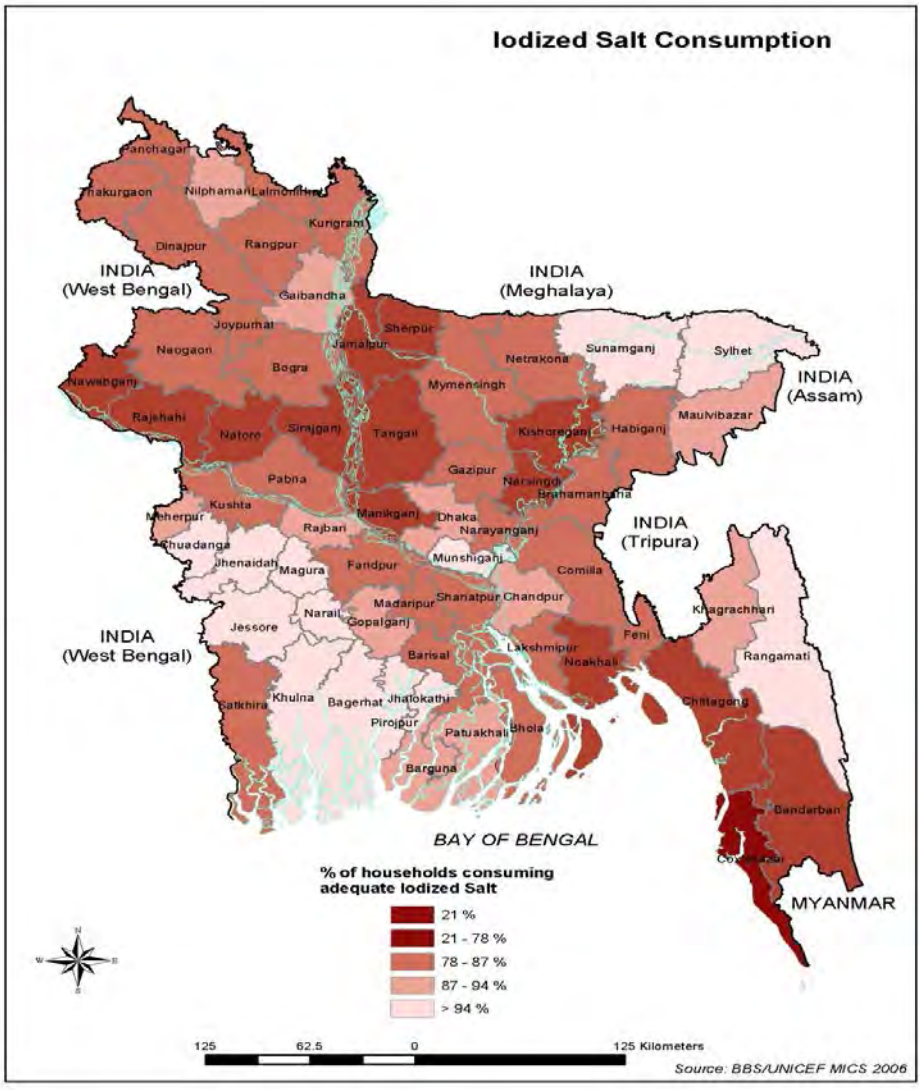


Fig. 10: Areas of different percentage of iodized salt consumption in Bangladesh

2.7 Cause of Thyroid Diseases

The prevalence and the pattern of thyroid disorders depend on ethnic and geographical factors and especially on iodine intake. (Bjoro et al., 2000)

The thyroid is the main site of iodine uptake in the body, which is then incorporated into Thyroid hormone. The highest iodine content is found in fish, with smaller amounts in milk, eggs and meat.Iodine deficiency is typically due to the consumption of local produce in areas where the

soil has low iodine content (such as high mountainous areas and lowlands situated far from the oceans).The recommended daily intake of iodine for adults is 150-300 micrograms (mcg). Reduced iodine intake is the principal cause of thyroid disease worldwide;intake of <50 mcg/day is associated with reduced thyroid function or goiter (diffuse or nodular enlargement of the gland) whereby the gland size increases to compensate for the lower iodine in an effort to maintain normal TH levels.Over time, there is a risk that goitre may develop “autonomy”, resulting in production of TH, not under TSH control, potentially resulting in hyperthyroidism. (National Medicines Information Centre, 2014)

In iodine-replete regions, the commonest cause of thyroid dysfunction is autoimmune thyroid disease (AITD). This has been shown to affect up to 2% of the population in some regions and can result in over- or under-activity of TH.AITD is known to have a genetic component, probably involving multiple genes; 40-50% of patients report another family member with a thyroid disorder and there is a 5-10 fold increased risk in women compared with men.The genetic predisposition is thought to be triggered by environmental factors such as infectious agents, pollutants, hormones (especially estrogens), drugs (including lithium, interferon-α) and cytokines.(National Medicines Information Centre, 2014)

Hyperthyroidism has several causes. Graves’ disease, the most common intrinsic cause, is an autoimmune disorder associated with the development of long-acting thyroid stimulatingantibodies (LATS). Single or multiple thyroid nodules that produce thyroid hormones can alsocause hyperthyroidism. The use of excessive doses of the thyroid hormone supplementlevothyroxine is also a common cause. (Agency for Healthcare Research and Quality, 2004)

The most common cause of hypothyroidism is thyroiditis due to antithyroid antibodies, a condition called “Hashimoto’s thyroiditis.” Another common cause of hypothyroidism is prior treatment for Graves’ disease with surgery or radioiodine. (Agency for Healthcare Research and Quality, 2004)

2.8 Types of Thyroid Disease

2.8.1 Autoimmune Thyroid Disorder

2.8.1.1 Hyperthyroidism

Hyperthyroidism represents a myriad of thyroid disorders characterized by elevated levels of circulating thyroid hormones. The annual incidence of hyperthyroidism is three per 1,000 in the general population. Hyperthyroidism may result from generalized thyroid gland over-activity ("true" hyperthyroidism) or from causes other than over-activity of the gland. (DeRuiter, 2002)

"True" hyperthyroidism is caused by production of elevated levels of TSH (tumors, pituitary resistance), production of thyroid stimulators other than TSH (antibodies as in Graves' disease), or by thyroid autonomy (multinodular goiters). (DeRuiter, 2002)

The most common cause of hyperthyroidism is Graves' disease, a systemic autoimmune process in which the patient's body is producing auto-antibodies against the thyrotropin (TSH) receptor. These auto-antibodies called thyroid-stimulating immunoglobulins are present in 95% of patients with Grave's disease and activate the thyrotropin (TSH) receptor and stimulate the uncontrolled production and release of T4 and T3. Hyperthyroidism caused by factors other than thyroid gland over-activity may result from inflammatory thyroid disease (subacute thyroiditis, "painless" thyroid), the presence of ectopic thyroid tissue (strumaovarii, metastatic follicular carcinoma) or by exogenous sources of thyroid hormone. (DeRuiter, 2002)

2.8.1.2 Hypothyroidism

Hypothyroidism is the second most common endocrine disorder in the world after diabetes mellitus. (Islam, Hassan and Pathan, 2013)

Decreased thyroid hormone synthesis and low levels of circulating thyroid hormones result in biochemical and/or clinical hypothyroidism. This condition occurs more frequently in women;

the overall incidence is about 3% of the general population. The clinical presentation, particularly in elderly patients, may be subtle; therefore, routine screening of thyroid function tests is generally recommended for women more than 50 years of age.

Hypothyroidism is classified as primary or secondary. Primary hypothyroidism results from:

1) Defective hormone biosynthesis resulting from Hashimoto's or autoimmune thyroiditis (most common), other forms of thyroiditis (acute thyroditis, subacute thyroiditis), endemic iodine deficiency, or antithyroid drug therapy (goitrous hypothyroidism); and

2) Congenital defects or loss of functional thyroid tissue due to treatment for hyperthyroidism including radioactive iodine therapy or surgical resection of the thyroid gland. (DeRuiter, 2002)

In primary hypothyroidism the loss of thyroid function/tissue results in increased TSH secretion which promotes goiter formation. Secondary hypothyroidism may be caused by:

1) Insufficient stimulation of the thyroid from hypothalamic (decreased TRH secretion) or pituitary (decreased TSH secretion) disease, or

2) Peripheral resistance to thyroid hormones. Hypothyroidism secondary to pituitary or hypothalamic failure is relatively uncommon; most patients have clinical signs of generalized pituitary failure. The most common causes of secondary hypothyroidism are postpartum pituitary necrosis and pituitary tumor. (DeRuiter, 2002)

2.8.2 Thyroid Nodules

Thyroid nodules are "lumps" that commonly arise within an otherwise normal thyroid gland. Often these abnormal growths of thyroid tissue are located at the edge of the thyroid gland so they can be felt as a lump in the throat. When they are large or when they occur in very thin individuals, they can even sometimes be seen as a lump in the front of the neck. One in 12 to 15 women has a thyroid nodule while only one in 40 to 50 men have a thyroid nodule. More than

90% of all thyroid nodules are benign (non-cancerous growths). Some are actually cysts that are filled with fluid rather than thyroid tissue. (DeRuiter, 2002)

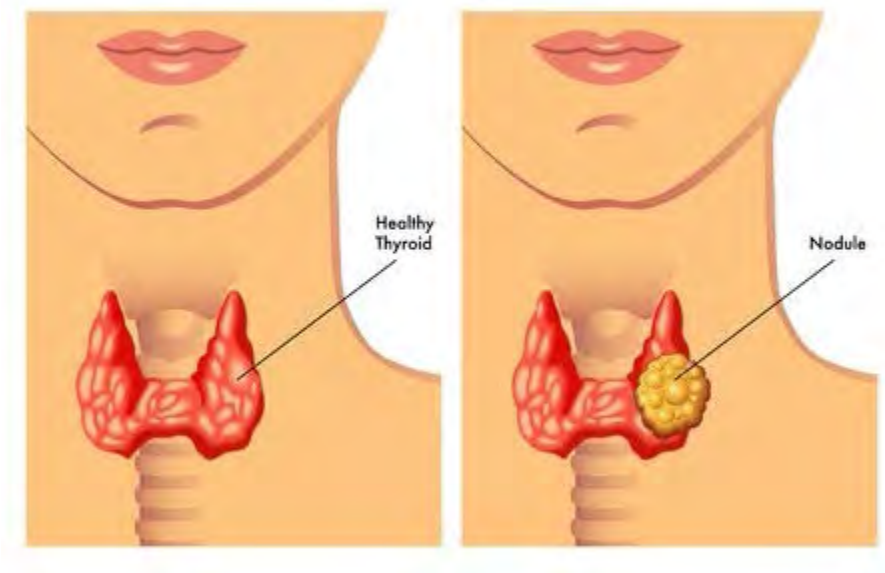


Fig. 11: Healthy Thyroid gland compared to Thyroid gland with a nodule

Thyroid nodules increase with age and are present in almost ten percent of the adult population. Autopsy studies reveal the presence of thyroid nodules in 50% of the population, so they are fairly common. Ninety-five percent of solitary thyroid nodules are benign, and therefore, only five percent of thyroid nodules are malignant. Common types of the benign thyroid nodules are adenomas (overgrowths of "normal" thyroid tissue), thyroid cysts, and Hashimoto's thyroiditis. (DeRuiter, 2002)

2.8.3 Thyroid Cancer

Although thyroid nodules are extremely common, malignant lesions derived from thyroid epithelial cells are relatively rare. (Alauddin and Joarder, 2004)

In the United States in 2010 an estimated 45,000 patients were diagnosed with thyroid cancer compared to over 200,000 patients with breast cancer and 140,000 patients with colon cancer. (American Thyroid Association, 2016)

While the causes of this form of cancer are not precisely understood, it is known that iodine deficiency, long-term use of goitrogenic drugs and exposure to ionizing radiation are risk factors for thyroid hyperplasia and ultimately malignancy. (DeRuiter, 2002)

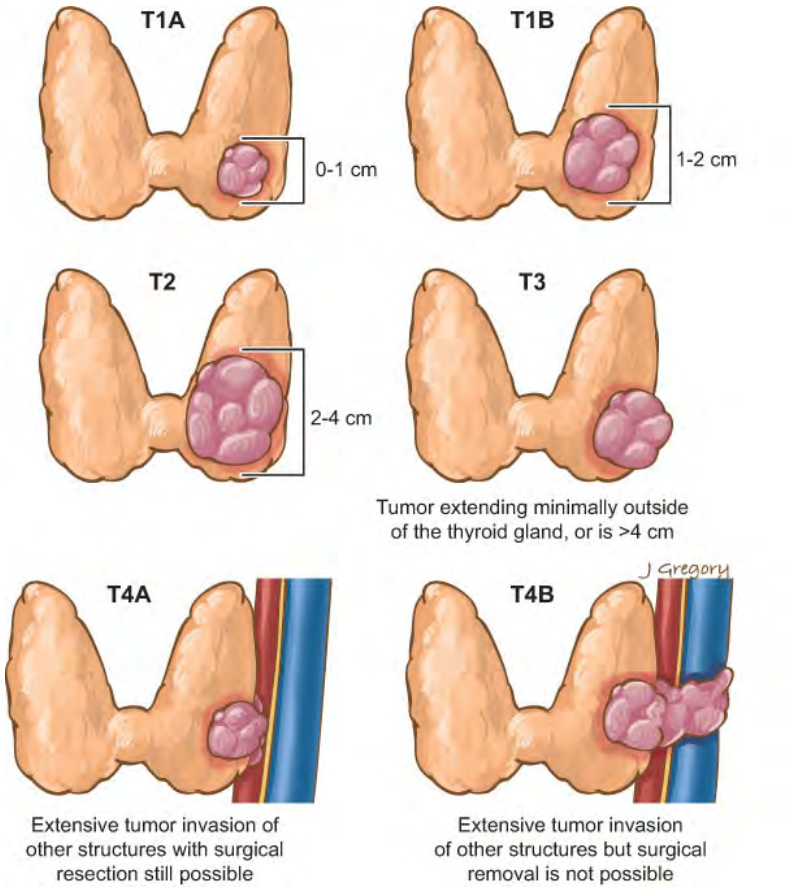


Fig. 12: Different Stages of Thyroid Cancer

Thyroid cancers typically present as a dominant solitary thyroid nodule that can be felt by the patient or even seen as a lump in the neck by family and friends. It is important to differentiate benign nodules from cancerous solitary thyroid nodules. While history, physical examination, laboratory tests, ultrasound, and thyroid scans can all provide information regarding a solitary thyroid nodule, the only test that can differentiate benign from cancerous thyroid nodules is a biopsy. Thyroid tissues are easily accessible to needles, so rather than operating to remove a portion of the tissue, a very small needle can be used to remove cells for microscopic examination. This method of biopsy is called a fine needle aspiration biopsy, or "FNA". Papillary carcinoma accounts for 60%, follicular carcinoma accounts for 12%, and the follicular

variant of papillary carcinoma accounting for 6% of total thyroid cancer types. These well-differentiated thyroid cancers are usually curable, but they must be found first. (DeRuiter, 2002)

Thyroid cancer can occur in any age group, although it is most common after age 30 and its aggressiveness increases significantly in older patients. (Mazumder et al., 2005)

Thyroid cancer is most often treated with surgery to remove the whole thyroid gland. (Womenshealth.gov, 2016)

2.8.4 Goiter

The term nontoxic goiter refers to enlargement of the thyroid that is not associated with overproduction of thyroid hormone or malignancy. The normal thyroid gland resides in the neck, with both lobes wrapping gently around the trachea. When thyroid becomes enlarged (goiter), it can grow a number of different directions. Usually, they will grow within the neck and can become very large so that it can easily be seen as a mass in the neck.

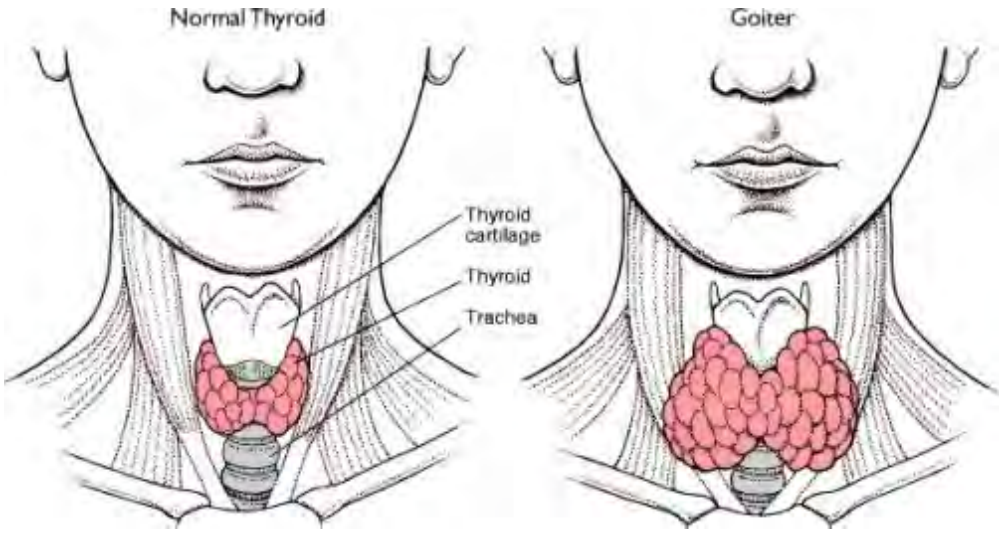


Fig. 13: Healthy Thyroid Gland compared to Thyroid gland with Goiter

There are a number of factors that may cause the thyroid to become enlarged. Thyroid gland synthesizes thyroxin and tri-iodothyronin from iodine. In iodine deficiency there is less synthesis

of thyroxin and tri-iodothyronin which in turn stimulate the pituitary gland to secrete more thyroid stimulating hormone. This high level of thyroid stimulating hormone stimulates the growth of the thyroid gland to produce goitre. (Badaruddin et al., 2009)

A more common cause of goiter in the US is an increase in thyroid stimulating hormone (TSH) in response to a defect in normal hormone synthesis within the thyroid gland. This enlargement usually takes many years to become manifest. (DeRuiter, 2002)

2.9 Symptoms of Different Thyroid Diseases

Not all people with thyroid disorder will exhibit the same symptoms. The symptoms that do surface will affect people to different degrees, from very severe to very mild. (McCormick Communications, Inc., 2010)

2.9.1 Hyperthyroidism

Thyroid hormone plays a significant role in the paceof many processes in the body. These processes arecalled metabolism. If there is too much thyroidhormone, every function of the body tends to speedup. It is not surprising then that some of the symptomsof hyperthyroidism are nervousness, irritability,increased perspiration, heart racing, hand tremors,anxiety, difficulty sleeping, thinning of skin, finebrittle hair and weakness in muscles—especiallyin the upper arms and thighs. More frequent bowel movement may be observed, but diarrhea is uncommon.Lose of weight despite a good appetite and,for women, menstrual flow may lighten and menstrualperiods may occur less often. Since hyperthyroidismincreases metabolism, many individuals initiallyhave a lot of energy. However, as the hyperthyroidismcontinues, the body tends to break down, so beingtired is very common.

Hyperthyroidism usually begins slowly but in someyoung patients these changes can be very abrupt.At first, the symptoms may be mistaken for simplenervousness due to stress. In Graves' disease, which is the most common form ofhyperthyroidism, the eyes may look enlarged becausethe upper lids are elevated. Sometimes, one or botheyes may bulge. Some patients have

swelling of thefront of the neck from an enlarged thyroid gland (agoiter). (American Thyroid Association, 2016)

2.9.2 Hypothyroidism

When thyroid hormone levels are too low, the body'scells can't get enough thyroid hormone and the body'sprocesses start slowing down. As the body slows, the following signs show; feeling colder, getting tired more easily,skin getting drier, forgetful anddepressed, and getting constipated.Because the symptoms are so variable and nonspecific,the only way to know for sure whether one hashypothyroidism is with a simple blood test for TSH. (American Thyroid Association, 2016)

2.9.3 Thyroid Cancer

Prompt attention to signs and symptoms is the best way to diagnose most thyroid cancersearly. Thyroid cancer can cause any of the following signs or symptoms:

- A lump in the neck, sometimes growing quickly
- Swelling in the neck
- Pain in the front of the neck, sometimes going up to the ears
- Hoarseness or other voice changes that do not go away
- Trouble swallowing
- Trouble breathing
- A constant cough that is not due to a cold

Many of thesesymptoms can also be caused by non-cancerous conditions or even other cancers of the neckarea. (Thyroid Cancer, 2014)

2.9.4 Goiter

The term "goiter" simply refers to the abnormal enlargementof the thyroid gland. It is important to know thatthe presence of a goiter does not necessarily mean thatthe thyroid gland is malfunctioning. A goiter can occur in a gland that is producing too much hormone

(hyperthyroidism),too little hormone (hypothyroidism), orthe correct amount of hormone (euthyroidism). A goiterindicates there is a condition present which is causingthe thyroid to grow abnormally. (American Thyroid Association, 2016)

2.10 Tests & Diagnosis of Thyroid Diseases

2.10.1 Physical Tests

The initial screening for thyroid dysfunction is performed as part of a head and neck examination. During a screening, the thyroid gland is examined with the patient's head extended to one side. The examiner uses the fingers of both hands to palpate the thyroid gland. Next, the patient is instructed to swallow, during which time the examiner can evaluate the anatomical extent of the lobules using the last three fingers of one hand. It is important to remember that the right lobule usually is larger than the left and that on relaxation the thyroid outline cannot be observed in a healthy patient. Any anatomical abnormality of the thyroid gland is defined by its consistency, size, tenderness and growth. If an abnormal finding is discovered, hormone and function studies need to follow. (Pinto and Glick, 2002)

2.10.2 Blood Tests

Blood tests to measure TSH, T4, T3 and Free T4 are readily available and widely used. Tests to evaluate thyroid function include the following: (American Thyroid Association, 2016)

2.10.2.1 TSH Tests

The best way to initially test thyroid function is to measure the TSH level in a blood sample. A high TSH level indicates that the thyroid gland is failing because of a problem that is directly affecting the thyroid (primary hypothyroidism). The opposite situation, in which the TSH level is low, usually indicates that the person has an overactive thyroid that is producing too much thyroid hormone (hyperthyroidism).

Occasionally, a low TSH may result from an abnormality in the pituitary gland, which prevents it from making enough TSH to stimulate the thyroid (secondary hypothyroidism). In most healthy individuals, a normal TSH value means that the thyroid is functioning normally.

2.10.2.2 T4 Tests

T4 circulates in the blood in two forms:

1) T4 bound to proteins that prevent the T4 from entering the various tissues that need thyroid hormone.

2) Free T4, which does enter the various target tissues to exert its effects.

The free T4 fraction is the most important to determine how the thyroid is functioning, and tests to measure this are called the Free T4 (FT4) and the Free T4 Index (FT4I or FTI). Individuals who have hyperthyroidism will have an elevated FT4 or FTI, whereas patients with hypothyroidism will have a low level of FT4 or FTI.

Combining the TSH test with the FT4 or FTI accurately determines how the thyroid gland is functioning.

The finding of an elevated TSH and low FT4 or FTI indicates primary hypothyroidism due to disease in the thyroid gland. A low TSH and low FT4 or FTI indicates hypothyroidism due to a problem involving the pituitary gland. A low TSH with an elevated FT4 or FTI is found in individuals who have hyperthyroidism. (Watt, 2008)

2.10.2.3 T3 Tests

T3 tests are often useful to diagnosis hyperthyroidism or to determine the severity of the hyperthyroidism. Patients who are hyperthyroid will have an elevated T3 level. In some

individuals with a low TSH, only the T3 is elevated and the FT4 or FTI is normal. T3 testing rarely is helpful in the hypothyroid patient, since it is the last test to become abnormal. Patients can be severely hypothyroid with a high TSH and low FT4 or FTI, but have a normal T3. In some situations, such as during pregnancy or while taking birth control pills, high levels of total T4 and T3 can exist. This is because the estrogens increase the level of the binding proteins. In these situations, it is better to ask both for TSH and free T4 for thyroid evaluation. (American Thyroid Association, 2016)

2.10.2.4 Thyroid Antibody Tests

The immune system of the body normally protects us from foreign invaders such as bacteria and viruses by destroying these invaders with substances called antibodies produced by blood cells known as lymphocytes. In many patients with hypothyroidism or hyperthyroidism, lymphocytes make antibodies against their thyroid that either stimulate or damage the gland. Two common antibodies that cause thyroid problems are directed against thyroid cell proteins: thyroid peroxidase and thyroglobulin. Measuring levels of thyroid antibodies may help diagnose the cause of the thyroid problems. For example, positive anti thyroid peroxidase and/or antithyroglobulin antibodies in a patient with hypothyroidism make a diagnosis of Hashimoto's thyroiditis. If the antibodies are positive in a hyperthyroid patient, the most likely diagnosis is autoimmune thyroid disease. (American Thyroid Association, 2016)

2.10.2.5 Thyroglobulin Tests

Thyroglobulin (Tg) is a protein produced by normal thyroid cells and also thyroid cancer cells. It is not a measure of thyroid function and it does not diagnose thyroid cancer when the thyroid gland is still present. It is used most often in patients who have had surgery for thyroid cancer in order to monitor them after treatment. Tg is included in this brochure of thyroid function tests to

communicate that, although measured frequently in certain scenarios and individuals, Tg is not a primary measure of thyroid hormone function. (American Thyroid Association, 2016)

2.10.3 Non Blood Tests

2.10.3.1 Radioactive iodine uptake

Because T4 contains much iodine, the thyroid gland must pull a large amount of iodine out from the blood stream in order for the gland to make an appropriate amount of T4. The thyroid has developed a very active mechanism for doing this. Therefore, this activity can be measured by having an individual swallow a small amount of iodine, which is radioactive. The radioactivity allows the doctor to track where the iodine molecules go. By measuring the amount of radioactivity that is taken up by the thyroid gland (radioactive iodine uptake, RAIU), doctors may determine whether the gland is functioning normally. A very high RAIU is seen in individuals whose thyroid gland is overactive (hyperthyroidism), while a low RAIU is seen when the thyroid gland is underactive (hypothyroidism). In addition to the radioactive iodine uptake, a thyroid scan may be obtained, which shows a picture of the thyroid gland. (American Thyroid Association, 2016)

2.11 Treatment & Management of Thyroid Disease

Early diagnosis and management of thyroid disease are crucial however, since it is associated with increased morbidity and mortality, especially in the elderly. (National Medicines Information Centre, 2014)

T4 is the replacement therapy of choice because of its long half-life, allowing once daily administration, ease of administration and low cost. It has been estimated that the full replacement dose of T4 for an athyreotic person (i.e. with no endogenous TH) is 1.6mcg/kg/day (median dosage of 125mcg/day). The starting dosage depends on the age, clinical status and TSH level of the patient. For patients <50 years, with no evidence of cardiovascular disease (CVD), a starting dose of 50-100mcg/day of T4 is recommended; in older patients and/or those with CVD

the starting dose should not exceed 50mcg (and this may be further reduced to 25mcg in the presence of severe CVD). Response to T4 therapy should be monitored by TSH levels (taking into account the time lag in TSH response) and the dosage increased at 25-50mcg increments, up to a maximum daily dose of 200mcg, until clinical evidence of normal function is present and TSH levels are restored to within the normal range. In general, T4 replacement therapy is for life (except in the case of post-viral or postpartum thyroiditis). (Biswas, Jahan and Rahman, 2008)

Treatment options for hyperthyroidism include pharmacotherapy, surgery and radioactive iodine (^{131}I). Studies have shown similar outcomes between the various options (although pharmacotherapy may be associated with increased risk of relapse), therefore treatment is usually tailored to the individual patient, taking into account the likelihood of remission with medication alone, the potential (and timing) of future pregnancies, goiter size, presence of co-morbidities and patient preference. Patients with confirmed hyperthyroidism should be referred for specialist care in order to optimize their management plan.

Treatment Option	Indication for use
Anti-thyroid drugs	a. Newly diagnosed disease b. Short term therapy before surgery or Radioactive Iodine therapy c. During pregnancy
Surgery	a. Presence of large goiter b. Serious eye disease c. Serious adverse drug reaction to anti-thyroid drugs (including during pregnancy)
Radioactive I (^{131}I)	a. Newly diagnosed disease b. Relapsed disease c. Toxic nodular hyperthyroidism

Table 01: Treatment options for hyperthyroidism

All patients who have been treated with ^{131}I for hyperthyroidism must have long term follow up to detect the hypothyroidism. (Islam et al., 2013)

3. Objective

3.1 Primary Objective

The alarmingly increasing rates of occurrence of Thyroid Disorder in Bangladesh as well as globally needs to be investigated and studied thoroughly.

The objective of this study is to identify the prevalence, determine a critical age range for onset of thyroid disorder & characterizing the occurrence of thyroid disorder in Dhaka, Bangladesh by analyzing different cofactors on a survey based study.

3.2 Secondary Objective

1. To collect information and knowledge about Thyroid Disorder.
2. To learn the distinctiveness of Thyroid Disorder patients.
3. To review the facts based on different variables.
4. To investigate the biological and environmental factors.
5. To find out affiliation among the risk factors.
6. To evaluate the factors taking into consideration of different categories.

4. Material & Method

4.1 Place of Study

The study was carried out in an institution specialized in diagnosis & treatment of thyroid disorder patients. The name of the institution is 'The Thyroid Center' situated in Green Road, Dhaka.

4.2 Period of Study

The study was carried out from November, 2015 to January, 2016 for 3 (three) months.

4.3 Population of Study

The population of the study was thyroid disorder patients who were registered at the institute The Thyroid Center. A total of 186 subjects were taken under this study for investigating their cases.

4.4 Methodology

The study was conducted after taking the approval from Thesis coordinator, Dr. Mohammad Rafiqul Islam, Associate Professor, Department of Mathematics and Natural Sciences, BRAC University & Dr. A. K. M. Fazlul Bari, Chairman of The Thyroid Center.

The patients who were visiting The Thyroid Center with thyroid complications & registered at the institution were the subjects of the study. All the subjects went through the same assessment procedure by measuring height & weight and reviewing medical history by filling up the provided questionnaire. Each subject was handed by same questionnaire & an approval of consent certificate. Data analysis was performed for all the subjects enrolled in the study as per the provided questionnaire.

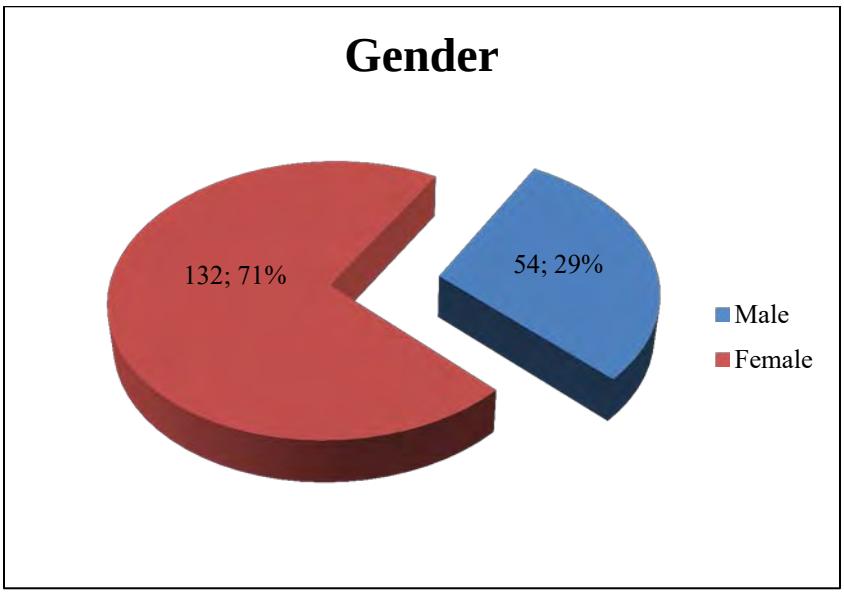
5. Analysis & Discussion

5.1 Distribution of Thyroid Disorder Patients based on Gender

One hundred & eighty six (186) patients were studied from November 2015 to December 2015. Among them one hundred thirty two (132) were female and the remaining fifty four (54) were male subject.

Table 02: Frequency Table of Distribution of Thyroid Disorder Patients based on Gender

Gender	Frequency	Percentage (%)
Male	54	29
Female	132	71
Total	186	100



Dia. 01: Distribution of Thyroid Disorder Patients based on Gender

In this study, it was observed that, the prevalence of thyroid disorder is highest in females. From a total of 186 patients, only 54 (29%) were male & 132 (71%) were female.

This supports the fact that, female preponderance with variable female to male ratio has been reported in almost all epidemiological studies. (Nusrath et al., 2015)

Various endogenous factors are attributed to higher predisposition of females particularly in younger age; these include hormonal imbalance at puberty, pregnancy, higher level of estrogen which cause rise in TSH levels which in turn induces expression of major histo-compatibility (MHC) class II molecules on cells including thyrocytes which may present self-antigens released due to infection of the thyroid there by setting in motion the process of auto-immunity. (Nusrath et al., 2015)

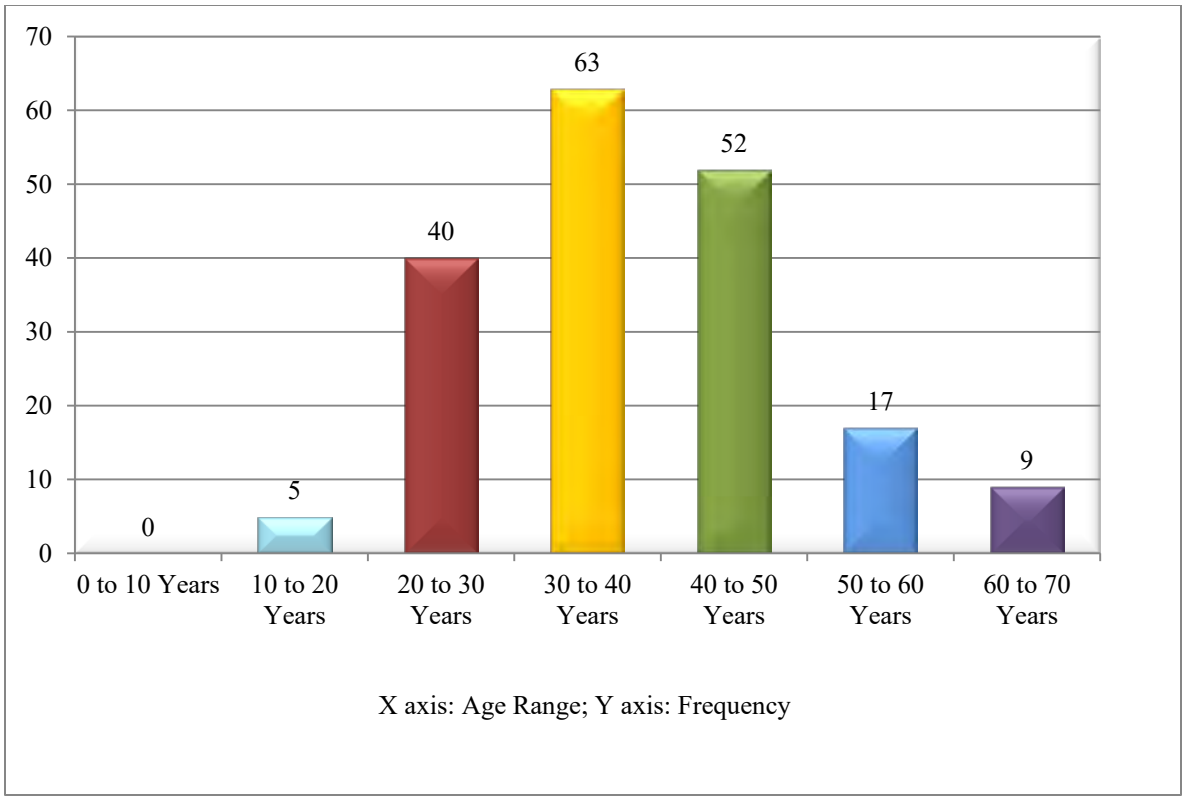
The skewed X-chromosome inactivation (XCI) hypothesis for high susceptibility to hypo is also gaining more credence as it claims that the existence of XCI in females results in self-antigen express ion in the thymus or in other peripheral sites which is involved in tolerance induction. Because of this reaction skewed XCI has been identified as a predisposition factor for the development of AITD. (Nusrath et al., 2015)

5.2 Distribution of Thyroid Disorder Patients based on Age Range

All the patients fall in the age range of 10 to 70. Out of the total number of patients age group of 10 to 20 years had 5 patients, 20 to 30 had 40 patients, 30 to 40 had 63 patients, 40 to 50 had 52 patients, 50 to 60 had 17 patients and 60 to 70 had 9 patients.

Table 03: Frequency Table of Distribution of Thyroid Disorder Patients based on Age

Age Group	Frequency	Percentage (%)
0-10	0	0
10-20	5	3
20-30	40	21
30-40	63	34
40-50	52	28
50-60	17	9
60-70	9	5
Total	186	100.0



Dia. 02: Distribution of Thyroid Disorder Patients based on Age Range

From the study it was observed that, the highest number of patients suffering from Thyroid Disorder fall in the age group of 30 – 40 years (34%). The percentage of patients suffering from Thyroid Disorders are found as follows, 40 – 50 years (28%), 20 – 30 years (21%), 50 – 60 years (9%), 60 – 70 years (5%), 10 – 20 years (3%) and 0 – 10 years (0%).

5.3 Distribution of Age range of the Thyroid Disorder Patients based on Gender

As revealed earlier, the most critical Age range for occurrence of Thyroid Disorder is 30 – 40 years. This data is observed to be factual for both male & female individuals.

Table 04: Cross Table Analysis between the Gender of the Thyroid Disorder Patients & their Age Range

Age	Gender		Total
	Male	Female	
0-10	0	0	0
10-20	0	5	5
20-30	8	32	40
30-40	23	40	63
40-50	13	39	52
50-60	7	10	17
60-70	3	6	9
Total	54	132	186

Among the 54 male patients, age group of 20 to 30 had 8 patients, 30 to 40 had 23 patients, 40 to 50 had 13 patients, 50 to 60 had 7 patients and 60 to 70 had 3 patients.

On the other hand, out of 132 female patients, age group of 10 to 20 had 5 patients, 20 to 30 had 32 patients, 30 to 40 had 40 patients, 40 to 50 had 39 patients, 50 to 60 had 10 patients and 60 to 70 had 6 patients.

From the data assembly it can be observed that, for both male & female patients, a large number of patients are from age range of 30 – 40 years. The next critical age range is 40 – 50 years for both the genders. Moreover, it can also be found that, age range of 20 – 30 years contains a significant number of female patients. Surprisingly, occurrence of Thyroid Disorder for female patients was discovered from age 10 – 20 years.

5.4 Distribution of Thyroid Disorder Patients based on Body Mass Index (BMI)

Body mass Index (BMI) is a measurement of body fat based on height and weight that applies to both men and women. BMI can be used to indicate if a person is overweight, obese, underweight or normal.

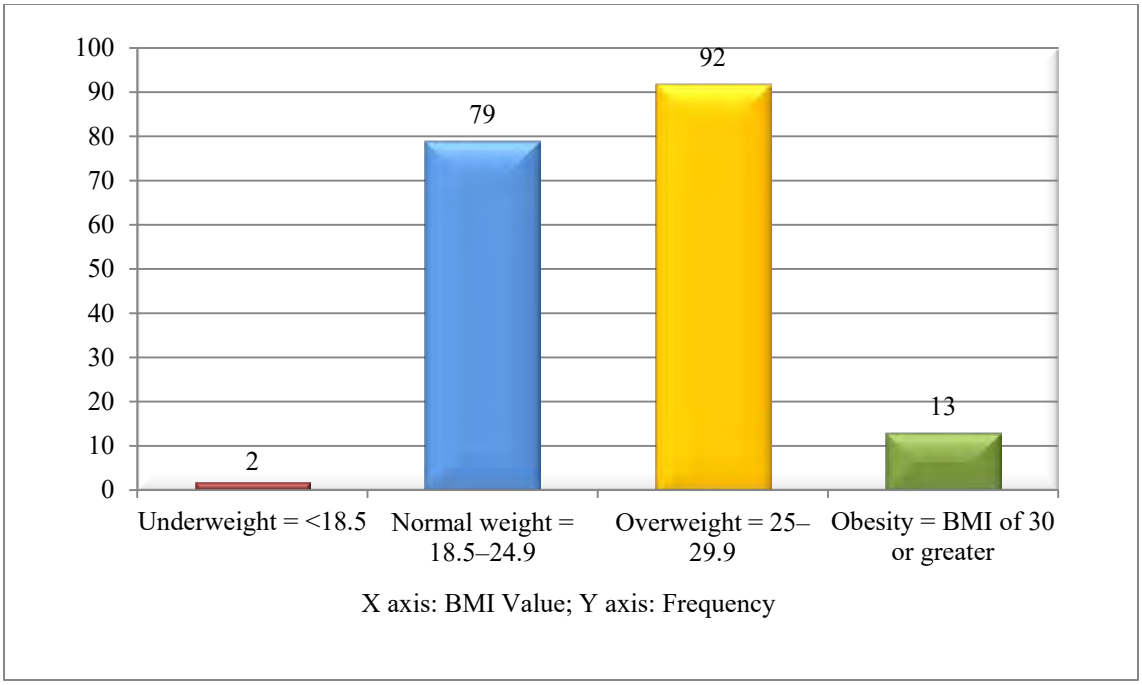
If BMI value of a person is found less than 18.5, he/she will be considered as underweight, 18.5 to 24.9 is normal, 25.0 to 29.9 is overweight and more than 30 is considered as obese. BMI can be calculated by using the following formula:

BMI = (Weight in Pounds / (Height in inches x Height in inches)) x 703

Out of all the patients, BMI value was found less than 18.5 for 2 patients, from 18.5 to 24.9 for 79 patients, from 25.0 to 29.9 for 92 patients and above 30 for 13 patients.

Table 05: Frequency Table of Distribution of Thyroid Disorder Patients based on Body Mass Index (BMI)

BMI	Frequency	Percentage (%)
Less than 18.5	2	1
18.5 to 24.9	79	43
25 to 29.9	92	49
More than 30	13	7
Total	186	100



Dia. 03: Distribution of Thyroid Disorder Patients based on Body Mass Index (BMI)

5.5 Distribution of Thyroid Disorder Patients based on Marital Status

One hundred forty one (141) patients were married and the rest forty five (45) patients were unmarried among the one hundred eighty six (186) patients.

Table 06: Frequency Table of Distribution of Thyroid Disorder Patients based on Marital Status

Marital Status	Frequency	Percentage (%)
Married	141	76
Unmarried	45	24
Total	186	100

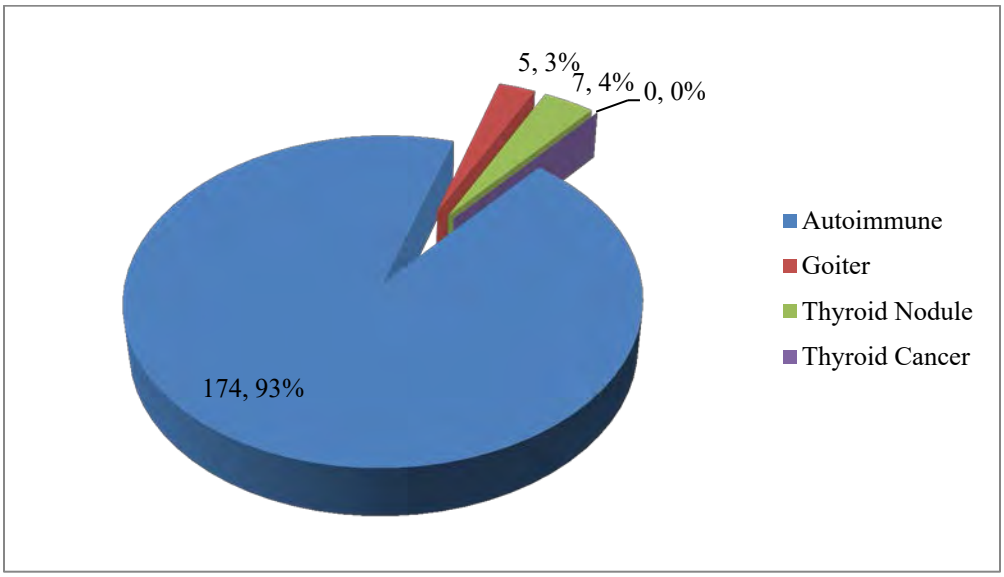
76% of the total patients were married whereas 24% of them were unmarried. No correlation between the marital status &occurrence of Thyroid Disorder can be connected from the data.

5.6 Distribution of Thyroid Disorder Patients based on Type of Thyroid Disorder

The prevalence of autoimmune disease was found more than goiter and thyroid nodule. Among the patients there was no thyroid cancer patient. One hundred seventy four (174) of the patients were suffering from autoimmune thyroid disorder. One the other hand, five (5) of the patients had goiter and seven (7) of them had thyroid nodules.

Table 07: Frequency Table of Distribution of Thyroid Disorder Patients based on Type of Thyroid Disorder

Type of Disease	Frequency	Percentage (%)
Autoimmune	174	93
Goiter	5	3
Thyroid Nodule	7	4
Thyroid Cancer	0	0
Total	186	100



Dia. 04: Distribution of Thyroid Disorder Patients based on Type of Thyroid Disorder

Most of the patients (93%) were suffering from Autoimmune Thyroid Disorder. Occurrence of Goiter & Thyroid Nodule was much less, only 3% & 4% respectively.

5.7 Distribution of Autoimmune Thyroid Disorder Patients based on Hormonal Status

The numbers of patients suffering from Hypothyroidism were significantly higher than of Hyperthyroidism. One hundred forty nine (149) patients had hypothyroidism & only thirty seven (37) patients had hyperthyroidism among the whole population.

Table 08: Frequency Table of Distribution of Autoimmune Thyroid Disorder Patients based on Hormonal Status

Hormonal Status	Frequency	Percentage (%)
Hypothyroidism	149	80
Hyperthyroidism	37	20
Total	186	100

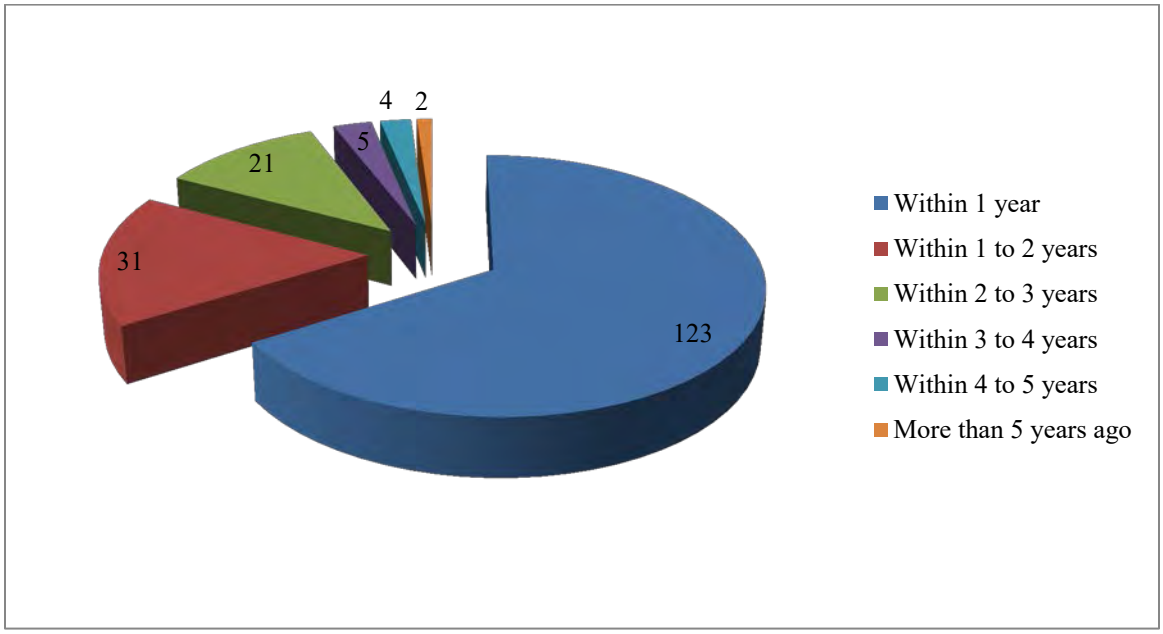
The difference between the percentage of Hypothyroidism patients & Hyperthyroidism patients is noteworthy. Only 20% of the patients were Hyperthyroid patients whereas 80% of them had Hypothyroidism.

5.8 Distribution of Thyroid Disorder Patients based on Period since Diagnosis

Patients who were diagnosed within less than a year with thyroid disorder were more in number than diagnosed for more than a year. Cases who were diagnosed within a year numbered one hundred twenty three (123), within 1 to 2 years were 31, within 2 to 3 years were 21, within 3 to 4 years were 5, within 4 to 5 years were 4 and diagnosed for more than 5 years were 2 patients.

Table 9: Frequency Table of Distribution of Thyroid Disorder Patients based on Period since Diagnosis

Diagnosis On	Frequency	Percentage (%)
Within 1 year	123	66
Within 1 to 2 years	31	17
Within 2 to 3 years	21	11
Within 3 to 4 years	5	3
Within 4 to 5 years	4	2
More than 5 years ago	2	1
Total	186	100



Dia. 5: Distribution of Thyroid Disorder Patients based on Period since Diagnosis

From the data, it can be observed that, most of the patients (66%) were diagnosed with Thyroid Disorder within 1 year. 17% were diagnosed within 1 to 2 years, 11% were diagnosed within 2 to 3 years, 3% were diagnosed within 3 to 4 years, 2% were diagnosed within 4 to 5 years & 1% were diagnosed more than 5 years ago.

5.9 Distribution of Thyroid Disorder Patients based on Other Diseases

It was found from a relevant study that, Diabetic patients have a higher prevalence of thyroid disorders than the general population.(Begum et al., 2014)

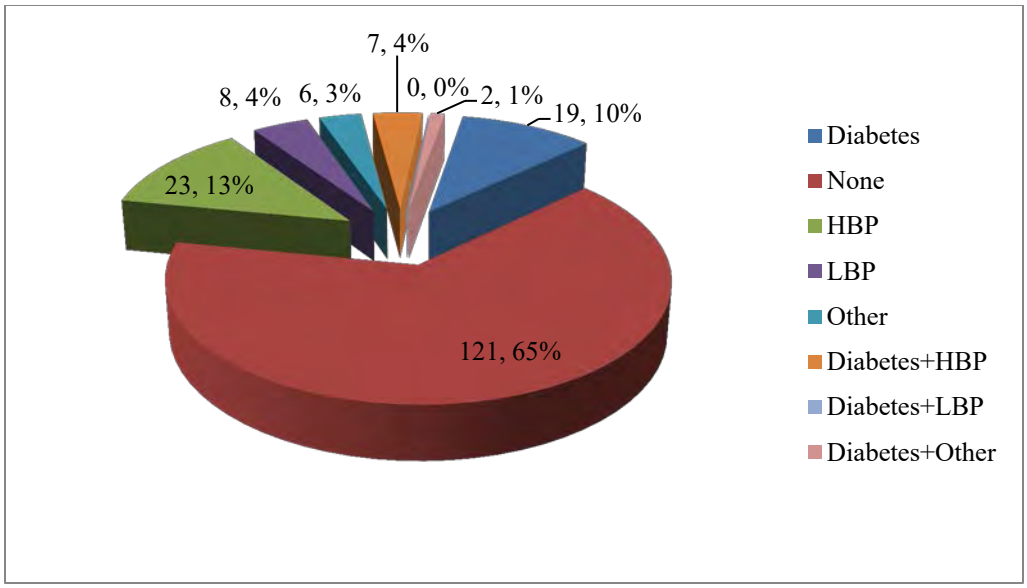
Although this co-occurrence have been observed mainly in type 1 diabetes mellitus (T1DM), thyroid dysfunctions also co-occur in type 2 diabetes mellitus (T2DM) to a significant level.(Lovely et al., 2012)

Hypothyroidism is also found to be associated with Ischemic Heart Disease (IHD).(Mondal, et al.)

Hypothyroidism appears to be associated with abnormalities in the serum cholesterol or triglyceride levels in the Sylheti population. There might be a potential link between hypothyroidism and cardiovascular diseases such as atherosclerosis. (Rahman, Jahan and Sultana)
Due to small sized population of this study the particular point could not be proven here.

Table 10: Frequency Table of Distribution of Thyroid Disorder Patients based on Other Diseases

Other Diseases	Frequency	Percentage (%)
Diabetes	19	10
None	121	66
HBP	23	13
LBP	8	4
Other	6	3
Diabetes+HBP	7	4
Diabetes+LBP	0	0
Total	186	100



Dia. 6: Distribution of Thyroid Disorder Patients based on Other Diseases

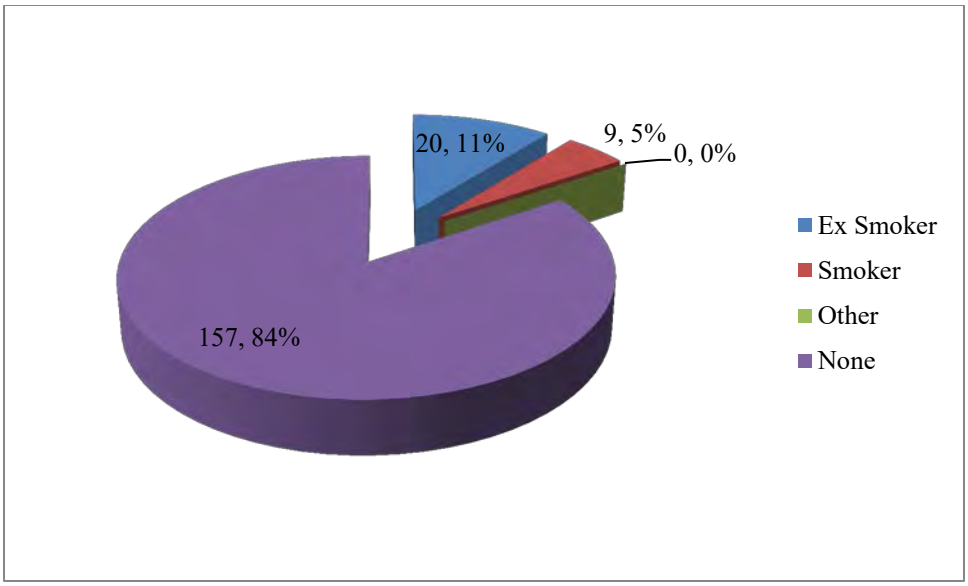
Out of all the patients one hundred twenty one had no other diseases, 19 had only diabetes, 23 had high blood pressure, 8 had low blood pressure, 7 had diabetes & high blood pressure, 2 had other diseases with diabetes and 6 patients reported to had other diseases like gastric ulcer, asthma & renal disorder.

5.10 Distribution of Thyroid Disorder Patients based on Habitual Acts

157 patients among all other had no habitual acts, 20 were ex-smokers and 9 were smokers.

Table 11: Frequency Table of Distribution of Thyroid Disorder Patients based on Habitual Acts

Habit	Frequency	Percentage (%)
Ex-Smoker	20	11
Smoker	9	5
None	157	84
Other	0	0
Total	186	100



Dia. 7: Distribution of Thyroid Disorder Patients based on Habitual Acts

Form the data, it can be found that, 84% of the patients do not have any habitual acts, 11% used to smoke & 5% of the patients are active smokers.

5.11 Distribution of Thyroid Disorder Patients based on Family History

27 cases have been found where the subject had thyroid disorder from maternal side, 22 had paternal history and the rest 137 patients had no family history of thyroid disorder of any kind.

Table 12: Frequency Table of Distribution of Thyroid Disorder Patients based on Family History

Family History	Frequency	Percentage (%)
Maternal	27	14
Paternal	22	12
Both	0	0
None	137	74
Total	186	100

From the study it is found that, most of the patients (74%) did not have any kind of family history of Thyroid Disorder. 14% patients had maternal and only 12% patients had paternal history of Thyroid Disorder from their family. No subject had both maternal & paternal family history both.

5.12Distribution of Body Mass Index of Autoimmune Thyroid Disorder Patients under Study

Thyroid hormones play a vital role in metabolism, sensitivity of tissues to other hormones and also in oxygen consumption of almost all cells of the body. However, mild to moderate decrease in function of thyroid gland may occur with advancing age even in apparently healthy elderly patients. (Rahman, Jahan and Sultana)

Table 13: Cross Table Analysis between Autoimmune Thyroid Disorder Patients & their Body Mass Index (BMI) value

BMI Value	Hormonal Status		Total
	Hypothyroidism	Hyperthyroidism	
Less Than 18.5 (Underweight)	0	2	2
18.6 – 24.9 (Normal Weight)	48	31	79
25 – 29.9 (Overweight)	88	4	92
30 and more (Obese)	13	0	13
Total	149	37	186

We can correlate the effect of excess or deficient thyroid hormone on Body Mass Index (BMI) from this study. Among 149 hypothyroid patients who have less thyroid hormone in their system but high level of Thyroid Stimulating Hormone (TSH), 13 (9%) of the patients were measured as suffering from obesity. 88 (59%) patients were leveled as overweight, 48 (32%) were of normal weight and none of the patients were of

underweight. The average BMI of hypothyroid patients is 25.9, which lies in the range for overweight individual.

On the other hand, from a total of 37 hyperthyroid patients, no patients were found to be obese and only 4 (11%) were rated overweight. The majority of the patients, 31 (84%) fall into normal weight range and 2 (5%) were found underweight. The average BMI of hyperthyroid patients is 22.2, which falls in the lower range for normal weight individual.

All the patients suffering from hypothyroidism reported sudden weight gain before diagnosis whereas the patients who had hyperthyroidism reported drastic weight loses before diagnosis. The data matches with the symptomatic signs & could be considered as a critical indicator of early thyroid disorder detection.

5.13 Distribution of Age range of Thyroid Disorder Patients under Study

From the present study, it can be observed that, autoimmune disease can be occurred at a much younger age than goiter and thyroid nodule.

Table 14: Cross Table Analysis between Thyroid Disorder Patients & their Age

Age	Type of Thyroid Disorder				Total
	Autoimmune Thyroid Disorder	Goiter	Thyroid Nodule	Thyroid Cancer	
0-10	0	0	0	0	0
10-20	5	0	0	0	5
20-30	39	0	0	0	39
30-40	59	1	1	0	61
40-50	48	1	3	0	52
50-60	15	2	3	0	20
60-70	8	1	0	0	9
Total	174	5	7	0	186

Out of 186 patients, 174 were suffering from Autoimmune Thyroid Disorder, where 5 patients fall in 10 – 20 years age range, 39 in 20 – 30 years, 59 in 30 – 40 years, 48 in 40 – 50 years, 15 in 50 – 60 years & 8 in 60 – 70 years age range. 5 patients were suffering from Goiter where, 1 subject fall in 30 – 40 years age range, 1 in 40 – 50 years, 2 in 50 – 60 years & 1 in 60 – 70 years age range. A total of 7 patients were suffering from Thyroid Nodule where, 1 subject fall in 30 – 40 years age range, 3 in 40 – 50 years & 3 in 50 – 60 years age range.

The youngest subject suffering from goiter is found in the age range of 30-40 years and the youngest subject who had thyroid nodules also fell in age range of 30-40 years. On the other hand, out of 174 patients suffering from autoimmune thyroid disorder there were 5 patients who aged between 10-20 years.

5.14 Distribution of Age range of Autoimmune Thyroid Disorder Patients under Study

In case of autoimmune thyroid disorder, hypothyroidism has the evidence to occur at a younger age than hyperthyroidism.

Table 15: Cross Table Analysis between Autoimmune Thyroid Disorder Patients & their Age

Age	Hormonal Status		Total
	Hypothyroidism	Hyperthyroidism	
0-10	0	0	0
10-20	5	0	5
20-30	36	4	40
30-40	46	17	63
40-50	44	8	52
50-60	11	6	17
60-70	7	2	9
Total	149	37	186

Among the 37 hyperthyroidism suffering patients 4 (11%) patients were of 20-30 years age range, 17 (46%) were of 30-40 years, 8 (22%) were of 40-50 years, 6 (16%) were of 50-60 years and 2 (5%) of patients were of 60-70 years age range.

In contrast, there were a total of 149 hypothyroidism suffering patients. 5 (3%) of them were of 10-20 years age range, 36 (24%) were of 20-30 years, 46 (31%) were of 30-40 years, 44 (30%) were of 40-50 years, 11 (7%) were of 50-60 years and 7 (5%) were of 60-70 years age range.

From the above data, most critical age for onset of Autoimmune Thyroid Disorder can be interpreted as 30 – 40 years. At this age range highest number of patients was found under both types of Thyroid Disorders. 20 – 30 years & 40 – 50 years are the next crucial age range mostly for onset of Hypothyroidism.

5.15 Distribution of Type of Thyroid Disorder based on Gender

Prevalent occurring of autoimmune thyroid disorder is found in both male & female patients.

Table 16: Cross Table Analysis between Types of Thyroid Disorder & Gender of the Patients

Gender	Type of Thyroid Disorder				Total
	Autoimmune Thyroid Disorder	Goiter	Thyroid Nodule	Thyroid Cancer	
Male	49	4	1	0	54
Female	125	1	6	0	132
Total	174	5	7	0	186

From the study, we found that, 49 (91%) of total 54 male patients and 125 (95%) of total 132 female patients were suffering from autoimmune thyroid disorder. Whereas, 4 (7%)

male & 1(1%) female patients had goiter and 1 (2%) male & 6 (4%) female patients were suffering from thyroid nodules.

No subject was found who is suffering from Thyroid Cancer. That infrequency could indicate the less chance of occurrence of Thyroid Cancer than the other type of cancers. But due to the small population in our study no conclusion can be drawn on the point.

5.16 Distribution of Autoimmune Thyroid Disorder based on Gender

An interesting point came into light by the present study that, in Bangladesh, male individual are more prone to hyperthyroidism whereas most of the hypothyroidism patients are female.

Table 17: Cross Table Analysis between Autoimmune Thyroid Disorder Patients & their Gender

Gender	Hormonal Status		Total
	Hypothyroidism	Hyperthyroidism	
Male	20	34	54
Female	129	3	132
Total	149	37	186

Among the 54 male patients 34 (63%) of the patients had Hyperthyroidism and only 20 (37%) were suffering from Hypothyroidism. On the other hand, in a total of 132 female patients only 3 (2%) were suffering from Hyperthyroidism & 129 (98%) had Hypothyroidism. Though the population was small, a concrete fact cannot be defined from this data, but the significant difference between the data from male & female patients should worth to investigate for further proofs.

If any correlation can be linked with any environmental or life style factors with the occurrence of hyperthyroidism at a higher rate in male individual; the diagnosis, treatment and prevention of thyroid disorder will more successful.

5.17 Correlation of Thyroid Disorder and Family History

Correlation of occurrence of Thyroid Disorder with previous family history has been studied on the study population. Male patients had higher percentage of family history from paternal side, but female patients had higher percentage of family history from maternal side.

Table 18: Cross Table Analysis between the Gender of the Thyroid Disorder Patients and their Family History

Gender	Family History				Total
	Maternal	Paternal	Both	None	
Male	5	16	0	33	54
Female	22	6	0	104	132
Total	27	22	0	137	186

Among the male patients under the study, 5 of 54 (9%) patients had maternal history of Thyroid Disorder, 16 (30%) had paternal history, none (0%) had both of maternal and paternal history and 33 (61%) of the patients did not have any kind of family history of Thyroid Disorder.

From the total of 132 female patients under the study, 22 (17%) of the patients had maternal history of Thyroid Disorder, 6 (4%) had paternal history, none (0%) had both of

maternal and paternal history and 104 (79%) of the patients did not have any kind of family history of Thyroid Disorder.

It should be noted that, most of the patients did not have any kind of family history of Thyroid Disorders. So, a definite statement was not confirmed if there is a correlation between occurrences of Thyroid Disorders and family history.

5.18 Limitations of the Study

The geographical effect on occurrence of thyroid disorders cannot be defined from this study as all of the investigated patients were from Dhaka, Bangladesh.

One of the limitations of this study is, it was performed on a small size of population. Again, no test was done for screening for antibodies responsible for autoimmune thyroid disorders. Also, the status of iodine intake was not assessed.

Further studies on similar interest should be conducted on larger population & broader point of investigation to draw a more definitive conclusion on trend, prevalence & cause of thyroid disorder in Bangladesh in recent times.

6. Conclusion

This is evident from the study that, there is a noticeable increasing trend in the prevalence of Autoimmune Thyroid Disorders particularly hypothyroidism in present Bangladesh. Most of the subjects under investigation were diagnosed before less than a year of this study. That indicates the incidence of onset of Thyroid Disorder has spiked than before.

An alarming prevalence rate of thyroid disorder is observed in women especially in the age group of 30 – 40 years. This data was proved both for men & women subjects. But in case of female subjects, a significant number was found in the age range of 20 – 30 years, which signifies the vulnerability of female individuals toward Thyroid Disorders.

From the study, it was observed that, Hyperthyroidism was found to be more prevalent in men than women & Hypothyroidism is prevalent in women. The possible explanation of the molecular mechanism behind this trend needs to be discovered urgently.

Lifestyle can be a critical point of concern behind the rise in number of Thyroid patients in our country. As Bangladesh is situated in an Iodine deficient region, iodization of table salt was a necessary step to fight against the deficiency. But it was never determined, how much salt is required daily to provide the essential amount of iodine for a person. According to United States regulatory body, 150 micro grams of iodine is required daily for most adults.

Recent studies proved that excess iodine intake can also develop clinical indications like Hypothyroidism. This is especially true in individuals that already have thyroid problems. Administration of large amounts of iodine through medications, radiology procedures and dietary excess can cause or worsen hyperthyroidism and hypothyroidism. In addition, individuals who move from an iodine-deficient region to a region with adequate iodine intake may also develop thyroid problems since their thyroids have become very good at taking up and using small amounts of iodine. In particular, these patients may develop iodine-induced hyperthyroidism. (American Thyroid Association, 2016)

So, not only further studies are required nationwide to correlate lifestyle with onset of Thyroid Disorder in our country but also we have to think twice before adding additional salt in our food during meals.

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Annexure - 01

Questionnaire for thesis on Detection of Prevalence & Characterization of Thyroid Disorder Patients in Dhaka: A Survey Based Study

Patient No.: ……

Date of note taken: …….

Points to be considered	Class
Sex	i. Male ii. Female
Age	i. 0 – 10 ii. 10 - 20 iii. 20 – 30 iv. 30 – 40 v. 40 – 50 vi. 50 – 60 vii. More than 60
Weight	
Height	
Calculated BMI (Body Mass Index)	
Marital Status	i. Married ii. Unmarried
Type of thyroid disease	i. Malignant ii. Goiter iii. Autoimmune
Hormonal status	i. Hyperthyroidism ii. Hypothyroidism
If Hyperthyroidism	i. Graves' disease ii. Pituitary gland malfunctions or cancerous growths in the thyroid gland iii. Other ……..
If Hypothyroidism	i. Hashimoto's thyroiditis ii. Removal of the thyroid gland iii. Other ……

Occupation	
Diagnosed on	
Other disease	i. Diabetes ii. Heart disease iii. Obesity iv. Other: ……
Smoking Habit	i. Yes ii. No iii. Not anymore since ……
If yes (for how long)	i. 1 – 5 years ii. 5 – 10 years iii. More than 10 years
Alcohol consumption	i. Yes ii. No iii. Not anymore since …….
If yes (for how long)	i. 1 – 5 years ii. 5 – 10 years iii. More than 10 years
Any other habitual act	
If yes (for how long)	i. 1 – 5 years ii. 5 – 10 years iii. More than 10 years
Family history of Thyroid Disease	i. Maternal ii. Paternal iii. Both iv. None
Treatment done since diagnosis	i. Surgery ii. Medication iii. Both iv. Others: ……..
Does quality of life improved since treatment started?	i. Yes ii. No

Annexure - 02

Patient Consent Form

I hereby give my well informed and conscious consent for participation in the study conducted by Mr. Md. Shafiul Alam, in The Thyroid Center, Green Road, Dhaka. This study may bring some precious medical information to be useful for me and for human being in future.

I have been informed that written records regarding my illness, treatment and follow up will be kept by the investigator & The Thyroid Center.

I am convinced that during participation in the study I will not be exposed to any physical, psychological, social or legal risk.

The privacy and confidentiality of mine will be secured. I have read the above which was fully explained to me and give my informed consent for the study.

_____	_____
Signature/Thumb impression of the patient	Signature of investigator
Date:	Date: