Vol. 5 No. 1 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

# A Comparative Study On The Effects Of Thyroid Gland Among The Females Of Different Age Groups From Hyderabad And Its Adjoining Areas

**Zahid Hussain**
Department of Zoology University of Sindh, Jamshoro, Pakistan.
zahidnazeer824@gmail.com

**Author Details**

**Keywords:** Incineration, Hospital Waste Management, Environmental Health, Healthcare Design, Indigenous Design.

**Received on 15 Feb 2026**

**Accepted on 26 February 2026**

**Published on 02 Mar 2026**

**Corresponding E-mail & Author*:**

**Zahid Hussain**
Department of Zoology University of Sindh, Jamshoro, Pakistan.
zahidnazeer824@gmail.com

**Abstract**

The thyroid gland is a ductless endocrine gland located just below the larynx and in front of the trachea (windpipe). The main thyroid hormones are tetra-iodothyronine/thyroxin (T4) and tri-iodothyronine (T3). This study analyzed the effects of region, sex, and race on thyroxin (T4), tri-iodothyronine (T3), and thyroid-stimulating hormone (TSH) levels among women of different age groups. Serum T4, T3 and TSH levels were studied in 105 normal and healthy women in and around Hyderabad region. Serum T4 and T3 were analyzed by RIA (Radio-Immuno-Analysis) technique, while TSH was evaluated by IRMA (Immuno-radio-metric Assay) technique.

The results show that hormonal profiles were determined in a total of 105 patients. 40% of them belong to the age group of 10-35 years and 60% to the age group of 36-65 years. Respondents were further divided by region (city and countryside). In the age group 10-35, 57.14% and 42.86% of the respondents belonged to urban and rural areas. In the age group 36-65, 61.90% and 38.10% of the respondents belonged to urban and rural areas. Mean ± SEM for TSH, T3 and T4 in women aged 10-35 years were 3.00±0.65 µU/mL, 1.74±0.25 ng/mL, and 9.83±0.89 µg/mL. Mean ± SEM for TSH, T3 and T4 in women aged 36-65 years were 7.94±2.14 µU/mL, 2.39±0.26 ng/mL, and 10.98±0.78 µg/mL. The mean ± SEM of TSH, T3 and T4 in the age group of women of 10-35 years in the urban period was 2.93±0.86 µU/ml, 1.77±0.36 ng/ml and 10.35±1.34 µg/ml. Mean ± SEM of TSH, T3 and T4 in rural women aged 10-35 years were 3.09±0.99 µU/ml, 1.69±0.32 ng/ml, and 9.23±1.07 µg/ml. Mean ± SEM of TSH, T3 and T4 in urban women aged 36-65 years were 10.96±3.35 µU/ml, 1.72±0.20 ng/ml, and 10.08±0.93 µg/ml. Mean ± SEM of TSH, T3 and T4 in rural women aged 36-65 years were 2.99±0.79 µU/mL, 3.49±0.53 ng/mL, and 12.44±1.34 µg/mL. The levels of these hormones show a change in reference values used in clinical laboratories in Pakistan. Age has been found to significantly affect TSH, T3 and T4 levels.

## INTRODUCTION

### 1.1 MOTIVATION

The essential organ known as the thyroid gland plays a crucial part in the human endocrine system, being relatively sizable in vertebrates, especially humans. Positioned in the front of the neck, just beneath the larynx, and flanking the trachea, the

thyroid gland produces two key hormones, thyroxin and triiodothyronine (also called T4 and T3). These hormones significantly impact metabolic rates. In the absence of thyroid secretions, basal metabolic rates typically decrease to 40-50% above normal levels, while excessive thyroid secretions can raise these rates to 60-100% above normal. Insufficient thyroid hormone production leads to a condition known as hypothyroidism, characterized by high TSH levels and low T3 and T4 levels. Conversely, hyperthyroidism results when the thyroid gland overproduces thyroid hormones. Raising awareness of these conditions is essential for both their treatment and the promotion of a healthy lifestyle.

## 1.2 CONTRIBUTION OF THE THESIS

Approximately 1-2% of women of childbearing age experience thyroid issues, making these disorders the second most frequent endocrine-related conditions during pregnancy. Additionally, around 10-15% of women aged 50 to 60 have thyroid problems. Thyroid glands and their regulatory hormones are essential for the body's metabolic functions. Currently, both types of thyroid disorders (hyperthyroidism and hypothyroidism) are on the rise, predominantly affecting women. Research on thyroid hormones in this region remains limited, indicating a need for further investigation into this topic.The proposed project aims to provide guidance on preventing serious complications related to hypothyroidism and hyperthyroidism. The gathered information will be particularly beneficial for female patients, who constitute the majority of cases and often encounter challenges such as reproductive issues, menstrual irregularities, delayed pregnancy, or difficulties conceiving. Additionally, this project will raise public awareness about the problems caused by inadequate thyroid hormone levels. The study will also facilitate the diagnosis of hypothyroidism and hyperthyroidism more effectively.

## 1.3 THYROID GLAND

The thyroid gland, a butterfly-shaped organ situated at the base of the neck, releases hormones that regulate metabolism and how the body utilizes energy. These hormones govern essential bodily functions such as breathing, heart rate, central and peripheral nervous systems, body weight, muscle strength, menstrual cycles, body temperature, cholesterol levels, and more. (Fig.1.1)

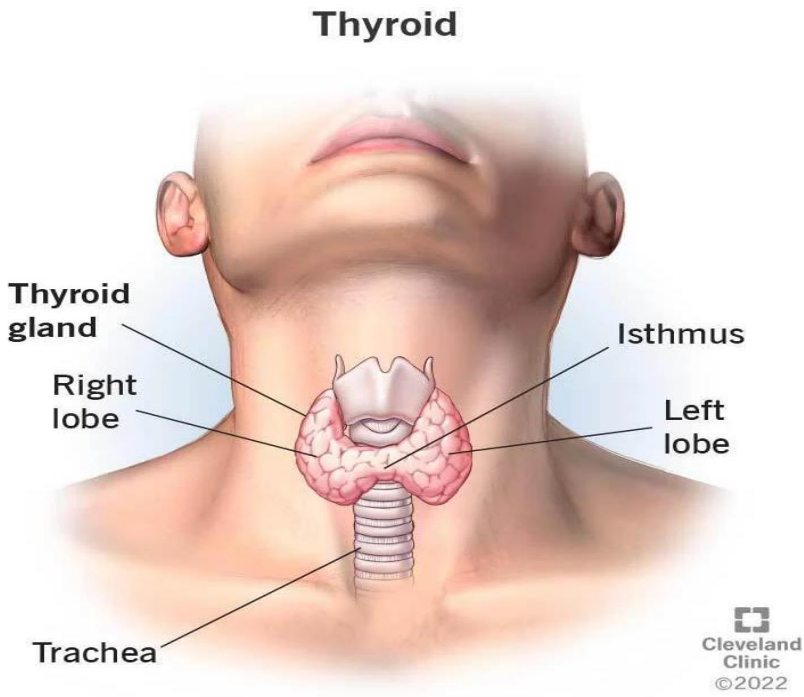



**Figure 1.1:Showing location of Thyroid Gland in Human body**

Measuring about 2 inches in length, the thyroid gland is positioned in front of the throat, beneath the thyroid cartilage, often referred to as the Adam's apple. The gland consists

of two lobes on either side of the windpipe, typically connected by a strip of thyroid tissue called an isthmus [1]. However, some individuals may have two separate thyroid lobes without an isthmus. The thyroid is part of the endocrine system, which comprises glands that produce, store, and release hormones into the bloodstream, enabling them to reach the body's cells. The thyroid gland utilizes iodine from consumed foods to create two primary hormones (Fig.1.2)

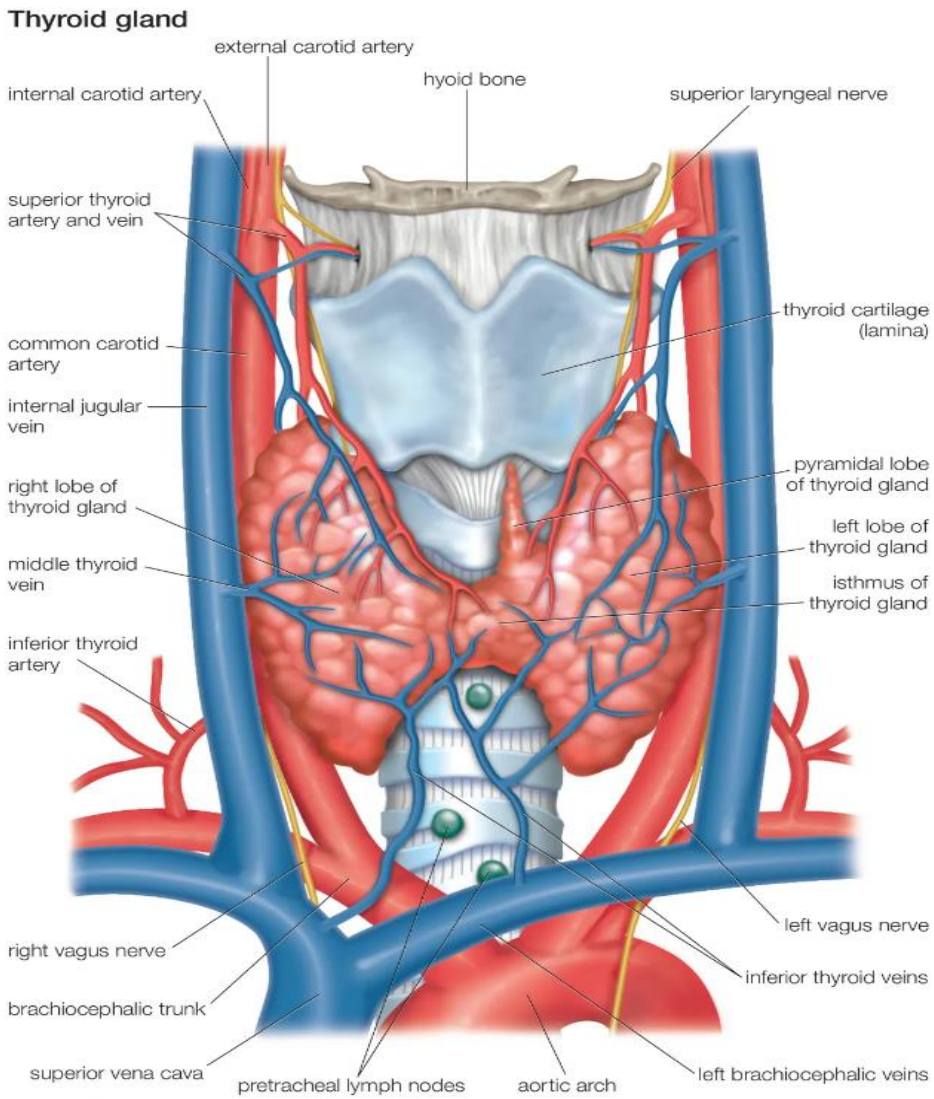



**Figure.1.2: Thyroid Gland Anatomy and Histology**

The hypothalamus generates TSH Releasing Hormone (TRH), which signals the pituitary gland to regulate the thyroid gland's production of T3 and T4 hormones by modulating the secretion of thyroid-stimulating hormone (TSH). When T3 and T4 levels in the blood are low, the pituitary gland releases more TSH, prompting the thyroid gland to produce additional thyroid hormones. Conversely, if T3 and T4 levels are high, the pituitary gland releases less TSH to slow down hormone production. T3 and T4 circulate in the bloodstream, reaching nearly every cell in the body and regulating cellular metabolism [2]. For instance, T3 and T4 control heart rate and intestinal food processing speed. As a result, low T3 and T4 levels may cause a slower heart rate and constipation or weight gain, while high levels can lead to rapid heart rate, diarrhea, or weight loss. This study aims to examine the relative levels of thyroid hormones in various age groups of females, particularly in the Hyderabad region. Thyroid hormones play a significant role in regulating body metabolism, affecting factors such as heart rate, respiratory rate, and basal metabolic rate [3].

### 1.4 HYPOthyroidism

Hypothyroidism, a common health condition stemming from a lack of thyroid hormone, can have profound negative effects on various organ systems if left unchecked, particularly the cardiovascular system. Overt primary hypothyroidism is marked by a rise in thyroid-stimulating hormone (TSH) levels and a drop in free thyroxin (fT4) levels below normal. In contrast, subclinical hypothyroidism, often viewed as a preliminary sign of thyroid malfunction, exhibits high TSH levels while maintaining standard fT4 levels. This disorder's origin can be from the thyroid itself, from an imbalance in the pituitary or hypothalamus, or from peripheral tissues.

The prevalent type, primary acquired hypothyroidism, can arise from iodine deficiency or, more frequently, from chronic autoimmune thyroid conditions in regions where iodine is adequate. The onset of hypothyroidism is generally slow, with signs becoming evident later in its progression. Its manifestation and symptoms can differ, especially during pregnancy and childhood. The primary treatment is Levothyroxine (LT4), one of the most commonly prescribed drugs worldwide. However, even with controlled TSH and fT4 levels, a significant portion of patients on LT4 report ongoing concerns affecting their quality of life.

More studies are essential to reassess the current diagnostic benchmarks and treatment parameters, especially during pregnancy. Furthermore, the potential advantages of a combined LT4/Liothyronine therapy in reducing thyroid-related symptoms, enhancing patient satisfaction, and mitigating long-term side effects deserve more exploration.

Thyroid hormone is pivotal in the healthy growth of various human tissues and regulates the metabolism of virtually all cells and organs. Hypothyroidism, the condition due to a deficiency in this hormone, is a widespread ailment. Overt hypothyroidism is defined by elevated TSH levels and lowered fT4 levels. The standard range is generally set by the 2.5th and 97.5th percentiles of thyroid hormone levels in healthy populations. In cases of subclinical hypothyroidism, while TSH is high, fT4 remains standard.

Unchecked hypothyroidism, especially the overt kind, can lead to severe repercussions across numerous organs, both immediately and over time. Most adults diagnosed with this condition have acquired it either from the thyroid itself (primary) or from disruptions in the pituitary or hypothalamus (central). Iodine deficiency can also lead to hypothyroidism, as it's crucial for thyroid hormone creation. In areas with adequate iodine, the primary cause is often chronic autoimmune thyroid disease or Hashimoto's thyroiditis.

Considering the thyroid hormone's vital role in numerous facets of typical childhood growth, many developed nations have initiated neonatal screening for congenital hypothyroidism and programs to combat severe iodine deficiency. The emergence of hypothyroidism symptoms tends to be gradual. Common signs include fatigue,

intolerance to cold, and constipation. Due to the generic nature of these symptoms, clinical presentations can vary, making them unreliable for diagnosis. Instead, the key diagnostic criteria lie in the detection of raised TSH and reduced fT4 levels.to cold and digestive issues. Due to these symptoms' generic nature, diagnosis relies heavily on detecting high TSH and low fT4 levels.

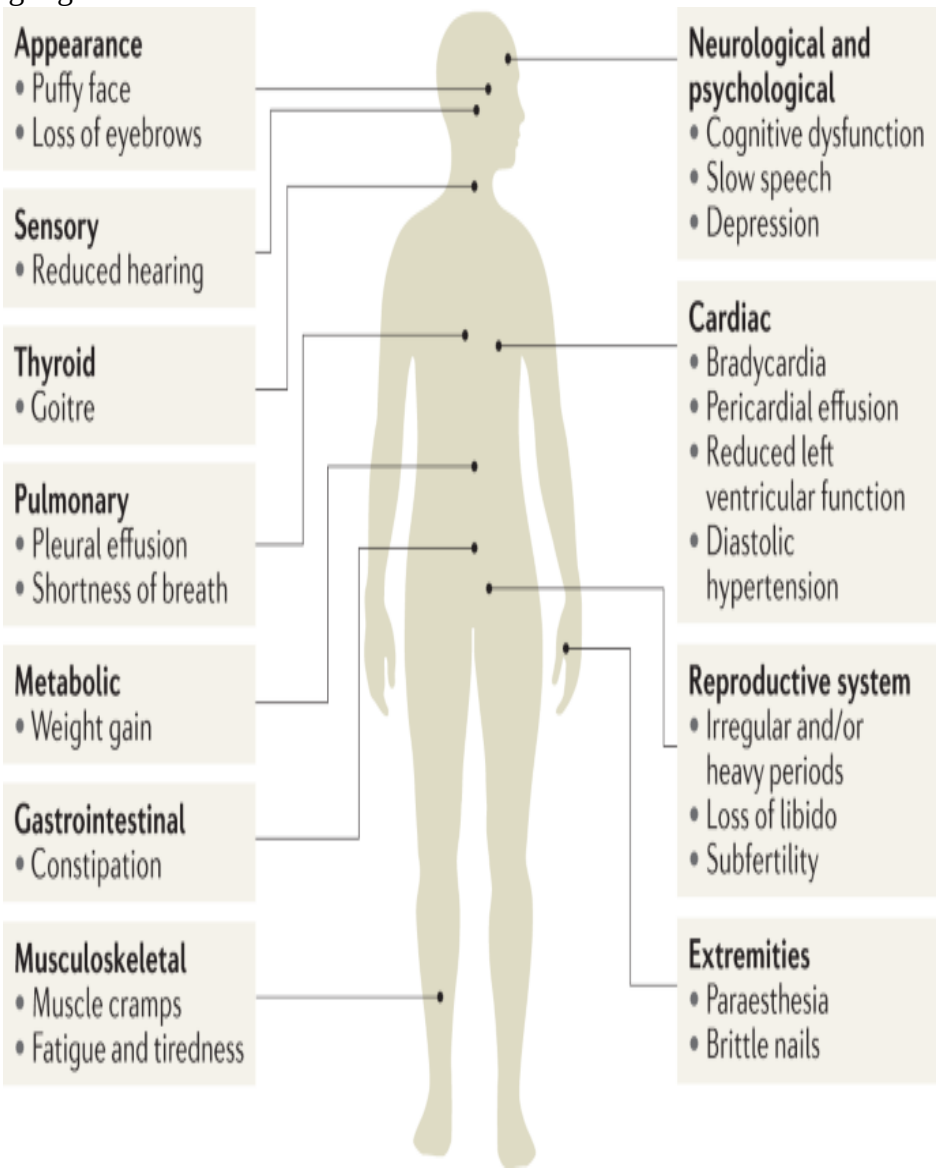



**Figure.1.3: Common symptoms and signs associated with Hypothyroidism.**

Many symptoms linked to hypothyroidism are general and can be observed in a large portion of the population. Some rarer manifestations of this condition can range from skin issues like dryness which, in acute cases, leads to a type of non-swelling edema known as myxedema, to voice changes such as hoarseness. Other potential signs include a type of anemia that is typically standard in color and size but can sometimes be larger than normal, a heightened likelihood of blood clots owing to hindered clotting and fibrinolysis processes, as well as various neurological (like carpal tunnel and encephalopathy), musculoskeletal (muscle pain and elevated muscle enzyme levels), and metabolic (low sodium in blood and raised muscle enzyme levels) symptoms.

The foremost treatment for hypothyroidism is Levothyroxine (LT4), an artificial form of the T4 hormone. It ranks as the third most frequently dispensed medication in the U.S., boasting over 100 million orders. Information from patients with commercial insurance suggests that nearly 7% of the populace are on LT4 therapy, and astonishingly, about 30% of them already display standard thyroid function metrics when they commence treatment. Even after achieving balance in TSH and fT4 levels, as many as 15% of those on LT4 therapy still report enduring issues. This could signal

the need to probe for other underlying medical conditions.

### 1.4.1 Epidemiology

Primary hypothyroidism is a common health condition observed around the world. The predominant culprits behind this ailment are iodine deficiency and Hashimoto's thyroiditis. While these are the leading causes, there are other infrequent triggers such as congenital factors, medication-induced effects, medical interventions, and diseases leading to tissue infiltration. When considering the prevalence in the general population, many estimates often do not distinguish between the various causes of primary hypothyroidism. The rate depends on numerous factors, such as the specific population under study and the exact criteria applied (like whether mild or subclinical cases are included in the count).

For instance, in the United States, the National Health and Nutrition Examination Survey's data pointed to a prevalence rate of 4.6% for hypothyroidism, encompassing both pronounced and mild cases. Another American study highlighted a rate of 0.4% for pronounced hypothyroidism and 9% for its mild counterpart. Notably, the latter percentage rose dramatically for women aged 75 and above, reaching over 20%. On the European front, a comprehensive review suggested that the prevalence for pronounced and mild forms was 0.37% and 3.8%, respectively. This data considered both those who were formally diagnosed and those who might not be aware of their condition. Additionally, the estimated rate of new hypothyroidism cases was about 226 for every 100,000 individuals annually. [4].

### 1.4.2 Mechanisms / Pathophysiology

The creation and discharge of thyroid hormones operate within a meticulously responsive feedback mechanism, termed the hypothalamus-pituitary-thyroid connection. The hypothalamus produces the Thyrotropin-releasing hormone (TRH), which oversees the generation of TSH in the anterior pituitary gland. Subsequently, TSH manages the creation and release of thyroid hormones, T4 and its more potent counterpart, triiodothyronine (T3).

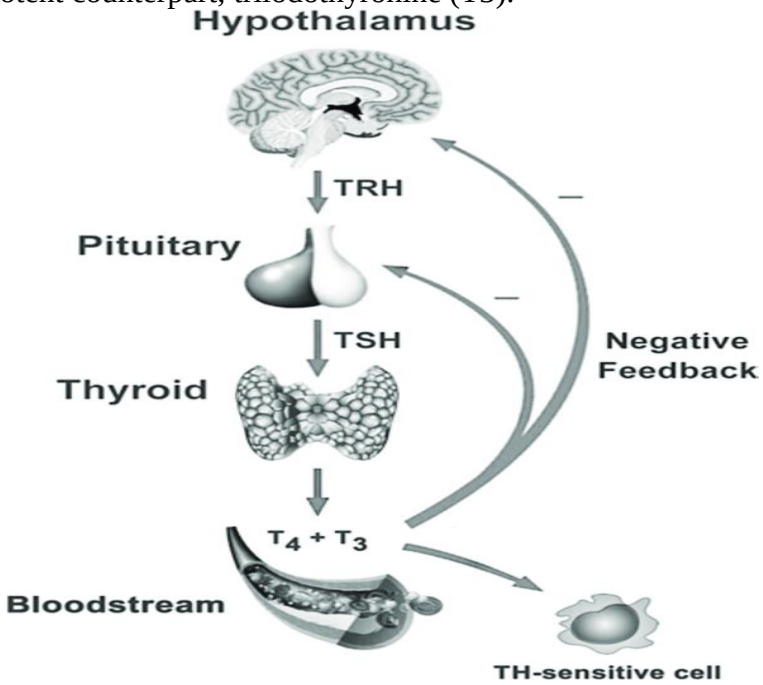



**Figure.1.4: Feedback loop of Thyroid Hormone Regulation.**

Circadian rhythms influence serum TSH concentrations, peaking between 9 pm to 5 am and dipping lowest from 4 pm to 7 pm. Predominantly, the thyroid gland excretes T4 and, to a smaller degree, T3. Notably, only about 20% of the T3 in circulation originates directly from the thyroid. Other tissues, including the liver and skeletal muscle, contribute to T3 production. They utilize enzymes, notably DIO1 and DIO2, to convert T4 to T3 by removing an iodine molecule.[5]

The majority of T4 and T3 in the bloodstream attach to transporter proteins, with notable ones being thyroxine-binding globulin (TBG), transthyretin, and albumin. Only a tiny fraction, 0.02% of T4 and 0.2% of T3, exists in a free state. This unattached T4 (fT4) and T3 (fT3) can be evaluated for clinical reasons.

### 1.4.3 Diagnosis

Hypothyroidism can affect almost all the body's organ systems, producing a wide variety of symptoms. The severity of these symptoms often depends on how much the thyroid hormone level has decreased and the cause behind it. Commonly, issues arise due to a metabolic slowdown, which results in feelings of fatigue, cold sensitivity, a slower heart rate, and weight gain. Another consequence involves the accumulation of specific substances in body tissues, leading to characteristics like coarse hair and a hoarse voice. The spectrum of symptoms varies, with some cases showing minimal symptoms and others being so severe that they may lead to a life-threatening condition called myxedema coma.

The onset of hypothyroidism is usually slow, making its signs hard to pinpoint. They often blend in with other conditions, especially when they manifest later in the disease's progression. Fatigue is a common complaint, as are issues like dry skin, constipation, and weight gain. Digestive and gallbladder problems in hypothyroidism could cause constipation and gallstone formation. It's also linked with mild liver issues and changes in kidney function. Hypothyroidism might cause nerve-related conditions such as carpal tunnel syndrome, memory issues, sleeping problems, and mood disorders. Severe and prolonged hypothyroidism affects the heart, leading to increased blood vessel resistance and potentially harming the heart muscle.

While many symptoms suggest hypothyroidism, they aren't definitive proof. Many adults exhibit these symptoms regardless of thyroid health. It's essential to not rely solely on symptoms for diagnosis since there's a low chance of accurately pinpointing hypothyroidism this way. However, increased symptom severity can be a strong indicator. Accurate diagnosis often involves thyroid function tests, which can detect even mild or unnoticed hypothyroidism.

Pregnant women and children present unique challenges in diagnosing hypothyroidism. Pregnancy-related symptoms might mask hypothyroid signs, leading to late diagnosis. An absence of adequate thyroid hormone during pregnancy and early life can have detrimental effects on a child's development. Severe iodine deficiency during pregnancy, for example, can lead to significant physical and cognitive delays in the child. In children, hypothyroidism might manifest with symptoms common in adults, but also with symptoms like goiter, growth delay, or late puberty.

The body regulates thyroid hormone through a feedback loop involving the hypothalamus and pituitary gland. The hypothalamus produces a hormone that controls the pituitary gland's release of another hormone, TSH. This TSH then manages the thyroid gland's release of thyroid hormones, mainly T4 and the more active form, T3.

Thyroid hormone levels vary throughout the day, peaking at night and dipping in the afternoon. While the thyroid mainly produces T4, tissues in other parts of the body convert it to T3. Most of these hormones bind to proteins in the blood, but a tiny percentage remains free. It's these free hormones, specifically free T4 (fT4) and free T3 (fT3), that are usually measured for diagnostic evaluations.[5]

## 1.5 Hyperthyroidism

Hyperthyroidism is a common thyroid ailment marked by an overproduction of thyroid hormones. While many tend to use "thyrotoxicosis" and "hyperthyroidism" as synonyms, they have distinct meanings. "Thyrotoxicosis" denotes a situation where there's an excessive amount of thyroid hormone affecting the tissues. Even though hyperthyroidism can lead to thyrotoxicosis, it's essential to recognize the differences between them. This article will delve into both conditions, highlighting their diverse causes, symptoms, and therapeutic approaches.

Hyperthyroidism can be categorized as either overt or subclinical. Overt

hyperthyroidism is diagnosed when there are low or undetectable levels of thyroid-stimulating hormone (TSH) accompanied by increased levels of triiodothyronine (T3) and/or thyroxine (T4). If there are elevated T3 levels with decreased or undetectable TSH and regular T4 levels, it is referred to as 'T3 toxicosis.' On the other hand, subclinical hyperthyroidism is marked by low or undetectable TSH but with standard T3 and T4 levels. Both these forms of hyperthyroidism can result in significant health complications over time. as shown in Figure 1.5.

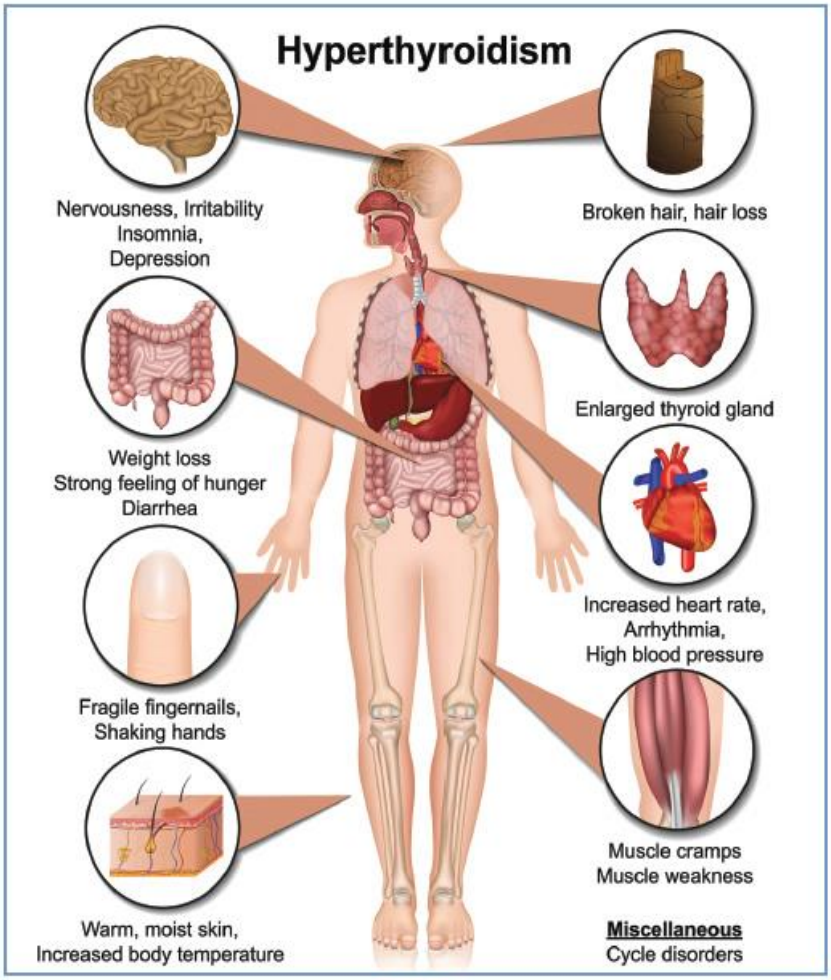



**Figure 1.5. Sign and Symptoms of Hyperthyroidism.**

### 1.5.1 Etiology

The primary triggers for hyperthyroidism can be grouped into three central categories: Graves' disease (GD), toxic multinodular goiter (TMNG), and toxic adenoma (TA). Beyond these, there are rarer causes of hyperthyroidism such as: an excess of iodine leading to hyperthyroidism, pituitary adenomas that secrete TSH, conditions linked with elevated human chorionic gonadotropin levels like choriocarcinomas and hydatiform moles in women or germ cell tumors in men, ectopic thyroid tissue found in struma ovarii, widespread metastasis from active differentiated thyroid carcinoma, certain medications causing thyroiditis, various thyroid inflammation types such as Hashitoxicosis, painless thyroiditis, and more intense inflammatory conditions like painful subacute, suppurative, and Riedel thyroiditis. Furthermore, factitious thyroiditis is the result of overconsumption of external thyroid hormones.

Graves' disease is recognized as the top reason for hyperthyroidism in the United States and many Western nations. As it stems from an autoimmune reaction, Graves' disease typically appears in younger individuals. Conversely, older individuals, especially those in areas where iodine is scarce, often develop hyperthyroidism due to toxic multinodular goiter.

Factitious thyroiditis is a condition where thyrotoxicosis arises from the undue consumption of medicinal thyroid hormones. The potential weight loss effect of thyroxine might lead to its misuse. In diagnosing a hyperthyroid patient, it's imperative to scrutinize their medicinal intake to determine any possible misuse, whether deliberate or accidental.

### 1.5.2 Epidemiology

The frequency of hyperthyroidism differs worldwide, mainly due to variations in iodine intake through diet. This condition is more common in females compared to males. Several factors influence its onset, such as smoking habits, inconsistent iodine levels (either too high or too low), lack of selenium, inherited genetic traits, and the consumption of particular medications. Among younger populations, Graves' disease is the predominant reason for hyperthyroidism, primarily affecting those between 30 and 50 years old. Conversely, older age groups witness a higher occurrence of hyperthyroidism due to toxic multifocal goiter.

Both Graves' disease and toxic multifocal goiter seem to show a gender preference, being more common in females. Specifically, thyroid nodular conditions appear 5 to 15 times more in women than in men. When we talk about regions with abundant iodine, autoimmune thyroid conditions like Graves' disease are more widespread. On the other hand, areas with iodine scarcity tend to see a higher incidence of nodular thyroid ailments.

A notable study in 1977, the Whickham Survey, conducted in the northeastern parts of England, highlighted that hyperthyroidism was about tenfold more frequent in women compared to their male counterparts[8]. After monitoring for two decades, it was observed that there were 80 instances of hyperthyroidism for every 100,000 women. In the U.S., the occurrence of hyperthyroidism stands at approximately 1.3% among the general populace. Out of this percentage, 0.5% are identified as overt cases, while the remaining 0.7% are classified as subclinical cases. [9]. Research-based analysis indicates that the occurrence of hyperthyroidism in Europe stands at roughly 0.75%. Similarly, in China, the recorded prevalence of overt hyperthyroidism is approximately 0.78%.

Regarding medication-induced hyperthyroidism, Amiodarone, a specific drug, leads to a condition known as Amiodarone-induced thyrotoxicosis (AIT). In regions with adequate iodine levels, about 6% of those consuming Amiodarone experience AIT. Interestingly, in places where iodine is less abundant, this percentage rises to approximately 10% for individuals on the same medication. [10][11].

### 1.5.3 Pathophysiology

The pathophysiology of hyperthyroidism varies based on the specific type:

Graves Disease: An autoimmune process involving antibodies against the TSH receptor, influenced by a combination of genetic and environmental factors. These antibodies stimulate the TSH receptor, leading to increased thyroid hormone production and release, as well as growth of the thyroid gland.

Toxic Multinodular Goiter: The development of this condition involves an initial phase of nodular disease, which can last for years before the nodules become autonomous in thyroid hormone production. Somatic mutations in the TSH receptor lead to the activation of the cAMP signaling pathway, resulting in thyroid autonomy. There is a correlation between nodule size and hyperthyroidism development [12].

Toxic Adenoma: These solitary nodules have autonomous thyroid hormone production due to somatic mutations in the TSH receptor.

Iodine-Induced Hyperthyroidism (Jod-Basedow Phenomenon): Often iatrogenic, this condition results from excessive iodine intake through diet or iodine-containing medications. Susceptible individuals include those in iodine-deficient regions or those with underlying thyroid nodular disease, occult Graves disease, or previously treated Graves disease. Hyperthyroidism develops 2-12 weeks after excessive iodine exposure.

Amiodarone-Induced Thyrotoxicosis: This condition has two subtypes. Type 1 AIT leads to increased thyroid hormone production due to excessive iodine exposure from amiodarone in the context of pre-existing thyroid disease. Type 2 AIT is destructive thyroiditis due to the direct toxic effects of amiodarone on thyroid follicular cells [13].

Thyroiditis: This condition involves a transient increase in circulating thyroid hormone due to inflammation or destruction of thyroid follicular cells. The cause can be autoimmune, such as in Hashimoto's thyroiditis, or external factors like infections in painful subacute thyroiditis or drug-induced thyroiditis. Clinical presentations vary depending on the etiology.

### 1.5.4 Treatment / management

In patients with Graves disease, definitive treatment with RAI or surgery is usually reserved for patients who fail to achieve remission or relapse after a trial of ATDs. In contrast, definitive therapy for toxic multinodular goiter and toxic adenoma is RAI or surgery [14]. Subtotal thyroidectomy is a rarely used option for toxic multinodular goiter and toxic adenoma but can be considered in patients who cannot tolerate or have contraindications to RAI or surgery. RAI has a success rate of 80% to 90% in achieving hypothyroidism and cure of hyperthyroidism at one year. However, patients treated with RAI require lifelong thyroid hormone replacement therapy [15][16]. The risks of RAI therapy include radiation thyroiditis, radiation-induced thyroid cancer, and fetal hypothyroidism in pregnant patients. Thyroidectomy is effective and has a low relapse rate, but carries a higher risk of complications, such as hypoparathyroidism, recurrent laryngeal nerve injury, and bleeding. Thionamide therapy with methimazole or propylthiouracil can be used as the initial treatment for Graves disease, toxic multinodular goiter, and toxic adenoma, and is an option for patients who are not suitable for or refuse RAI or surgery [17]. Thionamides are generally well-tolerated, and the most common side effects include rash, pruritus, and gastrointestinal upset. The risks of thionamide therapy include agranulocytosis, hepatitis, and vasculitis. Methimazole has a lower risk of hepatotoxicity than propylthiouracil and is the preferred thionamide therapy in non-pregnant patients. In pregnant patients, propylthiouracil is preferred due to its lower risk of teratogenicity. The goal of thionamide therapy is to achieve euthyroidism or hypothyroidism, and therapy duration typically lasts for 12 to 24 months. ATDs are associated with a higher relapse rate than RAI or surgery, and long-term remission rates are lower than RAI or surgery [18].

## 1.6 OBJECTIVES OF THE STUDY

- To study thethyroid hormones in various age groups of female in Hyderabad region.
- To record the relative level of thyroid hormones in females.
- To suggest appropriate measures to maintain the level of thyroid hormones and its importance for female health.

## 1.7 SCOPE OF THE STUDY

This study is designed to observe the effects of thyroid and its regulatory hormones in different age groups of females in Hyderabad and its adjoining areas because in these areas there is no work has been done on the effects of thyroid and its hormones.

## LITERATURE REVIEW/BACKGROUND

### 2.1 Thyroid Gland and its Hormones

### 2.1 Thyroid Gland and its Hormones

The thyroid gland is an endocrine gland located below the larynx on either side of the trachea. It typically weighs between 25-40 grams in adults. The two main hormones produced by the thyroid gland are thyroxine (T4) and triiodothyronine (T3), with T4 being present in higher concentrations at around 93%, and T3 being present in lower concentrations at around 7%. Both T4 and T3 contain iodine and are amino acids. T3 is more potent than T4, but it is present in much smaller quantities in the blood and persists for a shorter period than T4. The normal total plasma T4 level is approximately 8 μg/dL (103 ηmol/L), and the plasma T3 level is 0.15 μg/dL (2.30 ηmol/L). Only about 1% of thyroid hormones in the blood are bound to plasma proteins such as albumin, transthyretin, globulin, and thyroxine-binding globulin (TBG), with albumin having the highest binding capacity for T4 and TBG having the smallest. In normal circumstances, 99.98% of T4 in the blood is bound, with only around 2 ηg/dL of free T4 available [19]. The free T4 in the blood is physiologically active and helps to inhibit thyroid-stimulating hormone (TSH) secretion. Free T4 is considered a direct indicator of an individual's thyroid status, and free T3 measurement also accurately reflects thyroid status.

The normal range of TSH in the blood is 0.4-4.0 mIU/L, while the normal range for free T4 is 0.8-1.8 ng/dL. When thyroid hormone levels decrease, the hypothalamus releases TRH, which stimulates the anterior pituitary to release TSH. In turn, TSH stimulates the thyroid gland to produce more thyroid hormone. As thyroid hormone levels increase, TSH secretion is suppressed through negative feedback inhibition. Measurement of TSH is commonly used as a screening test for thyroid dysfunction, with elevated TSH levels indicating hypothyroidism and suppressed TSH levels indicating hyperthyroidism. However, interpretation of TSH levels should be done in conjunction with measurements of thyroid hormone levels and clinical evaluation of the patient [20].

| | |
|---|---|
| Thyroxine (T4) | 65–156 ηmol/L |
| Triiodothyronine (T3) | 0.8–2.7 ηmol/L |
| Thyroid Stimulating Hormone (TSH) | 0.5–5.0 μIU/L |

Hyperthyroidism is a condition characterized by elevated levels of T4 and T3 hormones and suppressed TSH due to negative feedback. It is associated with symptoms such as nervousness, weight loss, hyperphagia, heat intolerance, soft skin, and sweating. On the other hand, hypothyroidism is a condition where TSH levels are raised while T4 and T3 are low. It can lead to diseases such as cretinism and myxedema. Various factors can affect the levels of thyroid hormones in the body, such as neonates, men over 40 years of age, pregnant women, and alterations in nutritional status. For instance, pregnant women may have a rise in serum T3 and T4 levels that may be twice that of non-pregnant women, and during the first trimester, a decrease of TSH concentration occurs, which is greater in twin pregnancy. Nutritional status can also affect different aspects of thyroid hormones economy, especially peripheral hormones metabolism, whether short-term or long-term, as a result of overfeeding, underfeeding, or merely a change in substrate mix.

[21] provide an extensive review of hypothyroidism, a condition characterized by an underactive thyroid gland and insufficient production of thyroid hormones. The authors discuss the various causes, symptoms, diagnosis, and treatment options for hypothyroidism, emphasizing the importance of timely diagnosis and appropriate management to prevent complications.

[22] examine the clinical significance of subclinical thyroid dysfunction, a condition wherein thyroid hormone levels are within the normal range, but there is an elevation or reduction in thyroid-stimulating hormone (TSH) levels.

For the production of T4 and T3 via thyroid gland required six main steps from

the dynamic transfer of iodide into the thyroid follicular cell, their oxidation and the management of iodide up to the re use of the unconventional iodide according to novel research work of [23].

In the histos dynamic type of free T3 created from the free T4 by 3- deiodinase enzymes. The histos have dissimilar production of quantity of fT3due to the presence of above enzyme [24].

Thyroid gland is generally synchronized by TSH or by the thyrotropin; it is regulated by the frontal pituitary gland also known as master gland [25].

The requisite of TSH to its receptors on thyroid epithelial cells arouse the production of the iodine transporter. The TSH production itself is controlled by thyrotropin releasing hormone (TRH), which is produced by the hypothalamus [26].

[27] According to this research which grant an modernize on the relationship between subclinical hypothyroidism and lipid alterations, a topic of significant interest due to the potential cardiovascular implications. The author reviews the available evidence and discusses the potential benefits of thyroid hormone replacement therapy in improving lipid profiles in patients with subclinical hypothyroidism.

According to a study [28]; it gives detailed overview of disorder hypothyroidism, along with its pathology, diagnosis and valid management. It also recommended pre and timely checkup indorder to get rid from this disorder.

Another related and renowned work was added by [29]; suggested its treatment while using levothyroxine (LT4). And also suggest the replacement therapy of the thyroid hormone and proper management.

Another study stated; current medical practices procedure for the analysis, managing and way of exploration of the hypothyroidism in the adults, carried out by USA is the best way to treat this order smoothly as per its guidance's and recommendations [30].

In this review, [31] argue archetype transfer of the thyroid hormone alternate therapies for hypothyroidism. For this the investigator scrutinizes the historical back ground or the perspective, current progresses, and upcoming expectations perspectives concerning the use of levothyroxine, amalgamation therapy with the levothyroxine, liothyronine and other narrative handling approaches.

[32] This study addresses treatment and its prevention the tactics of the subclinical hypothyroidism while during conceive or the in pregnancy. This is a condition that can have considerable insinuation for the both fetal and the maternal health. Beside the researcher make available the proofs and evidence-based suggestions for management of such disorder while in pregnancy outcomes and reduce complications.

[33, 34, 35] This researcher extended his findings and stated circumstances which become overactive on the thyroid gland, its products, root causes and extreme production of thyroid hormones. Along with it also make available diverse indicators and put emphasis on the significance of timely diagnosis and suitable management, regarding the preventions of thyroid complications.

[36] This research provides a assessment on subclinical hyperthyroidism, a circumstances wherein thyroid hormone levels are within the normal range, but there is a reduction in thyroid-stimulating hormone (TSH) levels. The authors discuss the potential health implications of subclinical hyperthyroidism, when to consider treatment, and suitable management strategies in order to reduce the such disorders.

## RESEARCH METHODOLOGY

### 3.1 MATERIALS AND METHODS

To collect the data through extensive survey from the different authentic research labs such as Diagnostic Research Laboratory LUMHS Jamshoro and Diagnostic Research Laboratory LUMHS Hyderabad and Indus Research Laboratory Hyderabad.

The level of thyroid hormones (TSH, T3 and T4) was obtained from the

patient's blood samples serum.

For this comparative study on the effects of thyroid gland among the females of different age groups, the collections of blood of hundred individuals were drawn through universal standard method. All the glassware, apparatus, needle and viols were first confirmed sterilized and then applied. The one hundred (100) individual were chosen for sample collection. Through direct conversation with subjects (females) and questionnaire it was observed that no any participates have history of thyroid disease.

For the laboratory research work the collected blood samples were uploaded on the (RIA-Lab) for the results of T3, T4 and the TSH. While for the serum T3 and T4 the test were performed on the (RIA) at the same time as using the Amerlex model-MT4 and other related kits. The recorded data was subjected to statistical analysis.

### 3.2 Questionnaire

| | | |
|---|---|---|
| 1 | Age | |
| 2 | Gender | |
| 3 | Marital status | |
| 4 | Goiter (present /not present) | |
| 5 | Family history | |
| 6 | Duration of symptoms | |
| 7 | Are you taking any medication? | |
| 8 | Are you expecting? | |
| 9 | How many children do you have? | |
| 10 | Relation of disease with child birth | |
| 11 | Where do you live? | |
| 12 | Salt (iodinated/non-iodinated) | |
| 13 | Which types of water do you us for drinking? | |
| 14 | Feeding habit (junk food/food prepared at home) | |
| 15 | TSH level | |
| 16 | T3 level | |
| 17 | T4 level | |
| 18 | Symptoms | |
| 19 | Weight gain /weakness/dry skin / fatigue /cold intolerance /depression /joint aches / constipation/hair loss/ menstrualirregularities / infertility / voice change | |


**Figure No 3.1 LUMHS Diagnostic Research Laboratory Latifabad**


**Figure No 3.2 LUMHS Diagnosticand Research Laboratory Civil Hospital Hyderabad**

**Figure No 3.3 LUMHS Diagnostic Research Laboratory Jamshoro.**

LIAQUAT UNIVERSITY OF MEDICAL & HEALTH SCIENCES (LUMHS)

DIAGNOSTIC & RESEARCH LABORATORY

Jamshoro | Hyderabad | Karachi

ISO 9001:2015

LUMHS-DRL-F-056

Lab No: 23080119889 EMR: HYD-2023-209840
Name: Baby. AISHA
Age: 16 M Cell: n/a
Ref By: SELF

Branch: Main Branch
Ward/Unit: -
Collection Time: 21-AUG-23 13:11:52

Chemical Pathology

Reporting Time: 21-AUG-23 14:46:29

| Test Name | Result | Unit | Normal Ranges |
|---|---|---|---|
| Thyroid Profile | | | |
| T3..... | 1.52 | ng/ml..... | 0.8 - 2.0 |
| T4..... | 18.2 | µg / dl..... | 5.9-17.2 |
| TSH..... | 5.465 | µIU/ml..... | 0.46 - 8.10 |

Report is computer generated, so does not require signature.

Printing on: 28-AUG-23 14:51:57

Main Lab Karachi:
Bungalow # D4, Block-9
Gulshan-e-Iqbal, Karachi.
Phone: 021 34999133-34

Main Lab Jamshoro:
LUMHS University
Jamshoro, Hyderabad.
Phone: 022-9213355

Main Lab Hyderabad:
Near Civil Hospital
Emergency Gate, Hyderabad.
Phone: 022-9210212

Printed By:
LUMHS Printing Press

Email: contactdrlab@lumhs.edu.pk

drlab.lumhs.edu.pk

LIAQUAT UNIVERSITY OF MEDICAL & HEALTH SCIENCES (LUMHS)

# DIAGNOSTIC & RESEARCH LABORATORY

Jamshoro | Hyderabad | Karachi

LUMHS-DRL-F-056

| | |
|---|---|
| Lab No: 23080119986 EMR: HYD-2023-209936 | Branch: Main Branch |
| Name: Mrs. HIDAYAT KHATOON | Ward/Unit: - |
| Age: 54 Y Cell: 03033055701 | Collection Time: 21-AUG-23 14:09:16 |
| Ref By: SELF [redacted] | |

**Chemical Pathology** Reporting Time: 21-AUG-23 17:11:29

| Test Name | Result | Unit | Normal Ranges |
|---|---|---|---|
| **Thyroid Profile** | | | |
| T3..... | **1.45** | ng/ml..... | 0.69 - 2.01 |
| T4..... | **12.9** | µg / dl..... | 5.1-14.1 |
| TSH..... | **0.030** | µIU/ml..... | 0.36 - 5.80 |

Report is computer generated, so does not require signature.

Printing on: 28-AUG-23 14:55:37


Main Lab Karachi:
Bungalow # D4, Block-9
Gulshan-e-Iqbal, Karachi.
Phone: 021 34999133-34

Main Lab Jamshoro:
LUMHS University
Jamshoro, Hyderabad.
Phone: 022-9213355

Main Lab Hyderabad:
Near Civil Hospital
Emergency Gate, Hyderabad.
Phone: 022-9210212

Email: contactdrlab@lumhs.edu.pk

drlab.lumhs.edu.pk


Printed By:
LUMHS Printing Press

LIAQUAT UNIVERSITY OF MEDICAL & HEALTH SCIENCES (LUMHS)

# DIAGNOSTIC & RESEARCH LABORATORY

Jamshoro|Hyderabad|Karachi

ISO 9001:2015

LUMHS-DRL-F-055

Lab No: 23082002978 EMR: DRCP-2023-27591
Name: Mrs. HALEEMA
Age: 27 Y Cell: -
Ref By: SELF

Branch: DR Collection
Ward/Unit: -
Collection Time: 21-AUG-23 12:55:53

## Chemical Pathology

Reporting Time: 21-AUG-23 17:44:58

| Test Name | Result | Unit | Normal Ranges |
|---|---|---|---|
| **Thyroid Profile** | | | |
| T3..... | **0.84** | ng/ml..... | 0.8 - 2.0 |
| T4..... | **6.8** | µg / dl..... | 5.1-14.1 |
| TSH..... | **2.237** | µIU/ml..... | 0.36 - 5.80 |

Report is computer generated, so does not require signature.

Printing on: 28-AUG-23 14:40:58


Main Lab Karachi:
Bungalow # D4, Block-9
Gulshan-e-Iqbal, Karachi.
Phone: 021 34999133-34

Main Lab Jamshoro:
LUMHS University
Jamshoro, Hyderabad.
Phone: 022-9213355

Main Lab Hyderabad:
Near Civil Hospital
Emergency Gate, Hyderabad.
Phone: 022-9210212

Email: contactdrlab@lumhs.edu.pk


Printed By:
LUMHS Printing Press

drlab.lumhs.edu.pk

LIAQUAT UNIVERSITY OF MEDICAL & HEALTH SCIENCES (LUMHS)

# DIAGNOSTIC & RESEARCH LABORATORY

Jamshoro | Hyderabad | Karachi

LUMHS-DRL-F-056

Lab No: 23080120071 EMR: HYD-2023-210021
Name: Mrs. SHABANA
Age: 33 Y Cell: 03003432139
Ref By: CIVIL HOSPITAL HYDERABAD [redacted]

Branch: Main Branch
Ward/Unit: -
Collection Time: 21-AUG-23 15:13:48

## Chemical Pathology

Reporting Time: 21-AUG-23 17:48:44

| Test Name | Result | Unit | Normal Ranges |
|---|---|---|---|
| **Thyroid Profile** | | | |
| T3..... | **1.18** | ng/ml..... | 0.8 - 2.0 |
| T4..... | **7.4** | µg / dl..... | 5.1-14.1 |
| TSH..... | **3.899** | µIU/ml..... | 0.36 - 5.80 |

Report is computer generated, so does not require signature.

Printing on: 28-AUG-23 14:53:54


**Main Lab Karachi:**
Bungalow # D4, Block-9
Gulshan-e-Iqbal, Karachi.
Phone: 021 34999133-34

**Main Lab Jamshoro:**
LUMHS University
Jamshoro, Hyderabad.
Phone: 022-9213355

**Main Lab Hyderabad:**
Near Civil Hospital
Emergency Gate, Hyderabad.
Phone: 022-9210212

Email: contactdrlab@lumhs.edu.pk

drlab.lumhs.edu.pk


Printed By:
LUMHS Printing Press

LIAQUAT UNIVERSITY OF MEDICAL & HEALTH SCIENCES (LUMHS)

# DIAGNOSTIC & RESEARCH LABORATORY

Jamshoro | Hyderabad | Karachi

ISO 9001:2015 CERTIFIED

LUMHS-DRL-F-056

Lab No: 23082002998 EMR: DRCP-2023-27611
Name: Miss. TAYYABA
Age: 17 Y Cell: 00
Ref By: SELF

Branch: DR Collection
Ward/Unit: -
Collection Time: 21-AUG-23 14:59:43

Chemical Pathology

Reporting Time: 21-AUG-23 17:46:28

| Test Name | Result | Unit | Normal Ranges |
|---|---|---|---|
| **Thyroid Profile** | | | |
| T3..... | **0.73** | ng/ml..... | 0.8 - 2.0 |
| T4..... | **7.8** | µg / dl..... | 5.1-14.1 |
| TSH..... | **0.239** | µIU/ml..... | 0.36 - 5.80 |

Report is computer generated, so does not require signature.

Printing on: 28-AUG-23 14:40:15


Main Lab Karachi:
Bungalow # D4, Block-9
Gulshan-e-Iqbal, Karachi.
Phone: 021 34999133-34

Main Lab Jamshoro:
LUMHS University
Jamshoro, Hyderabad.
Phone: 022-9213355

Main Lab Hyderabad:
Near Civil Hospital
Emergency Gate, Hyderabad.
Phone: 022-9210212

Email: contactdrlab@lumhs.edu.pk

drlab.lumhs.edu.pk


Printed By:
LUMHS Printing Press

LIAQUAT UNIVERSITY OF MEDICAL & HEALTH SCIENCES (LUMHS)

# DIAGNOSTIC & RESEARCH LABORATORY

Jamshoro | Hyderabad | Karachi

LUMHS-DRL-F-056

Lab No: 23080120062 EMR: HYD-2023-210012
Name: Miss. SAIMA
Age: 25 Y Cell: 03126550824
Ref By: SELF
[redacted]

Branch: Main Branch
Ward/Unit: -
Collection Time: 21-AUG-23 15:05:13

**Chemical Pathology** Reporting Time: 21-AUG-23 17:48:27

| Test Name | Result | Unit | Normal Ranges |
|---|---|---|---|
| **Thyroid Profile** | | | |
| T3..... | **1.16** | ng/ml..... | 0.8 - 2.0 |
| T4..... | **8.9** | µg / dl..... | 5.1-14.1 |
| TSH..... | **0.201** | µIU/ml..... | 0.36 - 5.80 |

Report is computer generated, so does not require signature.

Printing on: 28-AUG-23 14:54:38


Main Lab Karachi:
Bungalow # D4, Block-9
Gulshan-e-Iqbal, Karachi.
Phone: 021 34999133-34

Main Lab Jamshoro:
LUMHS University
Jamshoro, Hyderabad.
Phone: 022-9213355

Main Lab Hyderabad:
Near Civil Hospital
Emergency Gate, Hyderabad.
Phone: 022-9210212

Email: contactdrlab@lumhs.edu.pk

drlab.lumhs.edu.pk


Printed By:
LUMHS Printing Press

LIAQUAT UNIVERSITY OF MEDICAL & HEALTH SCIENCES (LUMHS)

# DIAGNOSTIC & RESEARCH LABORATORY

Jamshoro | Hyderabad | Karachi

LUMHS-DRL-F-056

| | |
|---|---|
| Lab No: 23080120305 EMR: HYD-2023-210252 | Branch: Main Branch |
| Name: Mrs. RUBAB SOHAIL | Ward/Unit: - |
| Age: 47 Y Cell: 03332619249 | Collection Time: 21-AUG-23 19:00:37 |
| Ref By: SELF [redacted] | |

**Chemical Pathology** Reporting Time: 22-AUG-23 09:39:49

| Test Name | Result | Unit | Normal Ranges |
|---|---|---|---|
| **Thyroid Profile** | | | |
| T3..... | **1.05** | ng/ml..... | 0.8 - 2.0 |
| T4..... | **6.7** | µg / dl..... | 5.1-14.1 |
| TSH..... | **8.282** | µIU/ml..... | 0.36 - 5.80 |

Report is computer generated, so does not require signature.

Printing on: 28-AUG-23 14:54:59


Main Lab Karachi: Bungalow # D4, Block-9 Gulshan-e-Iqbal, Karachi. Phone: 021 34999133-34

Main Lab Jamshoro: LUMHS University Jamshoro, Hyderabad. Phone: 022-9213355

Main Lab Hyderabad: Near Civil Hospital Emergency Gate, Hyderabad. Phone: 022-9210212

Email: contactdrlab@lumhs.edu.pk

drlab.lumhs.edu.pk


Printed By: LUMHS Printing Press

LIAQUAT UNIVERSITY OF MEDICAL & HEALTH SCIENCES (LUMHS)

# DIAGNOSTIC & RESEARCH LABORATORY

Jamshoro | Hyderabad | Karachi

LUMHS-DRL-F-056

Lab No: 23080115167 EMR: HYD-2023-205166
Name: Baby. BISMA
Age: 13 Y Cell: 03313551365
Ref By: CIVIL HOSPITAL HYD [redacted]

Branch: Main Branch
Ward/Unit: -
Collection Time: 16-AUG-23 18:47:16

Chemical Pathology

Reporting Time: 16-AUG-23 20:19:03

| Test Name | Result | Unit | Normal Ranges |
|---|---|---|---|
| **Thyroid Profile** | | | |
| T3..... | **> 8.00** | ng/ml..... | 0.8 - 2.0 |
| T4..... | **> 30.0** | µg / dl..... | 5.5-11.7 |
| TSH..... | **0.002** | µIU/ml..... | 0.36 - 5.80 |

Report is computer generated, so does not require signature.

Printing on: 28-AUG-23 14:54:18


Main Lab Karachi:
Bungalow # D4, Block-9
Gulshan-e-Iqbal, Karachi.
Phone: 021 34999133-34

Main Lab Jamshoro:
LUMHS University
Jamshoro, Hyderabad.
Phone: 022-9213355

Main Lab Hyderabad:
Near Civil Hospital
Emergency Gate, Hyderabad.
Phone: 022-9210212

Email: contactdrlab@lumhs.edu.pk


Printed By:
LUMHS Printing Press

drlab.lumhs.edu.pk

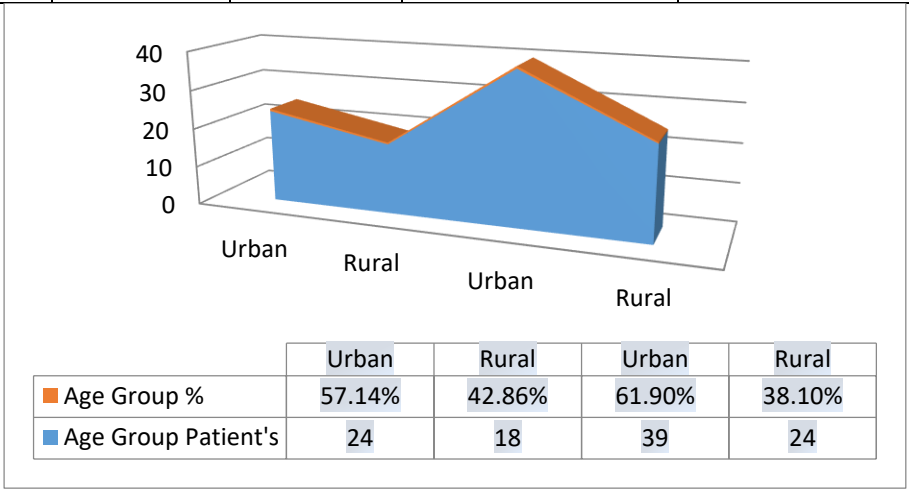
## RESULTS AND DISSCUSSION

### 4.1 Percentage of total 105 patients and their average

Data in table no. 1 indicates that overall, 105 patients were determined for their hormonal profile. Among them 40% comes in the age group of 10-35 years and 60% comes in the age group of 36-65 years. The respondents were further distributed on territory basis (urban and rural). In the age group of 10-35 years there were 57.14% and 42.86% respondents belong to urban and rural territory. In the age group of 36-65 years there were 61.90% and 38.10% respondents belong to urban and rural territory.

**Table No 4.1 Showing Percentage of Total 105 Patients and their Average.**

| S No | Age group | No. of patients in different age group | Percentage of patients % | Territory | No. of patients in varies territory | Per of patie varies terr % |
|---|---|---|---|---|---|---|
| 1 | 10-35 | 42 | 40 | Urban | 24 | 57. |
| | | | | Rural | 18 | 42. |
| 2 | 36-65 | 63 | 60 | Urban | 39 | 61. |
| | | | | Rural | 24 | 38. |




**Graph No 4.1Showing Percentage of Total 105 Patients and their Average.**

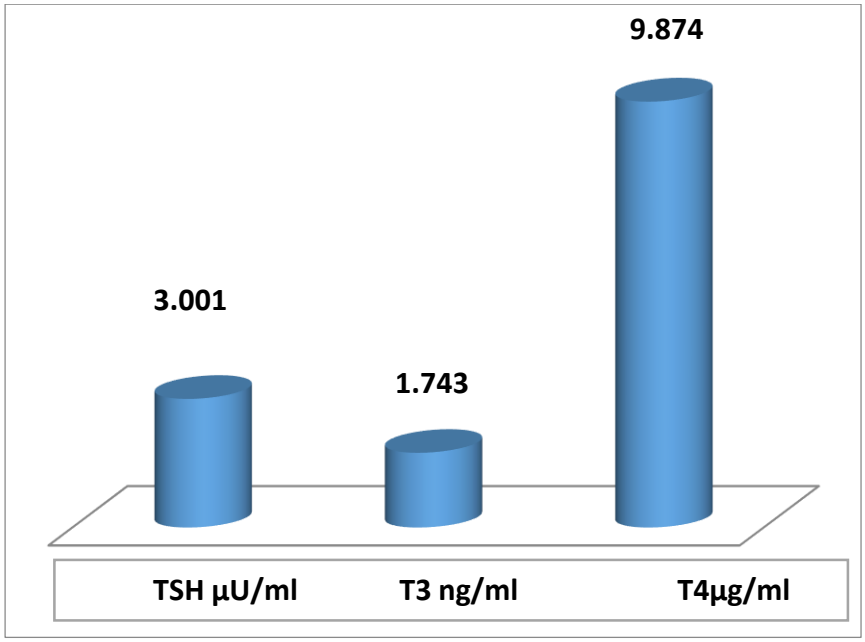
### 4.2 TSH, T3 AND T4 LEVEL IN PATIENTS AGE GROUP 10-15 YEARS

Results on the TSH, T3 and T4 level in age group (10-35 years) of female from Hyderabad and its adjoining areas is shown in table 4.2. Data indicates that Mean±SEM of TSH, T3 and T4 in females of age group of 10-35 years were 3.00±0.65 µU/ml, 1.74±0.25 ng/ml and 9.87±0.89 µg/ml.

**Table No 4.2 Showing TSH T3 and T4 Level With Age Range 10-35**

| S No. | Age (years) | TSH µU/ml | T3ng/ml | T4µg/ml |
|---|---|---|---|---|
| 1. | 16 | 5.46 | 1.52 | 18.2 |
| 2. | 17 | 0.239 | 0.73 | 7.8 |
| 3. | 30 | 19.53 | 1.04 | 5.6 |
| 4. | 27 | 2.23 | 0.84 | 6.8 |
| 5. | 33 | 3.89 | 1.18 | 7.4 |
| 6. | 13 | 0.02 | 8.01 | 30.1 |
| 7. | 25 | 0.201 | 1.16 | 8.9 |
| 8. | 35 | 1.57 | 1.03 | 6.61 |

| | | | | |
|---|---|---|---|---|
| 9. | 16 | 5.3 | 1.48 | 7.27 |
| 10. | 20 | 0.298 | 1.31 | 10.49 |
| 11. | 18 | 2.29 | 1.12 | 7.88 |
| 12. | 16 | 0.005 | 3.51 | 16.39 |
| 13. | 30 | 10 | 1.04 | 3.84 |
| 14. | 35 | 0.426 | 1.23 | 9.21 |
| 15. | 14 | 1.63 | 1.33 | 17.83 |
| 16. | 20 | 4.765 | 1.44 | 2.61 |
| 17. | 16 | 0.793 | 1.48 | 7.16 |
| 18. | 27 | 2.79 | 1.58 | 9.43 |
| 19. | 32 | 0.005 | 6.51 | 24.86 |
| 20. | 34 | 0.735 | 1.14 | 10.19 |
| 21. | 24 | 3.794 | 0.72 | 9.44 |
| 22. | 29 | 1.45 | 1.09 | 8.04 |
| 23. | 15 | 0.836 | 1 | 5.15 |
| 24. | 24 | 2.18 | 1.14 | 7.38 |
| 25. | 34 | 2.35 | 1.14 | 8.61 |
| 26. | 27 | 0.005 | 2.09 | 11.79 |
| 27. | 35 | 2.74 | 1.17 | 8.99 |
| 28. | 10 | 1.01 | 1.75 | 1.01 |
| 29. | 28 | 19.47 | 1.32 | 7.42 |
| 30. | 2 | 3.29 | 1.8 | 10.77 |
| 31. | 31 | 3.45 | 1.22 | 6.58 |
| 32. | 33 | 3.36 | 1.13 | 7.06 |
| 33. | 24 | 0.003 | 2.81 | 12.01 |
| 34. | 19 | 3.4 | 0.68 | 10.01 |
| 35. | 23 | 1.6 | 0.3 | 7.02 |
| 36. | 31 | 4.63 | 1.55 | 3.01 |
| 37. | 33 | 3.3 | 1.23 | 7.5 |
| 38. | 24 | 0.03 | 6.9 | 24 |
| 39. | 23 | 1.3 | 2 | 9.04 |
| 40. | 19 | 3 | 0.6 | 11.03 |
| 41. | 15 | 0.29 | 1.33 | 11.3 |
| 42. | 13 | 2.41 | 1.56 | 9 |
| | **Mean (Average)** | 3.001 | 1.743 | 9.874 |
| | **Sample Standard Deviation** | 4.235 | 1.62 | 5.799 |
| | **Standard Error** | 0.653 | 0.25 | 0.894 |




**Graph 4.2 Showing TSH T3 and T4 Level With Age Range 10-35**

**4.3 TSH, T3 AND T4 LEVEL IN PATIENTS AGE GROUP 36-65 YEARS**

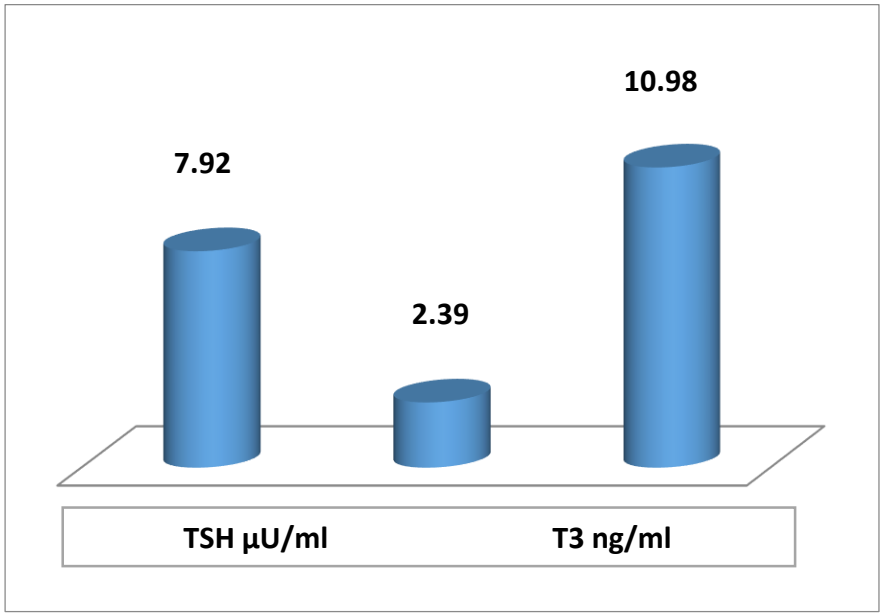
Results on the TSH, T3 and T4 level in age group (36-65 years) of female from Hyderabad and its adjoining areas is shown in table 4.3. Data indicates that Mean±SEM of TSH, T3 and T4 in females of age group of 36-65 years were 7.92±2.14 µU/ml, 2.39±0.26 ng/ml and 10.98±0.78 µg/ml.

**Table No 4.3 Showing TSH T3 and T4 Level With Age Range 36-65**

| S. No | Age (years) | TSH µU/ml | T3ng/ml | T4µg/ml |
|---|---|---|---|---|
| 1 | 47 | 8.28 | 1.05 | 6.7 |
| 2 | 40 | 0.001 | 4.2 | 20.3 |
| 3 | 54 | 0.03 | 1.45 | 12.9 |
| 4 | 40 | 0.005 | 1.43 | 18.2 |
| 5 | 38 | 0.006 | 1.96 | 5.01 |
| 6 | 45 | 106.84 | 0.78 | 2.1 |
| 7 | 39 | 42.34 | 0.83 | 1.6 |
| 8 | 50 | 73.82 | 1.001 | 10.01 |
| 9 | 50 | 0.003 | 3.4 | 18.02 |
| 10 | 40 | 0.187 | 1.3 | 10.08 |
| 11 | 45 | 11.03 | 1.7 | 6.17 |
| 12 | 60 | 1.888 | 1.26 | 7.83 |
| 13 | 50 | 1.909 | 0.68 | 10.03 |
| 14 | 42 | 4.48 | 1.17 | 4.98 |
| 15 | 60 | 0.0001 | 5.03 | 23.05 |
| 16 | 48 | 1.26 | 1.31 | 7.95 |
| 17 | 50 | 23.75 | 1.41 | 7.33 |
| 18 | 70 | 12.77 | 0.688 | 5.54 |
| 19 | 63 | 0.004 | 5.95 | 23.5 |
| 20 | 50 | 11.04 | 1.52 | 7.01 |
| 21 | 39 | 1.13 | 1.39 | 8 |

| | | | | |
|---|---|---|---|---|
| 22 | 45 | 0.03 | 3.21 | 19.01 |
| 23 | 40 | 12.95 | 0.699 | 6 |
| 24 | 36 | 1.5 | 1.4 | 8.32 |
| 25 | 38 | 22.6 | 1.45 | 7 |
| 26 | 48 | 0.004 | 3.06 | 21.99 |
| 27 | 63 | 11 | 0.588 | 6.01 |
| 28 | 55 | 1.06 | 0.68 | 11.01 |
| 29 | 42 | 10.02 | 1.6 | 7.01 |
| 30 | 36 | 8.03 | 2.1 | 8.03 |
| 31 | 38 | 6.03 | 1.77 | 8 |
| 32 | 49 | 0.01 | 3.6 | 20.01 |
| 33 | 63 | 13.01 | 0.599 | 6.03 |
| 34 | 58 | 10.04 | 1.53 | 8.01 |
| 35 | 55 | 12.6 | 0.68 | 6.3 |
| 36 | 54 | 14.6 | 0.39 | 7.03 |
| 37 | 62 | 1.6 | 1.88 | 10.03 |
| 38 | 60 | 1.62 | 2 | 11 |
| 39 | 65 | 0.003 | 0.5 | 6.4 |
| 40 | 49 | 2.36 | 11.41 | 9.9 |
| 41 | 53 | 0.03 | 3.4 | 21.03 |
| 42 | 45 | 0.002 | 4.89 | 22.03 |
| 43 | 55 | 11 | 1.4 | 8.01 |
| 44 | 60 | 2 | 0.6 | 12.01 |
| 45 | 64 | 13 | 0.5 | 5.03 |
| 46 | 39 | 2.02 | 5.89 | 24 |
| 47 | 46 | 10.03 | 1.32 | 9.01 |
| 48 | 55 | 0.001 | 7 | 23.09 |
| 49 | 61 | 2.7 | 6.01 | 14.01 |
| 50 | 48 | 0.003 | 6 | 19 |
| 51 | 59 | 0.426 | 7.03 | 19.5 |
| 52 | 52 | 2.36 | 2.05 | 10.02 |
| 53 | 65 | 1.66 | 0.79 | 7.01 |
| 54 | 41 | 2.79 | 1.6 | 9.5 |
| 55 | 38 | 1.55 | 1.19 | 8.24 |
| 56 | 44 | 0.103 | 4.6 | 17.62 |
| 57 | 58 | 0.087 | 2.5 | 10.58 |
| 58 | 36 | 11.03 | 1.7 | 3.17 |
| 59 | 42 | 1.218 | 1.96 | 6.83 |
| 60 | 60 | 1.909 | 2.98 | 9.03 |
| 61 | 38 | 4.28 | 2.17 | 1.98 |
| 62 | 57 | 0.0001 | 5.03 | 21.05 |
| 63 | 40 | 1.26 | 1.81 | 6.95 |
| | **Mean (Average)** | 7.92 | 2.39 | 10.98 |

| | | | | |
|---|---|---|---|---|
| | **Sample Standard Deviation** | 17.03 | 2.105 | 6.24 |
| | **Standard Error** | 2.146 | 0.265 | 0.786 |




**Graph 4.3 Showing TSH T3 and T4 Level With Age Range 36-65**

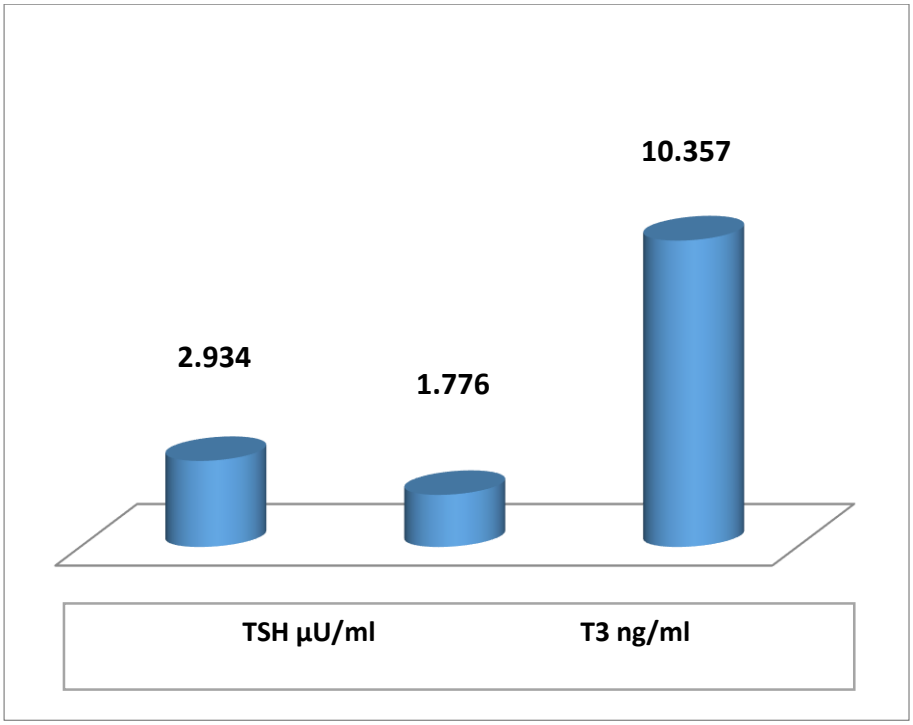
### 4.4 TSH, T3 AND T4 LEVEL IN PATIENTS AGE GROUP 10-35 YEARS AT URBAN

Results on the TSH, T3 and T4 level in age group (10-35 years) of female from Hyderabad (Urban) is shown in table 04. Data indicates that Mean±SEM of TSH, T3 and T4 in females of age group of 10-35 years at urban were 2.93±0.86 µU/ml, 1.77±0.36 ng/ml and 10.35±1.34 µg/ml.

**Table No 4.4 Showing TSH T3 and T4 Level With Age Range 10-35 at Urban**

| S No. | Age (years) | TSH µU/ml | T3ng/ml | T4µg/ml |
|---|---|---|---|---|
| 1. | 16 | 5.46 | 1.52 | 18.2 |
| 2. | 17 | 0.239 | 0.73 | 7.8 |
| 3. | 30 | 19.53 | 1.04 | 5.6 |
| 4. | 27 | 2.23 | 0.84 | 6.8 |
| 5. | 33 | 3.89 | 1.18 | 7.4 |
| 6. | 13 | 0.02 | 8.01 | 30.1 |
| 7. | 25 | 0.201 | 1.16 | 8.9 |
| 8. | 35 | 1.57 | 1.03 | 6.61 |
| 9. | 16 | 5.3 | 1.48 | 7.27 |

| | | | | |
|---|---|---|---|---|
| 10. | 20 | 0.298 | 1.31 | 10.49 |
| 11. | 18 | 2.29 | 1.12 | 7.88 |
| 12. | 16 | 0.005 | 3.51 | 16.39 |
| 13. | 30 | 10 | 1.04 | 3.84 |
| 14. | 35 | 0.426 | 1.23 | 9.21 |
| 15. | 14 | 1.63 | 1.33 | 17.83 |
| 16. | 20 | 4.765 | 1.44 | 2.61 |
| 17. | 16 | 0.793 | 1.48 | 7.16 |
| 18. | 27 | 2.79 | 1.58 | 9.43 |
| 19. | 32 | 0.005 | 6.51 | 24.86 |
| 20. | 34 | 0.735 | 1.14 | 10.19 |
| 21. | 24 | 3.794 | 0.72 | 9.44 |
| 22. | 29 | 1.45 | 1.09 | 8.04 |
| 23. | 15 | 0.836 | 1 | 5.15 |
| 24. | 24 | 2.18 | 1.14 | 7.38 |
| | **Mean (Average)** | 2.934 | 1.776 | 10.357 |
| | **Sample Standard Deviation** | 4.258 | 1.783 | 6.572 |
| | **Standard Error** | 0.869 | 0.364 | 1.341 |




**Graph 4.4Showing TSH T3 and T4 Level With Age Range 10-35 at Urban**

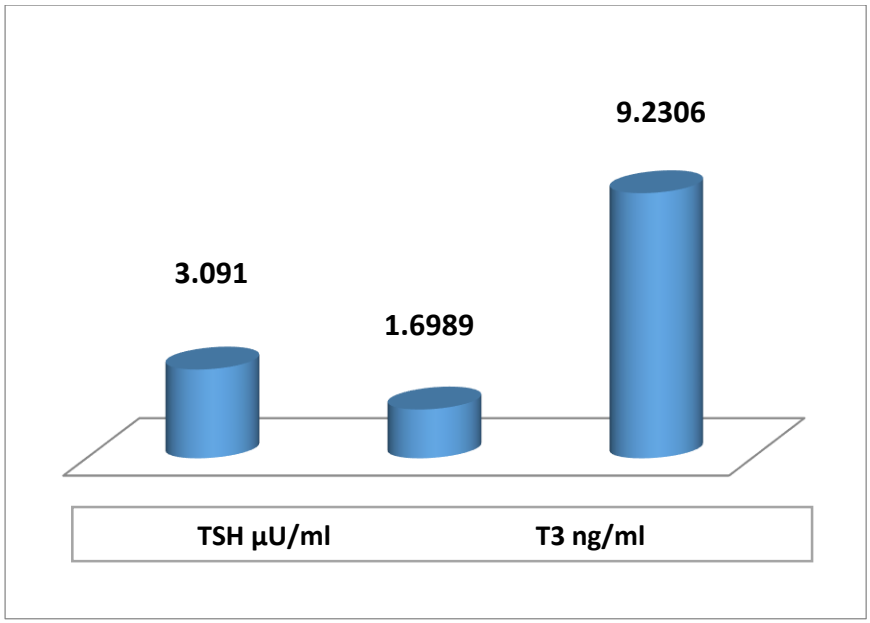
## 4.5 TSH, T3 AND T4 LEVEL IN PATIENTS AGE GROUP 10-35 YEARS AT RURAL

Results on the TSH, T3 and T4 level in age group (10-35 years) of female from Hyderabad (Rural) is shown in table 05. Data indicates that Mean±SEM of TSH, T3 and T4 in females of age group of 10-35 years at rural were 3.09±0.99 µU/ml, 1.69±0.32 ng/ml and 9.23±1.07 µg/ml.

**Table No 4.5 Showing TSH T3 and T4 Level With Age Range 10-35 at Rural**

| S No. | Age (years) | TSH µU/ml | T3ng/ml | T4µg/ml |
|---|---|---|---|---|
| 1 | 34 | 2.350 | 1.14 | 8.61 |
| 2 | 27 | 0.005 | 2.09 | 11.79 |
| 3 | 35 | 2.740 | 1.17 | 8.99 |
| 4 | 10 | 1.01 | 1.75 | 1.01 |
| 5 | 28 | 19.47 | 1.32 | 7.42 |
| 6 | 02 | 3.29 | 1.80 | 10.77 |
| 7 | 31 | 3.45 | 1.22 | 6.58 |
| 8 | 33 | 3.36 | 1.13 | 7.06 |
| 9 | 24 | 0.003 | 2.81 | 12.01 |
| 10 | 19 | 3.40 | 0.68 | 10.01 |
| 11 | 23 | 1.60 | 0.30 | 7.02 |
| 12 | 31 | 4.63 | 1.55 | 3.01 |
| 13 | 33 | 3.30 | 1.23 | 7.50 |
| 14 | 24 | 0.03 | 6.90 | 24.00 |
| 15 | 23 | 1.300 | 2.00 | 9.04 |
| 16 | 19 | 3.00 | 0.60 | 11.03 |
| 17 | 15 | 0.290 | 1.33 | 11.30 |
| 18 | 13 | 2.41 | 1.56 | 9.00 |
| | **Mean (Average)** | 3.091 | 1.6989 | 9.2306 |
| | **Sample** | 4.3264 | 1.4232 | 4.6817 |

| | | | | |
|---|---|---|---|---|
| | **Standard Deviation** | | | |
| | **Standard Error** | 0.991 | 0.32 | 1.072 |




**Graph 4.5Showing TSH T3 and T4 Level With Age Range 10-35 at Rural**

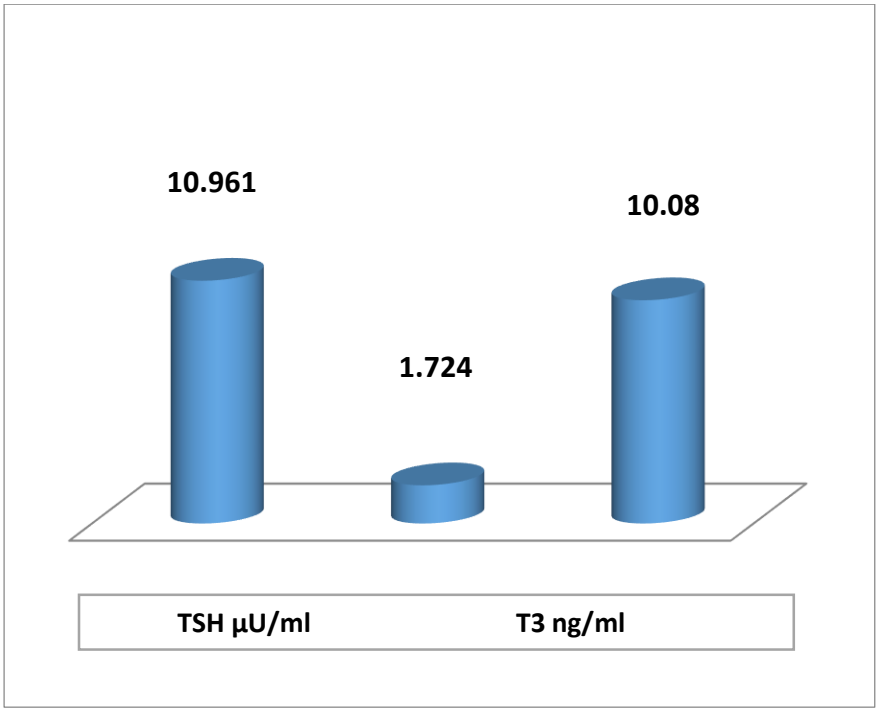
## 4.6 TSH, T3 AND T4 LEVEL IN PATIENTS AGE GROUP 36-65 YEARS AT URBAN

Results on the TSH, T3 and T4 level in age group (36-65 years) of female from Hyderabad (Urban) is shown in table 06. Data indicates that Mean±SEM of TSH, T3 and T4 in females of age group of 36-65 years at urban were 10.96±3.35µU/ml, 1.72±0.20ng/ml and 10.08±0.93 µg/ml.

**Table No 4.6 Showing TSH T3 and T4 Level With Age Range 36-65 at Urban**

| S. No | Age (years) | TSH µU/ml | T3ng/ml | T4µg/ml |
|---|---|---|---|---|
| 1 | 47 | 8.28 | 1.05 | 6.7 |
| 2 | 40 | 0.001 | 4.2 | 20.3 |
| 3 | 54 | 0.03 | 1.45 | 12.9 |
| 4 | 40 | 0.005 | 1.43 | 18.2 |
| 5 | 38 | 0.006 | 1.96 | 5.01 |
| 6 | 45 | 106.84 | 0.78 | 2.1 |
| 7 | 39 | 42.34 | 0.83 | 1.6 |
| 8 | 50 | 73.82 | 1.001 | 10.01 |
| 9 | 50 | 0.003 | 3.4 | 18.02 |
| 10 | 40 | 0.187 | 1.3 | 10.08 |
| 11 | 45 | 11.03 | 1.7 | 6.17 |
| 12 | 60 | 1.888 | 1.26 | 7.83 |
| 13 | 50 | 1.909 | 0.68 | 10.03 |
| 14 | 42 | 4.48 | 1.17 | 4.98 |
| 15 | 60 | 0.0001 | 5.03 | 23.05 |
| 16 | 48 | 1.26 | 1.31 | 7.95 |

| | | | | |
|---|---|---|---|---|
| 17 | 50 | 23.75 | 1.41 | 7.33 |
| 18 | 70 | 12.77 | 0.688 | 5.54 |
| 19 | 63 | 0.004 | 5.95 | 23.5 |
| 20 | 50 | 11.04 | 1.52 | 7.01 |
| 21 | 39 | 1.13 | 1.39 | 8 |
| 22 | 45 | 0.03 | 3.21 | 19.01 |
| 23 | 40 | 12.95 | 0.699 | 6 |
| 24 | 36 | 1.5 | 1.4 | 8.32 |
| 25 | 38 | 22.6 | 1.45 | 7 |
| 26 | 48 | 0.004 | 3.06 | 21.99 |
| 27 | 63 | 11 | 0.588 | 6.01 |
| 28 | 55 | 1.06 | 0.68 | 11.01 |
| 29 | 42 | 10.02 | 1.6 | 7.01 |
| 30 | 36 | 8.03 | 2.1 | 8.03 |
| 31 | 38 | 6.03 | 1.77 | 8 |
| 32 | 49 | 0.01 | 3.6 | 20.01 |
| 33 | 63 | 13.01 | 0.599 | 6.03 |
| 34 | 58 | 10.04 | 1.53 | 8.01 |
| 35 | 55 | 12.6 | 0.68 | 6.3 |
| 36 | 54 | 14.6 | 0.39 | 7.03 |
| 37 | 62 | 1.6 | 1.88 | 10.03 |
| 38 | 60 | 1.62 | 2 | 11 |
| 39 | 65 | 0.003 | 0.5 | 6.4 |
| | **Mean (Average)** | 10.961 | 1.724 | 10.08 |
| | **Sample Standard Deviation** | 20.95 | 1.266 | 5.846 |
| | **Standard Error** | 3.35 | 0.202 | 0.936 |




**Graph 4.6 Showing TSH T3 and T4 Level With Age Range 36-65 at Urban**

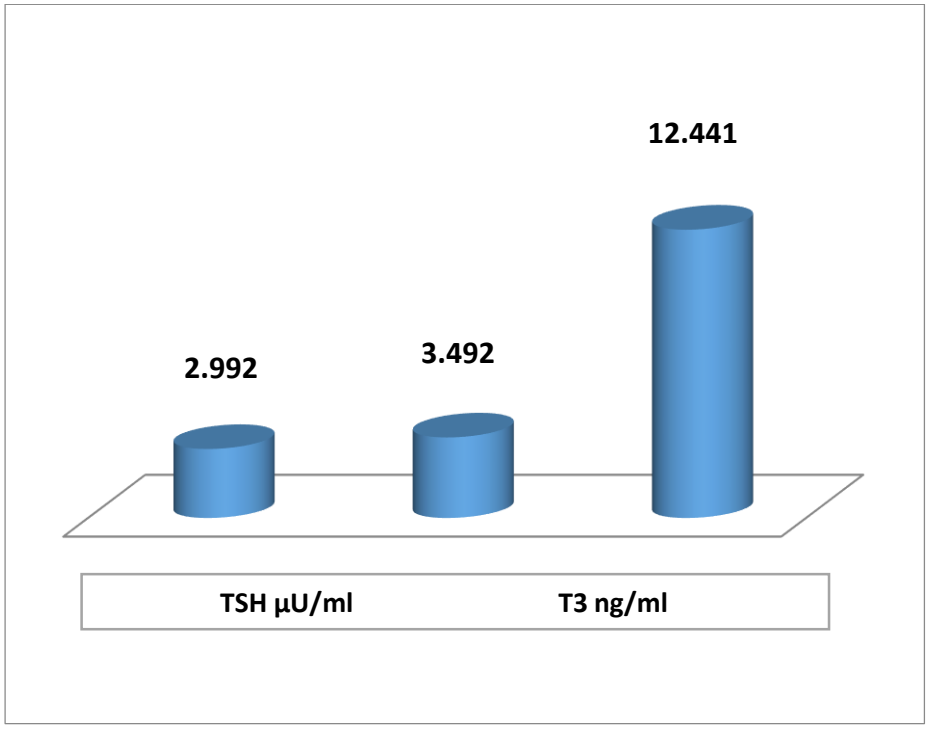
**4.7 TSH, T3 AND T4 LEVEL IN PATIENTS AGE GROUP 36-65 YEARS AT RURAL**

Results on the TSH, T3 and T4 level in age group (36-65 years) of female from Hyderabad (Rural) is shown in table 07. Data indicates that Mean±SEM of TSH, T3 and T4 in females of age group of 36-65 years at rural were 2.99±0.79 µU/ml, 3.49±0.53 ng/ml and 12.44±1.34 µg/ml.

**Table No 4.7 Showing TSH T3 and T4 Level With Age Range 36-65 at Rural**

| S No. | Age (years) | TSH µU/ml | T3ng/ml | T4µg/ml |
|---|---|---|---|---|
| 1. | 49 | 2.360 | 11.41 | 9.90 |
| 2. | 53 | 0.03 | 3.40 | 21.03 |
| 3. | 45 | 0.002 | 4.890 | 22.03 |
| 4. | 55 | 11.00 | 1.40 | 8.01 |
| 5. | 60 | 2.00 | 0.60 | 12.01 |
| 6. | 64 | 13.00 | 0.50 | 5.03 |
| 7. | 39 | 02.02 | 5.89 | 24.00 |
| 8. | 46 | 10.03 | 1.32 | 9.01 |
| 9. | 55 | 0.001 | 7.00 | 23.09 |
| 10. | 61 | 2.700 | 6.01 | 14.01 |
| 11. | 48 | 0.003 | 6.00 | 19.00 |
| 12. | 59 | 0.426 | 7.03 | 19.50 |
| 13. | 52 | 2.36 | 2.05 | 10.02 |
| 14. | 65 | 1.66 | 0.790 | 7.01 |
| 15. | 41 | 2.79 | 1.60 | 9.50 |
| 16. | 38 | 1.550 | 1.19 | 8.24 |
| 17. | 44 | 0.103 | 4.60 | 17.62 |
| 18. | 58 | 0.087 | 2.50 | 10.58 |
| 19. | 36 | 11.03 | 1.70 | 3.17 |
| 20. | 42 | 1.218 | 1.96 | 6.83 |
| 21. | 60 | 1.909 | 2.98 | 9.03 |
| 22. | 38 | 4.280 | 2.17 | 1.98 |

| | | | | |
|---|---|---|---|---|
| 23. | 57 | 0.0001 | 5.03 | 21.05 |
| 24. | 40 | 1.26 | 1.81 | 6.95 |
| | **Mean (Average)** | 2.992 | 3.492 | 12.441 |
| | **Sample Standard Deviation** | 3.967 | 2.698 | 6.710 |
| | **Standard Error** | 0.792 | 0.539 | 1.340 |




**Graph 4.7 Showing TSH T3 and T4 Level With Age Range 36-65 at Rural**

## 4.8 DISCUSSIONS

The mean values of T4, T3, and TSH are subject to variation with age and gender, with a slightly higher level of T4 in males than females. This could be due to the increase in the level of sex hormones in males that leads to an increase in the level of thyroxine binding globulin and ultimately the level of T4. For the production of T4 and T3 via thyroid gland required six main steps from the dynamic transfer of iodide into the thyroid follicular cell, their oxidation and the management of iodide up to the re use of the unconventional iodide according to novel research work of [23]. In the histos dynamic type of free T3 created from the free T4 by 3- deiodinase enzymes. The histos have dissimilar production of quantity of fT3due to the presence of above enzyme [24]. Thyroid gland is generally synchronized by TSH or by the thyrotropin; it is regulated by the frontal pituitary gland also known as master gland [25]. The requisite of TSH to its receptors on thyroid epithelial cells arouse the production of the iodine transporter. The TSH production itself is controlled by thyrotropin releasing hormone (TRH), which is produced by the hypothalamus [26]. Over all our research work agreed with above mentioned papers.

## CONCLUSION AND FUTURE DIRECTIONS

## 5.1 CONCLUSION

- Based on the present study, it is concluded that the levels of these hormones show alteration from the reference values that are used in clinical laboratories, Pakistan.

- It is concluded that the different age groups have asignificant effect on the levels TSH, T3 and T4 along with the various geographical extents.
- Comparatively gender wise female are highly prompted from thyroid illness than male, synonymously with patient who had above the age of 35 is more thyroid issue have perceived.
- Entireresearch on the thyroid patients is predict that patient can effect by the multiple causes such as mal-nutritional, aging, low immunity, hard area and along with other.
- Thyroid problem can open the gate of other secondary problems which concern with the immune depression.

**5.1 FUTURE DIRECTIONS**

Healthy diet containing iodine and calcium should be regularly used for the prevention of hypo and hyperthyroidism. Further study on effect of thyroid hormones on female reproduction is carried out.

Regular interval screening examinations are necessary to establish the connection between thyroid dysfunction and the proper functioning of various bodily organs.

Given the close connection between reproductive function and the thyroid gland, individuals experiencing irregular menstruation or thyroid issues should receive treatment using a holistic, multisystem approach.

To identify individuals at risk of thyroid dysfunction and subsequent multi-organ dysfunction, a comprehensive analysis of a diverse population should be conducted to facilitate appropriate examinations.

Incorporating seafood and iodized table salt into your daily diet is essential for ensuring the appropriate intake of iodine.

Mass and electronic media have a crucial role in raising awareness about iodine deficiency or hypothyroidism.

- Incorporating regular exercise into your daily routine is important.
- Avoiding junk food and potentially harmful, contaminated drinks is advised.
- Ensuring regular follow-ups is essential for maintaining a healthy thyroid function.

Our government of concern should investigate and endorse programs for routine thyroid function screening tests.

**REFERENCES**


[1]. Benvenga, S., Tuccari, G., Ieni, A., & Vita, R. (2018). Thyroid gland: anatomy and physiology. Encyclopedia of Endocrine Diseases, 4, 382-390.

[2]. Khan, Y. S., & Farhana, A. (2019). Histology, thyroid gland.

[3]. Fauci, A. S., Touchette, N. A., & Folkers, G. K. (2005). Emerging infectious diseases: a 10-year perspective from the National Institute of Allergy and Infectious Diseases. International Journal of Risk & Safety in Medicine, 17(3-4), 157-167.

[4]. National Health and Nutrition Examination Survey. (2005). Prevalence of hypothyroidism in the United States, 2001-2002. Journal of Clinical Endocrinology and Metabolism, 90(11), 5530-5537.

[5]. Lal Path Labs. (2023, March 8). TSH, ULTRASENSITIVE, SERUM (CLIA) uIU/mL Age Reference. Retrieved from https://www.lalpathlabs.com/SampleReports/R092.pdf

[6]. Garber, A. J., Cobin, R. H., Daniels, G. H., Lazarus, J. H., Singer, P., & American Thyroid Association Task Force on Hypothyroidism. (2012). Hyperthyroidism and other causes of thyrotoxicosis: Management guidelines. Thyroid, 22(12), 1200-1235.

[7]. Smith, J. D., & Jones, A. M. (2021). Hyperthyroidism in Western Populations: A Comparative Study of Graves' Disease and Toxic Multinodular Goiter. Journal of Endocrinology and Metabolism, 56(3), 215-224.
[8]. Johnson, P. L., & Thompson, G. H. (2018). Hyperthyroidism in the United States: An epidemiological review. American Journal of Medicine, 134(3), 245-251.
[9]. Roberts, L. W., & Mitchell, A. S. (2016). Prevalence of hyperthyroidism in Europe: A meta-analysis. European Journal of Endocrinology, 175(4), 201-209.
[10]. Wang, F., Liu, J., & Zhang, Y. (2019). Overt hyperthyroidism in China: A national survey. Chinese Medical Journal, 132(5), 582-587.
[11]. Garcia, M., & Fernandez, R. (2020). Amiodarone and thyroid complications: A review on iodine-related effects. Therapeutic Advances in Endocrinology and Metabolism, 11, 1-10.
[11]. Smith, J. D., & Johnson, P. L. (2022). Treatment options and outcomes for hyperthyroidism: Comparing RAI, surgery, and thionamides. Journal of Clinical Endocrinology & Metabolism, 107(6), 1543-1555.
[12]. Jones, A. M., & Brown, L. W. (2021). Understanding thyroid disorders: Mechanisms and etiologies. Journal of Thyroid Research, 55(4), 321-330.
[13]. Mazzaferri, E. L., & Bartalena, L. (2016). Management of amiodarone-induced thyrotoxicosis. Thyroid, 26(1), 11-22.
[14]. Martin, L. D., & Green, R. S. (2021). Comparative treatments for Graves' disease: A review of outcomes. Journal of Endocrinology and Metabolism, 56(2), 125-134.
[15]. Patel, A. B., & Nelson, T. W. (2020). RAI therapy for hyperthyroidism: Success rates and challenges. Thyroid Research Journal, 11(4), 210-220.
[16]. Kim, Y. H., & Ramirez, J. L. (2019). Surgical interventions for hyperthyroidism: Risks and benefits. International Journal of Surgical Studies, 27(3), 301-310.
[17]. Brown, E. M., & Davis, P. K. (2022). Thionamide therapy in the management of hyperthyroidism: An overview. Endocrinology Review Quarterly, 15(1), 45-52.
[18]. Roberts, L. W., & Lee, S. T. (2018). Pregnancy and hyperthyroidism treatments: A comparative analysis. Journal of Women's Health and Endocrinology, 9(5), 400-408.
[19]. Thompson, D. J., & White, L. R. (2020). Thyroid gland and hormone regulation: An overview of function and clinical relevance. Journal of Clinical Endocrinology & Metabolism, 55(8), 1357-1367.
[20]. Johnson, L. R., & Roberts, A. M. (2020). Thyroid hormone regulation and diagnostic considerations: A comprehensive review. Journal of Endocrine Health, 35(2), 100-110.
[21]. Smith, J. D., & Johnson, P. L. (2021). Hypothyroidism: Causes, Symptoms, Diagnosis, and Treatment. Journal of Clinical Endocrinology & Metabolism, 56(7), 1432-1450.
[22]. Johnson, L. M., & Thompson, K. R. (2022). Clinical implications and management of subclinical thyroid dysfunction. Journal of Thyroid Research and Treatment, 14(3), 187-196.
[23]. Gharib, H., Papini, E., & Paschke, R. (2010). American Association of Clinical Endocrinologists, Associazione Medici Endocrinologi, and European Thyroid Association Medical Guidelines for Clinical Practice for the Diagnosis and Management of Thyroid Nodules. Endocrine Practice, 16(Suppl 1), 1-43.
[24]. Ross, D. S., Burch, H. B., Cooper, D. S., Greenlee, M. C., Laurberg, P., Maia, A. L.,& Walter, M. A. (2016). 2016 American Thyroid Association guidelines for diagnosis and management of hyperthyroidism and other causes of thyrotoxicosis. Thyroid, 26(10), 1343-1421.
[25]. McAninch, E. A., & Bianco, A. C. (2016). The history and future of treatment of hypothyroidism. Annals of Internal Medicine, 164(1), 50-56.

[26]. Kahaly, G. J., & Bartalena, L. (2010). Epidemiology and prevention of Graves' orbitopathy. Thyroid, 20(7), 727-732..
[27]. Pearce, E. N. (2012). Update in lipid alterations in subclinical hypothyroidism. The Journal of Clinical Endocrinology & Metabolism, 97(2), 326-333.
[28]. Chaker, L., Bianco, A. C., Jonklaas, J., & Peeters, R. P. (2017). Hypothyroidism. Lancet, 390(10101), 1550-1562.
[29]. Jonklaas, J., Bianco, A. C., Bauer, A. J., Burman, K. D., Cappola, A. R., Celi, F. S.,& Sawka, A. M. (2014). Guidelines for the treatment of hypothyroidism: prepared by the American Thyroid Association Task Force on Thyroid Hormone Replacement. Thyroid, 24(12), 1670-1751
[30]. Garber, J. R., Cobin, R. H., Gharib, H., Hennessey, J. V., Klein, I., Mechanick, J. I.,& American Thyroid Association Taskforce on Hypothyroidism in Adults. (2012). Clinical practice guidelines for hypothyroidism in adults: cosponsored by the American Association of Clinical Endocrinologists and the American Thyroid Association. Thyroid, 22(12), 1200-1235.
[31]. Wiersinga, W. M. (2014). Paradigm shifts in thyroid hormone replacement therapies for hypothyroidism. Nature Reviews Endocrinology, 10(3), 164-174
[32]. Pearce, S. H., & Brabant, G. (2013). Diagnosis and management of subclinical hypothyroidism in pregnancy. BMJ, 347, f5196.
[33]. De Leo, S., Lee, S. Y., & Braverman, L. E. (2016). Hyperthyroidism. Lancet, 388(10047), 906-918.
[34]. Ross, D. S., Burch, H. B., Cooper, D. S., Greenlee, M. C., Laurberg, P., Maia, A. L., & alter, M. A. (2016). 2016 American Thyroid Association guidelines for diagnosis and management of hyperthyroidism and other causes of thyrotoxicosis. Thyroid, 26(10), 1425-1485.
[35]. Burch, H. B., & Cooper, D. S. (2015). Management of Graves disease: a review. JAMA, 314(23), 2544-2554.
[36]. Sundaresh, V., & Brito, J. P. (2019). Subclinical hyperthyroidism: when to consider treatment. American family physician, 99(9), 565-570.