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Original article

The Effect of Diet on The Prevalence of Thyroid Disorder Among Libyans

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Abstract
The thyroid gland's function is crucial in regulating numerous vital functions, significantly influencing physical and mental development. Iodine, an essential micronutrient, is required in moderate amounts for optimal thyroid gland function, as it prevents enlargement and promotes the production of thyroid hormones T4 and T3. Disruptions in these hormones impact overall health, leading to conditions such as thyroid enlargement, cognitive deficiencies, and increased risk of breast cancer. In Libya, several preventive procedures, including providing iodized salt, were implemented to combat iodine deficiency, yet the prevalence of thyroid diseases continues to rise. This study investigates the importance of thyroid hormones, the critical role of iodine intake and dietary factors, and the prevalence of thyroid disorders among both men and women in Tripoli, Libya. In a randomly selected hospital, 900 visitors of various ages were assessed for T4, T3, and TSH levels using Chemiluminescence Immunometric Assays (CIA). The results indicated elevated thyroid hormone levels in 7.3% of women and 6.4% of men, while 0.8% of women and 0.2% of men exhibited low TSH levels. Notably, women demonstrated a 5 to 10 times higher susceptibility to thyroid issues compared to men, although the reasons for this disparity remain uncertain. Factors such as iodine intake, the estrogenic hormonal influence, and genetic variations affecting thyroid hormone synthesis may play contributing roles. In conclusion, enhancing the diagnosis and management of thyroid disorders in Libya requires targeted awareness campaigns, robust research endeavors, and collaborative healthcare initiatives to improve health outcomes and quality of life.
Keywords. Hyperthyroidism, Hypothyroidism, Thyroid Gland Diseases, Hashimoto's Thyroiditis, Iodine.

Introduction

The thyroid gland, located in the anterior neck region, plays a critical role in synthesizing two predominant hormones: thyroxine (T4) and triiodothyronine (T3) [1]. These hormones are vital in regulating the body's metabolic rate as well as influencing heart rate, body temperature, and general energy levels [2]. Thyroid disorders encompass a spectrum of conditions characterized by abnormal thyroid gland activity, leading to either hypo- or hypersecretion of these hormones. The proper functioning of this gland is essential for maintaining metabolic homeostasis, energy levels, growth, and various physiological processes crucial for overall health [3].

Distinguishing between a normal thyroid state and pathological conditions is essential, as misclassifications can lead to misdiagnoses in clinical practice. Hypothyroidism occurs when the thyroid gland fails to produce sufficient hormones, which can lead to symptoms such as fatigue, weight gain, and depression [4]. Conversely, hyperthyroidism results from excessive hormone production, manifesting as weight loss, anxiety, and tachycardia [5]. Optimal thyroid function is particularly vital for health and well-being; it aids effective metabolism, energy management, cardiovascular health, and proper development, especially in pediatric populations [6].

In the North Africa and Middle East (NAME) region, thyroid cancer has shown a disturbing increase with an age-standardized incidence rate (ASIR) of 3.5 and an age-standardized mortality rate (ASMR) of 0.5 per 100,000 population from 1990 to 2019 [7]. Additionally, a health systems evaluation in this region has highlighted a higher prevalence of risk factors for thyroid disease [8]. Specifically, Arab American women demonstrate a heightened risk for thyroid cancer compared to their Caucasian counterparts [9]. Iodine is an essential mineral for the synthesis of thyroid hormones, with adequate intake being crucial for thyroid health. The fortification of table salt with iodine at a concentration of 1.5 grams/kg is recognized as sufficient to meet daily iodine requirements [10]. Deficiencies can lead to symptoms like fatigue, sluggishness, and weight gain [11]. Sadly, thyroid disorders, particularly those related to iodine deficiency, have been a historical concern in North African countries, including Libya. However, the prevalence of these disorders remains inadequately documented, as there have been few studies conducted on the epidemiology of thyroid diseases in Libya [12]. A significant gap exists in the available epidemiological data and interest from local health authorities, leading to a scarcity of relevant statistics and reports from reputable sources such as the World Health Organization (WHO) and the Libyan Ministry of Health [13]. Existing studies have noted limitations in data registries, underscoring the necessity for comprehensive evaluations of the burden and trends of thyroid problems [14]. To improve public health outcomes, it is

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crucial to report the burden of thyroid diseases accurately. Such reporting can assist health policymakers in making informed decisions regarding resource allocation and the development of effective disease control and prevention strategies [15]. The assessment of thyroid health typically involves detailed blood tests that measure levels of thyroid hormones, including TSH (thyroid-stimulating hormone), T4, and T3 [16]. Regular monitoring is essential, as even minor fluctuations in hormone levels can indicate potential thyroid dysfunction [17].

Typically, individuals with normal thyroid function do not require medical intervention. However, when imbalances occur due to stress or illness, healthcare providers may recommend treatment options to restore thyroid homeostasis. Options may involve medications or lifestyle modifications [18]. A healthy thyroid is fundamental for maintaining overall health and physiological balance. Greater awareness of thyroid function and regular monitoring can empower individuals to take proactive measures to support their thyroid health. If there are concerns about thyroid function, it is imperative to consult healthcare professionals for a thorough evaluation and tailored management plan [19]. In Africa, thyroid disorders pose significant public health challenges that often remain underdiagnosed and underreported, owing to various constraints, including limited healthcare resources and sociocultural barriers [20]. This paper aims to explore multiple factors contributing to the prevalence of thyroid disorders in Africa and discuss their health impacts, highlighting the crucial need to address this public health issue [21]. Improved diagnosis and management of thyroid disorders across Africa is achievable through targeted awareness campaigns, enhanced research initiatives, and collaborative healthcare efforts, ultimately enhancing the health and quality of life for those affected [22].

Given the context of Africa, thyroid disorders pose significant health challenges that often remain underdiagnosed and underreported due to various barriers, including limited healthcare resources and social challenges. This paper will further explore the factors contributing to the prevalence of thyroid disorders in Africa, their impacts on health, and the importance of addressing this public health issue.

It is possible to improve the diagnosis and management of thyroid disorders across the country through focused awareness campaigns, research initiatives, and collaborative healthcare efforts, ultimately enhancing the health and quality of life for affected individuals. The study aimed to estimate the burden of thyroid disorder in Tripoli, Libya, clarify the gender differences regarding this disease in Libya, compare Libyans' results with other countries' results, and raise awareness about the effect of diet patterns and iodine consumption on the prevalence of thyroid diseases.

Methods

Study setting

A random sample of 900 patients was collected from the Tripoli Reference Hospital records. Data included patients who regularly visited the Hospital for three months. The study started from late January 2024 to the end of April 2024. Samples were randomly selected by taking data from the hospital's daily records of several infected men and women. The study excluded patients who suffer from thyroid diseases and those who take medications that affect the structure or function of the thyroid gland, as it focused on people who suffer from an enlarged thyroid gland only.

Data collection

Blood samples were collected, and the immunoassay technique was used to calculate the concentration of both thyroxine T4 and triiodothyronine T3, compared with the normal range as the normal range for each of them is (58 to 151 nmol/L) (1.3 to 3.1 nmol/L), respectively. Then, the chemiluminescence immunometric assay technique was used to find hypo- or hyperthyroid cases by measuring the concentration of Thyroid-stimulating hormones (TSH), and its reference range is 0.39–4.6 mIU/L. This is a method provided by Nichols Institute Diagnostics kits, where the concentration of each of these hormones is found by comparing it to a standard curve (logit-log data calculations). The average concentration of these hormones and their standard deviation were collected. The study follows the methods of estimates of the Global Burden of Disease (GBD) Study 2019 to report the prevalence of thyroid disease and its attributable risk factor in Libya by age, sex, and sociodemographic index (SDI) [23].

Statistical analysis

Data were statistically analyzed using Excel 2018 and the SPSS software version 20 [SPSS, Inc., Chicago, IL, USA]. Descriptive statistics expressed as means, standard deviations, and frequency with percentages were calculated for interval and categorical variables. The least significant differences (LSD) test was calculated to evaluate the significance of differences at a p-value< 0.5.

Results

Among 900 cases of different ages who underwent a thyroid screening test by testing both T3, T4, and TSH, the results of this study revealed that 58 women have had hyperthyroidism and 8 women have had

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hypothyroidism. On the other side, 10 men of the sample cases were suffering from high thyroid hormones, and 2 men were suffering from Hypothyroidism (Table 1).

Table 1. The number of hyper and hypothyroid disorder cases.

Category	Women	Men	P value
Number of people with hyperthyroidism disorder	58[a]	10[b]	0.74
Number of people with hypothyroidism disorder	8[a]	2[a]	0.36
Total	66[a]	12[b]	0.76

Different letters (a,b) imply the significant differences in results

The normal range of TSH is 0.4 to 4.0 milli-international Units per liter (mIU/L), and the normal range of T4 is 4.5 to 11.5 micrograms per deciliter (mcg/dL). For T3, the normal range is 70 to 200 nanograms per deciliter (ng/dL). Table 2 presents the levels of the thyroid hormones T4, T3, and TSH in male and female participants in this study, categorized by high and low levels. The values are reported as means with standard deviations, allowing us to compare hormone levels effectively across genders and different categories. The T4 levels are significantly higher in males than in females, indicating a potential gender difference in T4 production or metabolism. Both males and females show a notable increase in T4 levels in the high category, suggesting that males may have a greater physiological capacity for T4 synthesis under normal conditions. The T3 levels illustrate a similar trend, with males having higher levels in both low and high categories. The stark difference in high-level T3 between genders suggests a greater metabolic rate or thyroid activity in males. TSH levels indicate a different pattern, with higher mean levels in females, particularly in the high category. This increase in TSH in females, despite lower T3 and T4 levels, may point to a compensatory mechanism in response to lower thyroid hormone levels or increased demand. Elevated TSH could signify possible thyroid dysfunction or the presence of conditions such as hypothyroidism, where the body is attempting to stimulate more hormone production.
The results of Table 2 and Figure 1 suggest significant gender discrepancies in thyroid hormone levels and potential Hormonal Influence. The higher levels of T4 and T3 in males may reflect different metabolic demands or hormonal influences that could warrant further investigation into the underlying biological mechanisms. In addition, the variation in TSH levels, particularly the heightened levels in females (6.40%), could indicate a higher prevalence of thyroid dysfunction or autoimmune conditions such as Hashimoto's thyroiditis in females, who are typically at greater risk for thyroid disorders.

Table 2. Thyroid hormones T_4, T_3, and TSH levels in the study cases.

Thyroid hormone	Female High level	Female Low level	Male High level	Male Low level
T_4 (mcg/dL)	(155.1 ± 11.28)	(33.70 ± 10.94)	(176.8± 31.0)	(25.50± 6.36)
T_3 (ng/dL)	(4.55 ± 0.584)	(0.750± 0.39)	(7.260± 2.15)	(0.850± 0.495)
TSH (mIU/L)	(11.35 ± 0.084)	(0.0920±0.049)	(8.14± 5.12)	(0.090±0.014)

Results are means and standard deviation (mean ± St Dev)

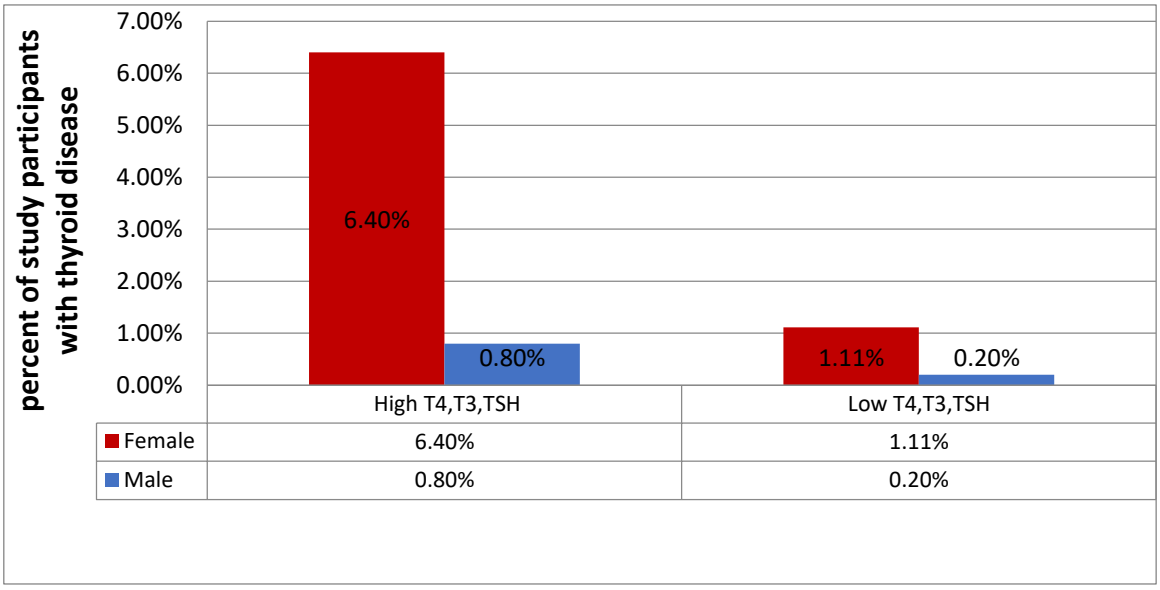

Figure 1. The percentage of thyroid gland disorder prevalence among Libyans

Discussion

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The analysis of thyroid disorder prevalence has shown that systematic factors, classifications of hypothyroidism, and community structures significantly influence reported rates. Variations based on age, race, and gender contribute to the complexity of making direct comparisons across different studies, limiting generalizations about thyroid dysfunction [24,25]. The occurrence and patterns of these disorders are not only affected by genetic predispositions but also by environmental factors such as iodine intake, geographic region, and ethnic background [26].

In the present study, the prevalence of Hashimoto's thyroiditis was found to be 49.18%. This result is consistent with existing research that reports a high hereditary factor in the incidence of the disease. For instance, a study found a 55% incidence rate in monozygotic twins compared to just 3% in dizygotic twins, highlighting the significant roles of genetic factors and environmental influences, alongside sex hormones, in the development of Hashimoto's thyroiditis [27-29]. International research indicates considerable variability in the incidence of Hashimoto's thyroiditis across different populations. For example, a systematic review detailed that the prevalence of Hashimoto's thyroiditis can vary widely, with studies reporting rates from as low as 1% to as high as 15% in certain populations [30]. The current research, which predominantly involved female participants, aligns with findings from Ngo et al. (2014) and Angum et al. (2020), which underscore that those women are disproportionately affected by autoimmune disorders, particularly as they age [30-33].

Furthermore, our results highlight that women are more susceptible to both high and low levels of thyroid hormones compared to men. Specifically, 6.4% of women in our study experienced high thyroid hormone levels, while 0.8% had low levels. In contrast, the corresponding rates for men were considerably less, with only 1.11% exhibiting high levels and 0.2% showing low levels [34]. This gender disparity in thyroid dysfunction susceptibility emphasizes the necessity for tailored approaches in the diagnosis and management of thyroid disorders among different demographic groups. Thus, while our study corroborates existing literature on Hashimoto's thyroiditis and its prevalence concerning gender, it also provides new insights into the gender-specific patterns of thyroid hormone secretion, which could inform future research and clinical practice [35-7].

Conclusion

The findings of this study displayed that the disease, as it is common worldwide, is widely spread in Libya. This disease is considered an increasing risk among Libyans, especially women. Inadequate awareness of the incidence of this disease can lead to delayed treatment and subsequent thyroid deterioration and failure. These results emphasize the need for more detailed investigations into the factors influencing thyroid function by gender, considering genetic and environmental determinants.

In conclusion, this study lays the groundwork for understanding thyroid hormone dynamics within the studied population and highlights the importance of gender differences in metabolic and hormonal responses to thyroid function.

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Conflict of Interest

There are no financial, personal, or professional conflicts of interest to declare.

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