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Prevalence of Thyroid Dysfunction in Children and Adolescents in Tobruk City, Libya

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ABSTRACT

Background: Thyroid disorders are among the most common endocrine diseases in children, with hypothyroidism—both congenital and acquired—being the predominant type. However, most existing studies have been hospital-based, potentially overestimating prevalence and lacking generalizability to the community level. Aim: This study aimed to determine the prevalence and gender distribution of thyroid dysfunction among tested children and adolescents in Tobruk, Libya. Methods: A retrospective review was conducted on 234 pediatric cases who underwent thyroid function testing at medical centers in Tobruk. Data on age, gender, and thyroid hormone levels (TSH, FT3, and FT4) were analyzed to identify the frequency and pattern of thyroid dysfunctions. Descriptive statistics and correlation analyses were performed to assess relationships among variables. Results: The majority of the study population was euthyroid (97.9%), while only 2.1 % exhibited thyroid dysfunction. Five cases were identified with abnormal thyroid profiles—three with hyperthyroidism and two with primary hypothyroidism—without any recorded cases of subclinical or secondary hypothyroidism. Although thyroid disorders were slightly more frequent among females, the gender difference was not statistically significant. Weak positive correlations were observed between age and certain thyroid parameters, particularly among adolescents. Conclusion: The findings indicate a remarkably low prevalence of thyroid disorders among tested children and adolescents and that further community-based studies are required to determine true prevalence. contrasting with higher rates reported in hospital-based studies from other regions. The absence of significant gender differences and the predominance of euthyroid cases suggest that thyroid dysfunction is not a major public health concern in this setting. Nevertheless, targeted screening for high-risk groups—such as children with autoimmune conditions or developmental delays—remains essential. Future prospective research incorporating antibody testing and neonatal screening data is recommended to validate these findings and explore regional variations in thyroid health among Libyan children.

1. INTRODUCTION

Thyroid disorders in children and adolescents represent a diverse group of endocrine conditions that vary in etiology, presentation, and prevalence across populations. Autoimmune thyroid diseases (AITD) are recognized as the most common acquired forms of thyroid dysfunction in childhood.

Brown (2013) emphasized that autoimmune thyroiditis (AIT) arises from a complex interaction between genetic susceptibility and environmental triggers, leading to gradual immune-mediated destruction of the thyroid gland. The condition most often manifests during adolescence, with hypothyroidism being the typical clinical outcome, and is diagnosed by the presence of thyroid peroxidase (TPO) and thyroglobulin (Tg) antibodies (Amr, 2018). Similarly, Cappa et al. (2011) described AITD—particularly Graves' disease and AIT—as the predominant cause of acquired thyroid disorders in children. They highlighted the need for early recognition, careful selection of pharmacological therapy (favoring Methimazole), and lifelong follow-up due to the chronic nature of these diseases (Cappa et al., 2011). These studies underline the autoimmune basis of most childhood thyroid dysfunctions and the importance of vigilant screening for early management. Beyond autoimmune causes, several studies have demonstrated the prevalence of hypothyroidism, both congenital and acquired, as the leading thyroid disorder in pediatric populations. Shah et al. (2013) found that among 50 children investigated for thyroid dysfunction, 37.5% had subclinical or acquired hypothyroidism, while 25% were diagnosed with congenital hypothyroidism, underscoring the necessity of early hormonal screening to prevent irreversible developmental damage. Similar findings were reported by Singh et al. (2016) in India, where hypothyroidism accounted for 93.8% of cases, with short stature and lethargy being the most common presenting symptoms. Yelluri (2016) also reported acquired hypothyroidism (47.2%) as the most frequent diagnosis, followed by congenital hypothyroidism and goiter, with a clear female predominance. These studies consistently point to hypothyroidism as the most prevalent thyroid abnormality in children and emphasize the value of early detection to prevent long-term complications. Studies from different regions have also shown important associations between thyroid disorders and other pediatric conditions. Kartal et al. (2016) examined children with vitiligo and found thyroid abnormalities in 22% of cases, particularly among those with non-segmental vitiligo, suggesting that autoimmune mechanisms may link the two disorders and justifying thyroid screening in such patients. Likewise, Oyenusi et al. (2017) identified congenital hypothyroidism as the most common thyroid condition (46.7%) among Nigerian children, frequently associated with Down syndrome and delayed diagnosis, and therefore called for routine newborn screening to mitigate developmental impairment. These findings indicate that thyroid disease in children often coexists with other autoimmune or genetic conditions, reinforcing the argument for targeted screening strategies. More recent large-scale studies have expanded the understanding of the pediatric thyroid disease spectrum. Al-Qahtani et al. (2023) reviewed seven years of cases from a Saudi Arabian endocrine clinic and confirmed acquired hypothyroidism as the most prevalent thyroid disorder, followed by congenital hypothyroidism, with a marked female predominance. Sosnowska-Sienkiewicz et al. (2024), focusing on surgically managed thyroid diseases, reported that thyroid cancer was present in 54.7% of pediatric thyroidectomies. They emphasized that while surgical outcomes were generally safe, transient hypoparathyroidism remained a notable complication, highlighting the importance of specialized surgical expertise and multidisciplinary care. Together, these findings portray a global pattern where hypothyroidism—especially autoimmune and congenital forms—dominates pediatric thyroid pathology, though regional variations exist in presentation and management approaches. The reviewed literature reveals that thyroid disorders in children are predominantly hypothyroid in nature—either congenital or acquired—with autoimmune thyroiditis being the leading cause in older age groups and a consistent female predominance across most studies (Singh et al., 2016; Shah et al., 2013; Al-Qahtani et al., 2023; Brown, 2013; Yelluri, 2016; Cappa et al., 2011; Kartal et al., 2016; Oyenusi et al., 2017). However, much of the existing evidence originates from tertiary hospitals or specialized endocrine clinics, where referral bias tends to inflate prevalence estimates and limit generalizability to the wider community. Furthermore, few studies have provided population-based data from North Africa, particularly Libya, where iodine status, screening practices, and environmental factors may differ substantially from other regions.

Therefore, the current study was designed to address this research gap by determining the prevalence and gender distribution of thyroid disorders among children and adolescents in Tobruk, providing region-specific data that can inform local screening and public health strategies.

Aim: This study aimed to determine the prevalence and gender distribution of thyroid disorders among children and adolescents.

2. METHOD

This study was a retrospective, descriptive analysis conducted in Tobruk City. Medical records of 234 children aged 1 day to 14 years, registered between January 2024 and December 2024, were reviewed. Of the participants, 127 were female and 107 were male.

Blood samples were collected from all participants, and serum concentrations of thyroid-stimulating hormone (TSH), triiodothyronine (T3), and thyroxine (T4) were measured to assess thyroid function. Patients were classified as euthyroid, hyperthyroid, or hypothyroid (primary, secondary, or subclinical) based on standard laboratory reference ranges

3. ETHIC APPROVAL

This study was conducted following ethical approval from the Institutional Review Board of Tobruk Medical Center (Ethical Approval Number: NBC:009. H.25.2). due to the retrospective nature of research, the committee granted waiver of the requirement for individual informed consent. To protect patient privacy, all data were fully anonymized and de-identified prior to analysis. The confidentiality of the patient's information was strictly maintained and the data were used exclusively for research purpose.

inclusion. The study adhered to ethical principles for research involving human participants, ensuring confidentiality and the right to withdraw at any time.

4. RESULT

Statistical Analysis

All statistical analyses were performed using R software (version 4.3.3). Continuous variables were summarized using mean and standard deviation, with medians and ranges also reported to provide a comprehensive description. Categorical variables were summarized using frequencies and percentages.

Comparisons of continuous variables between males and females were conducted using Mann Whitney u test, after assessing the data for normal distribution. The association between categorical variables, such as sex and thyroid status, was evaluated using the Chi-square test.

Age groups were categorized as follows: Infants (0–1 years), Early Childhood (2–5 years), School Age (6–10 years), and Adolescents (11–14 years). Thyroid function was classified according to established reference ranges: TSH (0.3–4.0 mIU/L), FT3 (1.4–4.2 pg/mL), and FT4 (0.8–2.0 ng/dL). A p-value of <0.05 was considered statistically significant for all analyses, and all tests were two-tailed. Continuous variables are presented as mean ± standard deviation, while categorical variables are presented as frequencies and percentages.

Normal distribution Test

The results of the Kolmogorov–Smirnov test (Table X) indicated that the distributions of TSH, T3, and T4 values significantly deviated from normality ($p < .001$ for all variables). These findings suggest that the data are not normally distributed, thereby justifying the use of nonparametric statistical methods, such as the Mann–Whitney U test.

Table: Kolmogorov–Smirnov normality test

Variable	Statistic	df	Sig.	Interpretation
TSH	0.131	234	0.000	Not normally distributed
T3	0.111	234	0.000	Not normally distributed
T4	0.346	234	0.000	Not normally distributed

1. Study Population Characteristics

A total of 533 records were initially reviewed. Of these, 324 participants were aged 0 months to 14 years, and 234 participants aged 1 month to 14 years were included in the final analysis. Thus, the study population comprised 234 children.

The sex distribution included 127 females (54.3%) and 107 males (45.7%). The overall mean age was 6.8 ± 4.6 years. Females had a slightly higher mean age of 7.5 ± 4.8 years, compared to 6.0 ± 4.2 years among males (Table 1).

Table 1. Demographic Characteristics of Study Population(n=223)

Gender	Count	Percentage (%)	Age in years (Mean ± SD)
Female	127	54.3	7.5 ± 4.8
Male	107	45.7	6.0 ± 4.2

2. Age and Gender Distribution

When stratified by age group, school-aged children (6–10 years) comprised the largest subgroup, with 73 participants (31.2%), followed by early childhood (2–5 years) with 67 participants (28.6%), and adolescents (11–14 years) with 58 participants (24.8%). Infants (0–1 year) accounted for 36 participants (15.4%).

Female participants outnumbered males in all age categories, except in the early childhood group, where males were slightly more prevalent (Table 2).

Table 2. Distribution by Age Groups and Gender

Age Group	Female	Male	Total	Percentage (%)
Infants (0-1y)	18	18	36	15.4
Early Childhood (2-5y)	30	37	67	28.6
School Age (6-10y)	37	36	73	31.2
Adolescents (11-14y)	42	16	58	24.8

3. Pattern of Thyroid Disorders

Out of the 234 children included in the study, 229 (97.86%) were euthyroid. Thyroid disorders were uncommon, with only 3 cases (1.28%) of hyperthyroidism and 2 cases (0.85%) of primary hypothyroidism identified. No cases of subclinical or secondary hypothyroidism were observed (Table 3).

These findings indicate that the vast majority of children and adolescents in this cohort had normal thyroid function, with thyroid dysfunction affecting less than 1% of the study population.

Table 3. Pattern of Thyroid Disorders

Thyroid Status	Count	Prevalence (%)
Euthyroid	229	97.86
Hyperthyroidism	3	1.28
Primary Hypothyroidism	2	0.85
Subclinical Hypothyroidism	0	0.00
Secondary Hypothyroidism	0	0.00

4. Distribution of Thyroid Disorders by Gender

When analyzed by gender, thyroid disorders were slightly more common among females than males, although this difference was not statistically significant ($p = 0.276$). Among female participants (n = 127), 123 (96.9%) were euthyroid, 3 (2.4%) had hyperthyroidism, and 1 (0.8%) had primary hypothyroidism.

Among male participants (n = 107), 106 (99.1%) were euthyroid, and 1 (0.9%) had primary hypothyroidism, with no cases of hyperthyroidism observed.

Overall, 229 participants (97.9%) were euthyroid, 3 (1.3%) had hyperthyroidism, and 2 (0.9%) had primary hypothyroidism (Table 4). These findings indicate that thyroid dysfunction was rare in both genders, with a slightly higher prevalence among females.

Table 4. Distribution of Thyroid Disorders by Gender

Gender	Euthyroid	Hyperthyroidism	Primary Hypothyroidism	*P-value
Female	123 (96.9%)	3 (2.4%)	1 (0.8%)	0.276
Male	106 (99.1%)	0 (0.0%)	1 (0.9%)	
Total	229 (97.9%)	3 (1.3%)	2 (0.9%)	

Using Chi-Square

5. Distribution of Thyroid Disorders by Age Group

When stratified by age group, thyroid disorders were more frequently observed among older children. All infants (0–1 year, n = 36) and children in early childhood (2–5 years, n = 67) were euthyroid.

In the school-age group (6–10 years, n = 73), 71 children (97.3%) were euthyroid, while 1 (1.4%) had hyperthyroidism and 1 (1.4%) had primary hypothyroidism. Among adolescents (11–14 years, n = 58), 55 (94.8%) were euthyroid, 2 (3.4%) had hyperthyroidism, and 1 (1.7%) had primary hypothyroidism.

Overall, 229 participants (97.9%) were euthyroid, 3 (1.3%) had hyperthyroidism, and 2 (0.9%) had primary hypothyroidism (Table 5). These results indicate that thyroid dysfunction was rare across all age groups but slightly more prevalent in older children and adolescents.

Table 5. Distribution of Thyroid Disorders by Age Group

Age Group	Euthyroid	Hyperthyroidism	Primary Hypothyroidism	Total
Infants (0–1y)	36 (100.0%)	0 (0.0%)	0 (0.0%)	36
Early Childhood (2–5y)	67 (100.0%)	0 (0.0%)	0 (0.0%)	67
School Age (6–10y)	71 (97.3%)	1 (1.4%)	1 (1.4%)	73
Adolescents (11–14y)	55 (94.8%)	2 (3.4%)	1 (1.7%)	58
Total	229 (97.9%)	3 (1.3%)	2 (0.9%)	234

6. Thyroid Hormone Levels by Gender

The Mann–Whitney U test results (Table X) showed no statistically significant gender differences in thyroid hormone levels. The comparison of thyroid hormone levels between genders revealed no statistically significant differences. The median serum TSH level was 2.31 mIU/L (IQR: 1.35-3.28) in females and 2.48 mIU/L (IQR: 1.61-4.07) in males ($p = 0.176$). Similarly, median FT3 was 2.30 pg/ml (IQR: 1.89-2.87) in females and 2.33 pg/ml (IQR: 1.92-2.88) in males ($p = 0.945$), while median FT4 was 8.71 ng/dl (IQR: 7.47-10.71) in females and 9.06 ng/dl (IQR: 7.35-10.71) in males ($p = 0.717$). None of these differences reached statistical significance using the Mann-Whitney U test (Table 6).

Table 6. Thyroid Hormone Levels by Gender (Median ± IQR)

Parameter	Female	Male	*P-value
TSH (mIU/L)	2.31 (1.35-3.28)	2.48 (1.61-4.07)	0.176
FT3 (pg/ml)	2.3 (1.89-2.87)	2.33 (1.92-2.88)	0.945
FT4 (ng/dl)	8.71 (7.47-10.71)	9.06 (7.35-10.71)	0.717

**Using Mann-Whitney U Test*

7. Overall Descriptive Statistics of Thyroid Hormones

Descriptive statistics for thyroid hormone levels are presented in Table 7. The mean serum TSH level was 3.89 ± 9.69 mIU/L, with a median of 2.39 mIU/L and a wide range from 0.00 to 100.00 mIU/L, indicating a markedly skewed distribution (skewness = 8.58) due to the presence of outliers.

For FT3, the mean was 2.43 ± 1.00 pg/mL, the median was 2.32 pg/mL, and values ranged from 0.27 to 10.00 pg/mL (skewness = 3.69). The mean FT4 level was 9.13 ± 2.84 ng/dL, with a median of 8.83 ng/dL, ranging from 0.42 to 24.86 ng/dL, showing moderate skewness (skewness = 1.83).

These results highlight variability in thyroid hormone levels within the study population, with TSH demonstrating the greatest dispersion and skewness.

Table 7. Descriptive Statistics of Thyroid Hormone Levels

Hormone	Mean	Std. Dev.	Median	Min	Max	Skew
TSH (mIU/L)	3.89	9.69	2.39	0.00	100.00	8.58
FT3 (pg/ml)	2.43	1.00	2.32	0.27	10.00	3.69
FT4 (ng/dl)	9.13	2.84	8.83	0.42	24.86	1.83

Reference Ranges:

- TSH: 0.3–4.0 mIU/L
- FT3: 1.4–4.2 pg/ml
- FT4: 0.8–2.0 ng/dl

Demographic Indication

The study population showed a slight female predominance, with 127 females (54.3%) compared to 107 males (45.7%). Age distribution revealed that the largest subgroup was school-aged children (6–10 years), comprising 73 participants (31.2%). The remaining participants were distributed as follows: early childhood (2–5 years, 67 cases), adolescents (11–14 years, 58 cases), and infants (0–1 year, 36 cases).

This distribution indicates a higher representation of children in the early childhood and school-age groups, providing important demographic context for interpreting the study findings.

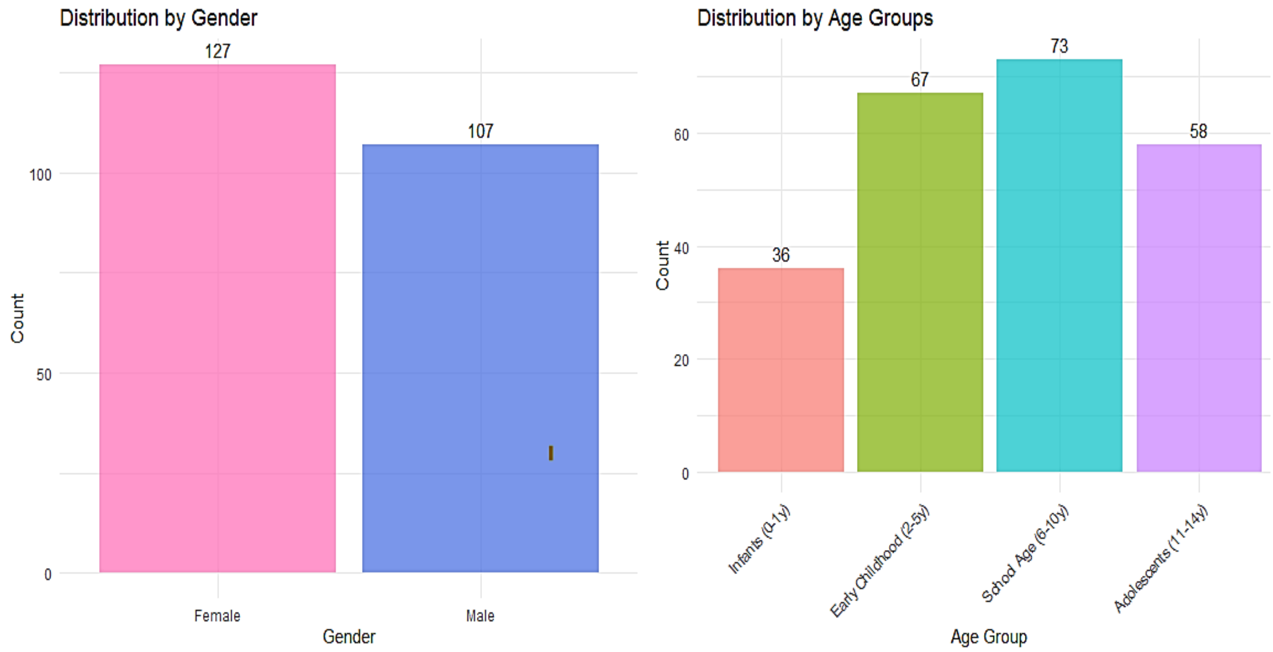

Fig.1: Demographic Distribution of the Study Population by Gender and Age Groups

Pattern and Gender Distribution

Assessment of thyroid function in this pediatric cohort revealed that the vast majority of participants were euthyroid (n = 229, 97.9%). The overall prevalence of thyroid disorders was low, with hyperthyroidism detected in 3 children (1.3%) and primary hypothyroidism diagnosed in 2 children (0.9%). Gender-based analysis showed a similar distribution of thyroid statuses between females and males.

These findings indicate that thyroid dysfunction is uncommon among children and adolescents in Tobruk City. The low prevalence observed provides a baseline for understanding thyroid health in this population and underscores the importance of targeted screening and early detection strategies, particularly for high-risk groups.

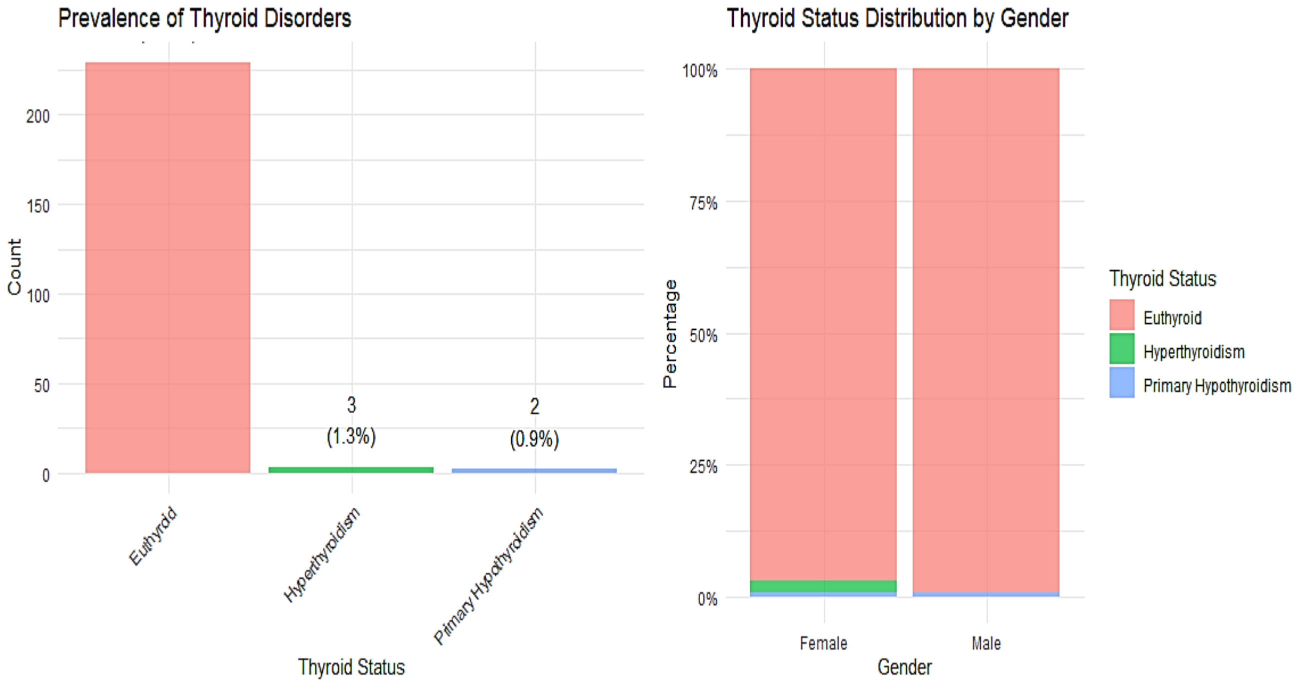

Fig.2: Prevalence and Gender Distribution of Thyroid Disorders Among the Study Population

Gender-Specific Analysis of Thyroid Hormone Levels

Analysis of thyroid hormone levels by gender revealed notable trends across TSH, FT3, and FT4. Median TSH levels were higher in females (median 1.2 mIU/L) compared to males (median 0.6 mIU/L), with several female values in the upper range, including outliers exceeding 5.0 mIU/L. This suggests potential sex-based differences in thyroid regulation.

In contrast, FT3 levels showed minimal intergender variation: females had a median of 2.8 pg/mL, while males had a median of 2.6 pg/mL, with overlapping interquartile ranges (IQR: 2.2–3.2 pg/mL for females; 2.3–2.9 pg/mL for males). FT4 levels demonstrated similar central tendencies, with both genders clustering around a median of approximately 1.1 ng/dL (females: median 1.1, IQR 0.9–1.3; males: median 1.0, IQR 0.9–1.2). Females exhibited slightly wider dispersion, with a few outliers above 1.8 ng/dL.

Notably, 75% of female participants had TSH values below 1.8 mIU/L, whereas male TSH levels were more evenly distributed within the reference range (0.3–4.0 mIU/L). Overall, the majority of hormone levels fell within established pediatric reference ranges (TSH: 0.3–4.0 mIU/L; FT3: 1.4–4.2 pg/mL; FT4: 0.8–2.0 ng/dL), indicating that most participants were euthyroid.

These findings emphasize the importance of considering gender-specific differences in thyroid function assessments, particularly in pediatric populations where hormonal dynamics may differ from those in adults.

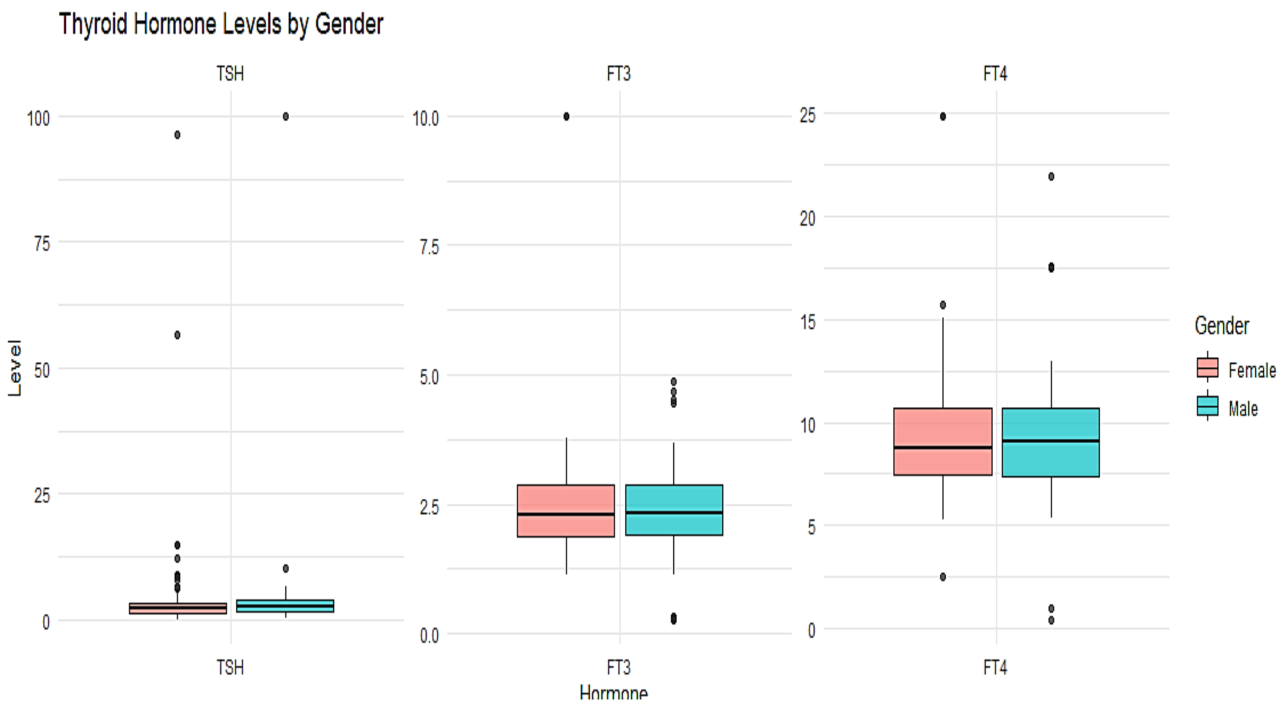

Fig.3: Gender-Specific Patterns in Thyroid Hormone Levels Among Pediatric Patients

Correlation Analysis Between Age and Thyroid Hormone Levels

Correlation analysis was conducted to evaluate the relationships between age and thyroid hormone parameters (TSH, FT3, and FT4) in the study population. Pairwise correlation coefficients were visualized using a heatmap, with color intensity indicating the strength and direction of associations (ranging from –1, strong negative, to +1, strong positive).

A weak positive correlation was observed between age and TSH ($r = 0.2$), suggesting a slight tendency for TSH levels to increase with age. Similarly, age demonstrated a modest positive association with FT3 ($r \approx 0.15$), while the correlation between age and FT4 was negligible ($r \approx 0.02$), indicating no meaningful relationship.

FT4 showed strong negative correlations with both TSH ($r = –0.7$) and FT3 ($r = –0.6$), highlighting an inverse relationship between free thyroxine and the other thyroid markers. Additionally, TSH and FT3 exhibited a moderate positive correlation ($r = 0.4$), consistent with expected physiological feedback mechanisms.

Overall, correlation coefficients ranged from low to moderate, indicating that age is not a major determinant of thyroid hormone levels in this cohort. These findings align with the minimal age-related variation observed in thyroid function, supporting the stability of hormonal profiles across developmental stages.

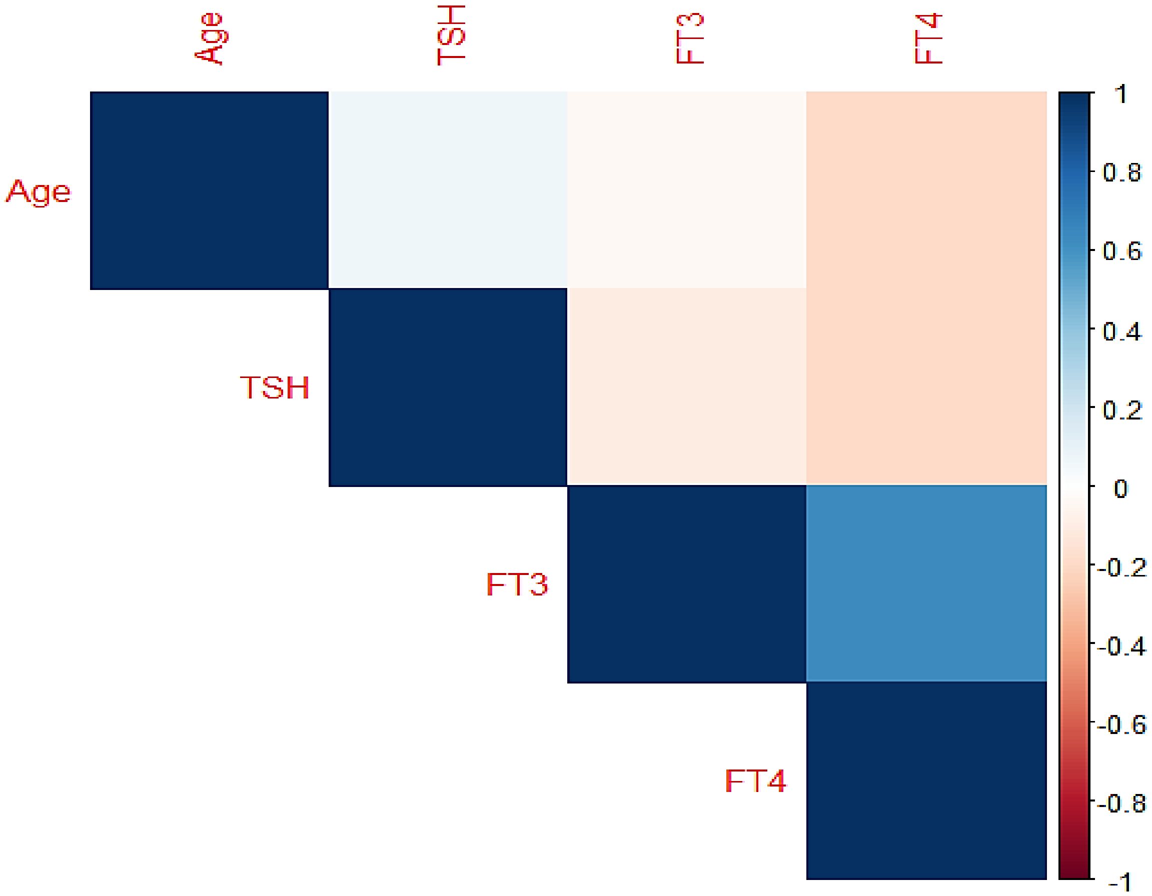

Fig.4: Correlation Matrix of Age and Thyroid Hormone Para

- **Study Population**
  1. Total records reviewed: 533; final included participants: 234 (aged 1 month–14 years).
  2. Gender distribution: 127 females (54.3%) and 107 males (45.7%).
  3. Overall mean age: 6.8 ± 4.6 years; females: 7.5 ± 4.8 years; males: 6.0 ± 4.2 years.
- **Age Distribution**
  1. Infants (0–1 year): 36 participants (15.4%).
  2. Early childhood (2–5 years): 67 participants (28.6%).
  3. School age (6–10 years): 73 participants (31.2%).
  4. Adolescents (11–14 years): 58 participants (24.8%).
  5. Females predominated in all age groups except early childhood.
- **Pattern of Thyroid Disorders**
  1. Euthyroid: 229 participants (97.9%).
  2. Hyperthyroidism: 3 participants (1.3%).
  3. Primary hypothyroidism: 2 participants (0.9%).
  4. No cases of subclinical or secondary hypothyroidism were observed.
- **Gender-Specific Thyroid Disorders**
  1. Females: 123 euthyroid (96.9%), 3 hyperthyroid (2.4%), 1 primary hypothyroid (0.8%).
  2. Males: 106 euthyroid (99.1%), 1 primary hypothyroid (0.9%), no hyperthyroidism.
  3. Differences were not statistically significant ($p = 0.276$).

- **Age-Specific Thyroid Disorders**
    1. Infants and early childhood: all euthyroid.
    2. School age: 71 euthyroid (97.3%), 1 hyperthyroid (1.4%), 1 primary hypothyroid (1.4%).
    3. Adolescents: 55 euthyroid (94.8%), 2 hyperthyroid (3.4%), 1 primary hypothyroid (1.7%).
- **Thyroid Hormone Levels by Gender**
    1. No statistically significant differences between genders.
- **Overall Thyroid Hormone Descriptive Statistics**
    1. TSH: mean 3.89 ± 9.69 mIU/L, median 2.39, range 0–100 mIU/L, skewness 8.58.
    2. FT3: mean 2.43 ± 1.00 pg/mL, median 2.32, range 0.27–10.00 pg/mL, skewness 3.69.
    3. FT4: mean 9.13 ± 2.84 ng/dL, median 8.83, range 0.42–24.86 ng/dL, skewness 1.83.
- **Gender-Specific Hormone Trends**
    1. Females had slightly higher median TSH (1.2 mIU/L) than males (0.6 mIU/L), with a few outliers above 5.0 mIU/L.
    2. FT3 and FT4 showed minimal gender differences; both medians fell within reference ranges.
    3. Majority of participants were euthyroid, regardless of gender.
- **Correlation Between Age and Thyroid Hormones**
    1. Age and TSH: weak positive correlation ($r = 0.2$).
    2. Age and FT3: modest positive correlation ($r \approx 0.15$).
    3. Age and FT4: negligible correlation ($r \approx 0.02$).
    4. FT4 inversely correlated with TSH ($r = –0.7$) and FT3 ($r = –0.6$).
    5. TSH and FT3: moderate positive correlation ($r = 0.4$).
    6. Overall, age had minimal impact on thyroid hormone levels.

5 Discussion

The present cross-sectional, retrospective review of 234 children in Tobruk reported an overwhelmingly euthyroid population (97.9%) with an overall thyroid dysfunction prevalence of 0.9%, a small female predominance that was not statistically significant, and a tendency for abnormalities to appear more often in school-age children and adolescents. These results contrast sharply with several hospital-based series from other regions that report much higher rates of thyroid dysfunction and a predominance of hypothyroidism; for example, Singh et al. (2016) found a very high proportion of hypothyroidism among children at a tertiary center in western India, and Shah et al. (2013) reported a substantial yield of subclinical and acquired hypothyroidism in a smaller screened sample. Similarly, recent experience from a Saudi teaching hospital described acquired hypothyroidism as the commonest disorder in pediatric endocrine clinics (Al-Qahtani et al., 2023; Vaisman et al., 2011). The discrepancy is likely multifactorial—differences in study setting (community/registry versus tertiary referral), case-finding methods (routine screening vs. symptomatic presentation), and population risk factors (iodine status, neonatal screening coverage, or local autoimmune prevalence) can all inflate prevalence estimates in hospital samples relative to community samples such as the Tobruk cohort.

Gender and age patterns in the Tobruk data also deserve comparison. Although the current study showed only a slight, non-significant female predominance and weak positive correlations between age and some hormone levels, many prior reports document stronger female predominance and adolescent peaks for autoimmune conditions. Reviews and large series emphasize that autoimmune thyroid disease (Graves' disease and autoimmune thyroiditis) commonly presents in adolescence and disproportionately affects females (Amr, 2018; Cappa et al., 2011; Yahyia & Yahmed, 2022; Moleti et al., 2023). Likewise, population studies from India and other settings reported higher rates in females and more symptomatic presentations with growth or development concerns in younger children (Singh et al., 2016; Yelluri, 2016). The Tobruk findings therefore align with the literature in identifying adolescence as a higher-risk period, but they differ in magnitude of sex differences—a plausible explanation being that autoimmune and congenital etiologies (which drive female excess) were uncommon or under-ascertained in this sample.

Regarding the type and clinical implications of detected disorders, the Tobruk review found three hyperthyroid and two primary hypothyroid cases with no subclinical or secondary hypothyroidism recorded. This contrasts with several studies where acquired or subclinical hypothyroidism formed a substantial component of pediatric thyroid disease (Shah et al., 2013; Al-Qahtani et al., 2023; Yelluri, 2016; Hong et al., 2017). The literature also highlights important comorbid patterns (for example, associations between vitiligo and thyroid autoimmunity [Kartal et al., 2016]) and the need for targeted screening in high-risk groups; by contrast, the low prevalence in Tobruk suggests that universal pediatric screening in this community might yield few new cases, but targeted approaches (newborn screening, children with other autoimmune diseases, or those with growth/neurological signs) remain justified and are supported by prior recommendations (Shah et al., 2013; Brown, 2013; Roberta et al., 2018; Moleti et al., 2023). In short, while the Tobruk data are reassuring regarding population prevalence, they reinforce the literature's message to prioritize screening where pretest probability is higher.

Finally, comparing methodologies and implications clarifies how these findings should guide practice and future research. Many of the higher-prevalence studies were hospital-based or specialty clinic series and therefore subject to referral bias; the Tobruk study's broader sampling provides useful community-level context but is limited by retrospective design and lack of antibody testing or neonatal screening data, which would better identify autoimmune or congenital cases and explain age-related trends (Singh et al., 2016; Shah et al., 2013; Cappa et al., 2011). Clinically, the Tobruk results support sustained vigilance (particularly in adolescents and symptomatic children) rather than blanket population screening in similar settings, and they argue for prospective studies including antibody assays and neonatal screening status to reconcile the regional differences reported in the literatur**e.**

6. CONCLUSION

The present study provides valuable epidemiological insight into the thyroid health status of children in Tobruk, revealing a remarkably low prevalence of thyroid dysfunction and a predominantly euthyroid pediatric population. These findings stand in contrast to several hospital-based studies from other regions that reported higher rates of both overt and subclinical hypothyroidism, largely due to differences in setting, case selection, and diagnostic coverage.

The weak gender differences and minimal age associations observed in the Tobruk cohort further suggest that widespread thyroid disorders are not a major concern in this community at present. However, the identification of a few hyperthyroid and hypothyroid cases underscores the importance of maintaining targeted screening for high-risk groups, such as children with autoimmune diseases, growth abnormalities, or developmental delays. Overall, the study highlights the need for larger, prospective research including thyroid antibody testing and neonatal screening data to confirm these reassuring findings and to better understand the regional variations in pediatric thyroid disease prevalence.

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