Prevalence and Risk Factors of Thyroid Dysfunction in Pregnant Women During the First Trimester at Da Nang Hospital for Women and Children

Lan ThiNgoc Vu[1], Thuy Chung Bui[2], Hang ThiLe Tran[2], Thuy Thi Le[1]*

ABSTRACT

Background: Thyroid dysfunction during pregnancy, particularly in the first trimester, poses risks to maternal and fetal health, including neurodevelopmental impairments and obstetric complications. Early detection is critical to mitigate adverse outcomes. ***Methods:*** A cross-sectional study was conducted from December 2023 to March 2024 at Da Nang Hospital for Women and Children, involving 282 pregnant women in their first trimester (6–13 weeks). Serum thyroid-stimulating hormone (TSH) and free thyroxine (FT4) levels were measured, with reference ranges of 0.1–4.0 mIU/L for TSH (American Thyroid Association [ATA] 2017) and 0.93–1.71 ng/dL for FT4 (hospital standard). Thyroid dysfunction was classified as clinical/subclinical hypothyroidism, clinical/subclinical hyperthyroidism, or isolated hypothyroxinemia. Risk factors (age, BMI, obstetric history, personal/family thyroid disease history) were analyzed using SPSS 20.0, with chi-square tests, Fisher's exact test, and odds ratios (OR) at $p < 0.05$. ***Results:*** Thyroid dysfunction prevalence was 15.25% (43/282), with subclinical hyperthyroidism (6.03%), isolated hypothyroxinemia (4.26%), clinical hyperthyroidism (2.84%), subclinical hypothyroidism (2.13%), and clinical hypothyroidism (0.35%). Significant risk factors included personal history of thyroid disease (OR = 6.29, 95% CI: 1.93–20.57, p = 0.004) and family history of thyroid disease (OR = 3.68, 95% CI: 1.36–9.96, p = 0.014). No significant associations were found with age >30 years (p = 0.586), BMI ≥23 kg/m² (p = 0.09), or abnormal obstetric history (p = 0.338). ***Conclusion:*** Thyroid dysfunction affects 15.25% of first-trimester pregnant women in Da Nang, with subclinical hyperthyroidism being most common. Personal and family history of thyroid disease are significant risk factors, supporting targeted screening in high-risk groups to improve maternal and fetal outcomes.

Keywords: *Thyroid Dysfunction, Pregnancy, First Trimester, TSH, FT4, Risk Factors*

[1] *Da Nang University of Medical Technology and Pharmacy, Da Nang, Vietnam*
[2] *Da Nang Hospital for Women and Children, Da Nang, Vietnam*

*** Corresponding author**
Thuy Thi Le
Email: lethithuy@dhktyduocdn.edu.vn

Received: November 28, 2024
Reviewed: November 30, 2024
Accepted: December 17, 2024

INTRODUCTION

Thyroid dysfunction is a common endocrine disorder in pregnancy, affecting maternal and fetal health [1]. Physiological changes in pregnancy, such as increased thyroid volume (10–30%), elevated thyroxine-binding globulin (TBG), and human chorionic gonadotropin (hCG)-induced suppression of thyroid-stimulating hormone (TSH), alter thyroid function, necessitating pregnancy-specific reference ranges [2,3]. Thyroid hormones are critical for fetal neurodevelopment, particularly in the first trimester when the fetus relies entirely on

maternal thyroxine [4]. Untreated thyroid dysfunction is associated with adverse outcomes, including spontaneous abortion, preterm birth, preeclampsia, and neurodevelopmental deficits in offspring [5,6].

The American Thyroid Association (ATA) 2017 guidelines define thyroid dysfunction in pregnancy as clinical/subclinical hypothyroidism, clinical/subclinical hyperthyroidism, or isolated hypothyroxinemia, based on TSH (0.1 – 4.0 mIU/L) and free thyroxine (FT4) levels [7]. Globally, prevalence varies due to differences in diagnostic criteria, iodine status, and population characteristics, ranging from 10.4% in India to 39.48% in Nepal [8,9]. In Vietnam, studies report prevalence of 17.03 – 38.5%, but data from the Central region are lacking [10,11].

This study aims to determine the prevalence of thyroid dysfunction in first-trimester pregnant women at Da Nang Hospital for Women and Children and identify associated risk factors. The findings may inform screening strategies to reduce maternal and fetal complications in Vietnam.

MATERIALS AND METHOD

Study Design

A cross-sectional study was conducted from December 1, 2023, to March 31, 2024, at the Obstetrics Clinic, Department of Emergency and General Examination, Da Nang Hospital for Women and Children.

Participants

The study included 282 pregnant women aged ≥ 16 years in their first trimester (6 – 13 weeks), with singleton pregnancies conceived naturally.

Inclusion criteria:

- Singleton, viable pregnancy.
- Gestational age 6 – 13 weeks, determined by last menstrual period (LMP) for regular cycles or ultrasound for irregular cycles.
- Consent to participate.

Exclusion criteria:

- Pregnancies via assisted reproductive techniques (IUI, IVF).
- Acute illnesses (e.g., infections, liver/renal failure).
- Pre-existing diagnosed thyroid disease treated with thyroid-affecting medications (e.g., levothyroxine, antithyroid drugs).
- Use of medications affecting thyroid function (e.g., amiodarone, lithium, corticosteroids).

Sampling method: Convenience sampling, including all eligible women during the study period.

Sample Size

Sample size was calculated using the formula for estimating a proportion:

$$n = \frac{Z^2_{1-\frac{\alpha}{2}} P(1-P)}{d^2}$$

With: (Z = 1.96) (95% confidence), (P = 0.38) (prevalence from Do Thi Tuyet Nhung [10]), (d = 0.1) (relative error). The minimum sample size was 90, adjusted to 95 for 5% loss. The study enrolled 282 participants.

Data Collection

Serum TSH and FT4 levels were measured at the Biochemistry Laboratory using standardized assays. TSH reference range was 0.1 – 4.0 mIU/L (ATA 2017 [7]); FT4 range was 0.93 – 1.71 ng/dL (hospital standard). Thyroid dysfunction was classified per Table 1. Demographic and clinical data (age, pre-pregnancy BMI, obstetric history, personal/family thyroid disease history) were collected via questionnaires. BMI was categorized using

WHO Asia-Pacific guidelines: normal (18.5 – 22.9 kg/m²), overweight/obese (≥ 23 kg/m²) [12].

Table 1. Diagnostic Criteria for Thyroid

Condition	TSH (mIU/L)	FT4 (ng/dL)
Clinical Hypothyroidism	>4.0	<0.93
Subclinical Hypothyroidism	>4.0	0.93–1.71
Clinical Hyperthyroidism	<0.1	>4.0
Subclinical Hyperthyroidism	<0.1	0.93–1.71
Isolated Hypothyroxinemia	0.1–4.0	<0.93

Data Analysis

Data were processed using SPSS 20.0. Categorical variables (e.g., age group, BMI group, thyroid history) were presented as frequencies and percentages. Chi-square or Fisher's exact tests compared proportions. Continuous variables (e.g., age, BMI) were reported as means ± standard deviations (normal distribution, Kolmogorov-Smirnov test $p \geq 0.05$) or medians (non-normal). Odds ratios (OR) with 95% confidence intervals (CI) assessed risk factor associations. Statistical significance was set at $p < 0.05$.

Ethical Issues

The study was conducted following the Declaration of Helsinki and approved by the Biomedical Ethics Committee of Da Nang University of Medical Technology and Pharmacy (No. 870/BB-HĐĐĐ, November 2023). Participants provided informed consent, and data were anonymized for research purposes.

RESULTS

Participant Characteristics

Mean gestational age was 11.44 ± 1.48 weeks. Mean maternal age was 29.82 ± 5.08 years (range: 16 – 46), with 45.04% (127/282) aged > 30 years (Figure 1A). Mean pre-pregnancy BMI was 20.99 ± 1.53 kg/m², with 9.23% (26/282) overweight/obese (BMI ≥ 23 kg/m², Figure 1B). Abnormal obstetric history (miscarriage, preterm birth) was reported in 7.45% (21/282). Personal thyroid disease history was noted in 4.26% (12/282), and family thyroid disease history in 6.74% (19/282) (Table 2).

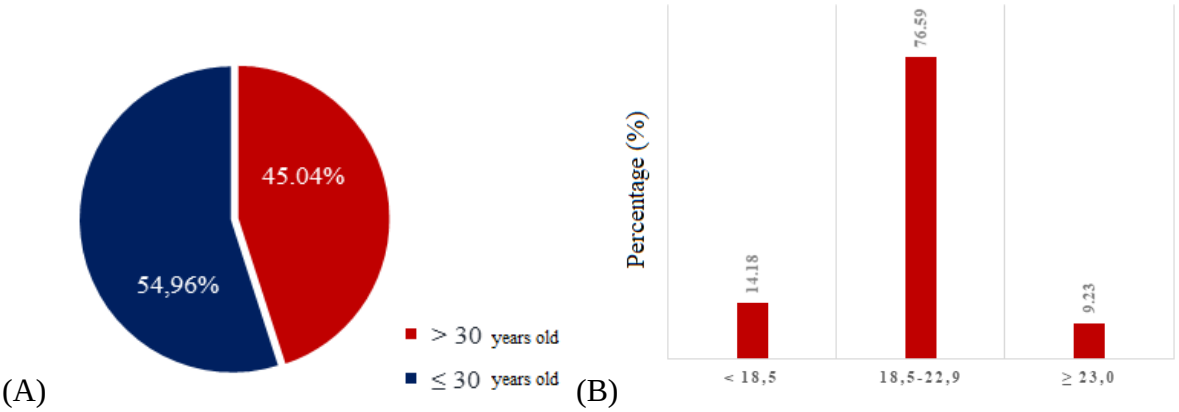

Figure 1. *Age Distribution and pre-pregnancy BMI Distribution of Participants*

Caption: 45.04% of participants were aged > 30 years. Caption: 79.79% had normal BMI (18.5–22.9 kg/m²); 9.23% were overweight/obese (≥ 23 kg/m²).

Table 2. *Clinical Characteristics*

Characteristic	
Gestational Age (weeks, mean ± SD)	11.44 ± 1.48
Maternal Age (years, mean ± SD)	29.82 ± 5.08
Age >30 years, n (%)	*127 (45.04%)*
Pre-Pregnancy BMI (kg/m², mean ± SD)	20.99 ± 1.53
BMI ≥23 kg/m², n (%)	*26 (9.23%)*
Abnormal Obstetric History, No. (percentage)	21 (7.45%)
Personal Thyroid Disease History, No. (percentage)	12 (4.26%)
Family Thyroid Disease History, No. (percentage)	19 (6.74%)

Prevalence of Thyroid Dysfunction

Thyroid dysfunction was detected in 15.25% (43/282) of participants (Figure 2). Subclinical hyperthyroidism was most common (6.03%, 17/282), followed by isolated hypothyroxinemia (4.26%, 12/282), clinical hyperthyroidism (2.84%, 8/282), subclinical hypothyroidism (2.13%, 6/282), and clinical hypothyroidism (0.35%, 1/282) (Table 3).

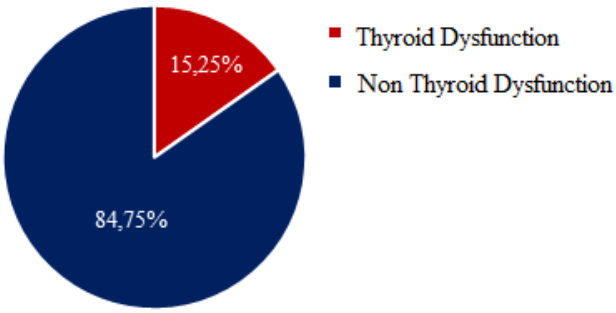

Figure 2. *Prevalence of Thyroid Dysfunction*

15.25% of participants had thyroid dysfunction; 84.75% had normal thyroid function.

Table 3*. Distribution of Thyroid Dysfunction*

Condition	n (%)
Normal Thyroid Function	239 (84.75%)
Subclinical Hyperthyroidism	17 (6.03%)

Isolated Hypothyroxinemia	12 (4.26%)
Clinical Hyperthyroidism	8 (2.84%)
Subclinical Hypothyroidism	6 (2.13%)
Clinical Hypothyroidism	1 (0.35%)

Risk Factors for Thyroid Dysfunction

Personal thyroid disease history was significantly associated with thyroid dysfunction (13.95% in affected vs. 2.51% in unaffected, p = 0.004, OR = 6.29, 95% CI: 1.93 – 20.57). Family thyroid disease history was also significant (16.28% vs. 5.02%, p = 0.014, OR = 3.68, 95% CI: 1.36 – 9.96). No significant associations were found with age >30 years (48.8% vs. 44.4%, p = 0.586), BMI ≥ 23 kg/m² (16.28% vs. 7.95%, p = 0.09), or abnormal obstetric history (11.63% vs. 6.69%, p = 0.338) (Table 4).

Table 4. *Risk Factors for Thyroid Dysfunction*

Risk Factor	**Thyroid Dysfunction** (percentage)	**Non Thyroid Dysfunction** (percentage)	**p-value**	**OR (95% CI)**
Age >30 years	48.8%	44.4%	0.586	-
BMI ≥23 kg/m²	16.28%	7.95%	0.090	-
Abnormal Obstetric History	11.63%	6.69%	0.338	-
Personal Thyroid Disease History	13.95%	2.51%	0.004	6.29 (1.93–20.57)
Family Thyroid Disease History	16.28%	5.02%	0.014	3.68 (1.36–9.96)

DISCUSSION

This cross-sectional study identified a 15.25% prevalence of thyroid dysfunction among 282 first-trimester pregnant women at Da Nang Hospital for Women and Children, with subclinical hyperthyroidism being the most common disorder (6.03%). Personal and family history of thyroid disease were significant risk factors, underscoring the need for targeted screening. These findings contribute to the sparse data on thyroid dysfunction in Vietnam's Central region, providing insights into regional epidemiology and clinical management.

Prevalence of Thyroid Dysfunction

The observed prevalence of 15.25% is lower than reported in other Vietnamese studies, such as Do Thi Tuyet Nhung's 38.5% at Hanoi hospitals and Nguyen Thi Minh Nguyet's 17.03% at Can Tho Maternity Hospital [10,11]. This discrepancy likely arises from differences in diagnostic criteria. The current study adopted the American Thyroid Association (ATA) 2017 TSH reference range (0.1–4.0 mIU/L), which has a higher upper limit than the ATA 2011 range (0.1–2.5 mIU/L) used in prior

Vietnamese studies [7,13]. A stricter TSH threshold increases the detection of subclinical disorders, inflating prevalence estimates. Additionally, regional variations in iodine status may contribute. Vietnam's national iodization program has achieved adequate iodine intake in urban areas like Da Nang, potentially reducing hypothyroidism prevalence compared to iodine-deficient regions [14].

Globally, prevalence varies widely due to diagnostic criteria, population genetics, and nutritional factors. Gupta et al. reported a 10.4% prevalence in India using ATA 2011 criteria, while Sharma et al. found 39.48% in Nepal, driven by high subclinical hypothyroidism (28.83%) [8,9]. A systematic review by Sepasi et al. in Iran reported 18.1%, with hypothyroidism predominant (13.01%) [15]. Dong et al.'s meta-analysis estimated global prevalences of 0.5% for clinical hypothyroidism, 3.47% for subclinical hypothyroidism, and 0.91% for clinical hyperthyroidism in the first trimester [16]. The lower prevalence in Da Nang aligns with Gupta's findings, possibly reflecting adequate iodine status and lower autoimmune thyroiditis rates compared to Nepal or Iran [17].

Subclinical hyperthyroidism was the most common disorder (6.03%), consistent with Vietnamese studies [10,11,18]. This may reflect physiological TSH suppression by human chorionic gonadotropin (hCG) in early pregnancy, a transient phenomenon often resolving without intervention [2]. In contrast, South Asian studies report higher subclinical hypothyroidism, linked to iodine deficiency and autoimmune thyroiditis [9,19]. The low clinical hypothyroidism rate (0.35%) in this study mirrors Dong et al.'s estimate, suggesting effective iodine screening in Vietnam's urban centers [16]. Isolated hypothyroidism (4.26%) aligns with Dong's 2.05%, though its clinical impact remains controversial, with studies reporting conflicting associations with preterm birth and neurodevelopmental outcomes [16,20].

Risk Factors for Thyroid Dysfunction

Personal history of thyroid disease was strongly associated with thyroid dysfunction (OR = 6.29, p = 0.004), corroborating Nguyen et al. (OR = 38.94) and Wang et al. (OR = 3.6) [11,21]. Pre-existing thyroid conditions, such as Hashimoto's thyroiditis or Graves' disease, may be exacerbated by pregnancy-induced immunological shifts or inadequate treatment, increasing dysfunction risk [22]. Family history of thyroid disease also elevated risk (OR = 3.68, p = 0.014), consistent with Wang et al. and genetic studies implicating autoimmune thyroid disease susceptibility loci [21,23]. Shared environmental factors, such as iodine intake or exposure to endocrine disruptors, may further amplify familial risk [24].

No significant association was found with maternal age > 30 years (p = 0.586), contrasting with Gupta et al., who reported higher hypothyroidism and hyperthyroidism rates in older women [8]. This discrepancy may stem from the study's small sample size, limiting power to detect age-specific effects across disorder subtypes. Similarly, pre-pregnancy BMI ≥ 23 kg/m² (WHO Asia-Pacific threshold) showed no association (p = 0.09), despite ATA 2017 identifying BMI ≥ 40 kg/m² as a risk factor [7]. The low prevalence of obesity (9.23%) in this cohort, typical of Vietnamese populations, may explain this finding [12]. Adjusting BMI thresholds to ≥ 23 kg/m² aligns with regional anthropometric norms but may dilute associations compared to higher Western thresholds [12]. A recent Chinese study by Zhang et al. found BMI > 25 kg/m² linked to

subclinical hypothyroidism, suggesting a dose-response relationship absent in leaner populations [25].

Abnormal obstetric history (miscarriage, preterm birth) was not significantly associated with thyroid dysfunction (p = 0.338), unlike Nguyen et al., who reported a nearly threefold increased risk with miscarriage history [11]. Korevaar et al.'s meta-analysis linked subclinical hypothyroidism and thyroid autoimmunity to preterm birth, but not consistently to miscarriage [26]. The small number of participants with obstetric complications (7.45%) may have underpowered this analysis. Additionally, the study did not assess thyroid peroxidase antibodies (TPOAb), a known risk factor for obstetric adverse outcomes, limiting exploration of autoimmune contributions [27].

Clinical and Public Health Implications

The 15.25% prevalence underscores the burden of thyroid dysfunction in early pregnancy, justifying targeted screening in high-risk groups per ATA 2017 guidelines [7]. Personal and family thyroid disease history are actionable risk factors for identifying women needing TSH and FT4 testing. Subclinical hyperthyroidism's predominance suggests most cases may be hCG-mediated and benign, but differentiation from Graves' disease requires clinical vigilance, as untreated hyperthyroidism risks preeclampsia and fetal growth restriction [28]. The low clinical hypothyroidism rate supports Vietnam's iodine sufficiency but highlights the need for monitoring subclinical cases, given their potential neurodevelopmental impact [4].

Vietnam's expanding obstetric care infrastructure supports integrating thyroid screening into antenatal protocols, particularly in urban centers like Da Nang. However, cost-effectiveness remains a concern, as universal screening is not recommended by ATA 2017 due to equivocal evidence on outcomes [7]. A targeted approach, focusing on women with risk factors, aligns with resource constraints in low-middle-income countries [29]. Establishing population-specific TSH reference ranges, as advocated by ATA 2017, is critical for Vietnam, given ethnic and geographic variations in thyroid function [7,30]. Current reliance on hospital-based FT4 ranges (0.93–1.71 ng/dL) may introduce diagnostic variability, as FT4 assays are method-dependent [31].

The study's limitations include a small sample size (n = 282), single-center design, and convenience sampling, limiting generalizability. The short data collection period (4 months) restricted risk factor analysis, particularly for rare disorders like clinical hypothyroidism. Lack of thyroid autoantibody (e.g., TPOAb) testing and iodine status assessment may have missed autoimmune or nutritional influences. Future longitudinal, multi-center studies with larger samples are needed to validate findings and assess outcomes.

CONCLUSION

In conclusion, this study highlights a significant prevalence of thyroid dysfunction in early pregnancy in Da Nang, driven by subclinical hyperthyroidism and modulated by personal and family thyroid disease history. These findings advocate for risk-based screening and region-specific reference ranges to optimize maternal and fetal health in Vietnam.

Supplementary Materials

None.

Funding

This research received no external funding.

Acknowledgments

We thank the staff and patients at Da Nang Hospital for Women and Children for their support.

Author Contributions

Study concept and design: TTL; data acquisition: TCB, HTT; data analysis and interpretation: LTV, TTT; statistical analysis: LTV; manuscript drafting: LTV; manuscript revising: TTL

Institutional Review Board Statement

The study was conducted per the Declaration of Helsinki and approved by the Biomedical Ethics Committee of Da Nang University of Medical Technology and Pharmacy (No. 870/BB-HĐĐĐ, November 2023).

Informed Consent Statement

Informed consent was obtained from all participants.

Data Availability Statement

Data are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest

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