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Research Article

Thyroid Function and Prolactin Levels of Pre-menopausal Women with Menstrual Irregularities: A Pilot Study

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Abstract
Thyroid hormones and prolactin are interdependently linked with menstrual disorders due to the indispensable roles they play in women's reproductive health. The objective of the study was to evaluate thyroid function and prolactin levels of pre-menopausal women diagnosed with menstrual irregularities. A total of 90 premenopausal women aged 18-40 years were enrolled for the study: 45 of them were diagnosed with menstrual irregularities, and 45 were healthy. Participants were recruited from Obstetrics and Gynaecology and General Outpatient Departments, Ahmadu Bello University Teaching Hospital, Shika-Kaduna State, Nigeria between 6th June and 31st October 2024 in a cross-sectional pattern. Thyroid hormones (TSH, fT3, fT4), prolactin (PRL), and lipids [total cholesterol (TC), triglycerides (TG), high-density lipoprotein-cholesterol (HDL-C) and low-density lipoprotein-cholesterol (LDL-C)] were assayed using enzyme-linked immunosorbent assay and enzymatic methods, respectively. Anthropometric indices [body mass index (BMI), blood pressure (BP), waist circumference (WC) and hip circumference (HC)] were measured using standard methods. There was no significant difference in the anthropometric indices between groups. Distribution of thyroid disorders among cases vs controls (overt hypothyroidism 17.78% vs 4.44%, subclinical hypothyroidism 17.78% vs 15.56%, overt hyperthyroidism 15.56% vs 22.22%, subclinical hyperthyroidism 22.22% vs 26.67%, Euthyroidism 26.67% vs 31.11%) Hyperprolactinemia was found in majority of cases compared to controls [n=29 (64.40%) vs n=13 (28.80%) p=0.001]. Significant positive correlation was observed between WC, BMI, and TG levels among cases. Women aged 18-40 years should be screened for metabolic risk factors such as HC, WC, BMI, TG and fT4, as indicators for subcutaneous fat-related menstrual irregularities.

Key Words: *Thyroid dysfunction, Prolactin, Menstrual irregularities, Pre-menopausal women, Zaria, Nigeria.*

INTRODUCTION

The incidence of thyroid disorders increases with age; as a result, these conditions are less common in younger individuals than in older adults (Ramya *et al*., 2017). The prevalence of thyroid dysfunction (TD) varies globally and is often region-specific due to differences in iodine intake from salt and other food sources. Males are less infrequently affected than females (Duntas and Brenta, 2018; Marabi *et al*., 2025). Thyroid hormones are essential in female reproductive physiology either through indirect interactions with sex hormone-binding globulin or direct effects on the ovaries (Ramya *et al*., 2017). Thyroid dysfunction is a major endocrine disorder in women of reproductive age, with prevalence rates ranging from 5 %–10 % for thyroid autoimmunity (TAI), 0.3 %–1 % for hyperthyroidism, 5 % to 7 % for subclinical hypothyroidism (SCH) and 0.2 %–4.5 % for overt hypothyroidism (OH) (Concepción-Zavaleta *et al*., 2023).

Thyroid dysfunction is broadly classified into; sub-clinical hypothyroidism, overt (clinical) hypothyroidism, sub-clinical hyperthyroidism, and overt (clinical) hyperthyroidism (IOM 2003). TD significantly affects lipoprotein metabolism and increases the risk of cardiovascular disease (Duntas and Brenta, 2018). Hypothyroidism and hyperthyroidism are linked with female reproductive disorders (Marabi *et al*., 2025) such as infertility and menstrual irregularities (Ramya *et al*., 2017). Menstrual irregularities such as polymenorrhea, menorrhagia, oligomenorrhea and amenorrhea constitute common gynaecological concerns among premenopausal women (Duntas and Brenta, 2018; Koyyada and Orsu, 2020). Although global estimates for thyroid disorders among premenopausal women largely remain elusive, recent studies in Nigeria show a high prevalence of thyroid disorders ranging from 6% among pregnant women (Habib *et al*., 2023) to 12% among women diagnosed with dysfunctional uterine bleeding (Okoli *et al*., 2024).

Hypothyroidism causes changes in menstrual blood flow and cycle length (Ramya *et al*., 2017) and about 30% of patients with primary hypothyroidism exhibit elevated serum prolactin levels (Aliu-Ayo *et al*., 2023). On the other hand, hyperthyroidism, which is characterised by suppressed TSH levels and elevated thyroid hormone levels, can also lead to reproductive disorders (Jagun *et al*., 2022). Hyperprolactinemia impairs the secretion of gonadotropin-releasing hormone (GnRH), which interferes with ovulation, resulting in infertility (Keerthanaa and Hiremath, 2020). The interplay between thyroid hormones and prolactin may provide insights into the complex thyroid-reproductive axis and provide simple solutions to female reproductive disorders.

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The aim of the study was to evaluate thyroid hormones and prolactin levels of premenopausal women with menstrual irregularities attending ABUTH, Shika-Kaduna State Nigeria.

MATERIALS AND METHODS

Ethical Approval: Ethical approval was obtained from the Health Research Ethics Committee of the Ahmadu Bello University Teaching Hospital, Shika, Kaduna State. Reference Number: NHREC/ABUTH-NHREC/29/08/23 dated 17th May 2024.

Study Population and Sites: A total of 90 premenopausal women aged 18-40 years were enrolled for the study: 45 of them were diagnosed with menstrual irregularities, and 45 were healthy, recruited from the Obstetrics and Gynaecology and General Outpatient Departments of Ahmadu Bello University Teaching Hospital, Shika-Kaduna State, Nigeria, between 6th June and 31st October 2024 in a cross-sectional pattern via convenience sampling. Pregnant or lactating women and those with known thyroid disorders receiving thyroid hormone replacement therapy/radioactive iodine therapy or history of recent thyroid surgery were excluded.

Methods: Blood samples were collected via venepuncture and used for biochemical assays. Lipids were assayed using Labkit chemistry reagents (Chemelex S.A., Barcelona, Spain) while serum TSH, fT4, fT3 and prolactin were measured using the enzyme linked immunosorbent assay (AccuBind ELISA kits-Monobind Inc., USA).

Normal Reference Ranges of Biochemical Parameters: Prolactin: 1.2-19.5 ng/mL, TSH: 0.5-5.0 m/u/mL, fT3: 1.4-4.2 pg/mL, fT4: 0.8-2.0 ng/dL, TC: 2.5-6.0mmol/L, HDL-C: 0.7-1.4 mmol/L, LDL-C: 1.3-3.7 mmol/L and TG: 0.5-2.3 mmol/L. Anthropometric indices were measured viz; Weight was measured in kilograms (kg) without shoes or heavy clothing with a hospital standard weighing scale and recorded to the nearest kilogram. Height was measured to the nearest 0.5 centimetre using a stadiometer. Body Mass Index was calculated using the formula, BMI = weight in kg/ (height in meters)^2. Waist circumference was measured at the level of the umbilicus using a non-stretchable flexible tape rule and recorded in centimetres. Hip circumference was measured at the superior border of the iliac crest after normal expiration using a non-stretchable flexible tape rule and recorded in centimetres. Waist to Hip Ratio (WHR) was calculated as the ratio of the waist circumference to hip circumference. Waist-to-Height Ratio (WHtR): WHtR was calculated as the ratio of waist circumference to height. Blood pressure was measured with a suitable mercury sphygmomanometer. After a 10-minute rest with the individual in a sitting position, blood pressure was measured 3 times at 5-minute intervals. The first (1st) and fifth (5th) Korotkoff sounds were used to determine the systolic (SBP) and diastolic blood pressure (DBP) measurements, respectively.

Data Collection: Data were collected using structured, interviewer-administered questionnaires and recorded in a Microsoft Excel sheet prior to statistical analysis. The questionnaire was structured into 3 sections. Section A captured participants' sociodemographic characteristics, and Section B captured participants' medical history, including questions on previous history of thyroid disorders and menstrual irregularity; parity; weight changes; current medications; menstrual history, including menstrual cycle pattern and type of menstrual irregularity; thyroid symptoms and symptom severity. Section C captured anthropometry measurements and laboratory investigations. Participants were engaged verbally via direct interviews for some unclear medical terminologies related to the intensity, duration, and frequency of menstrual bleeding.

Terminologies:

Hypothyroidism: Underproduction of thyroid hormones (e.g., Hashimoto's thyroiditis).

Hyperthyroidism: Overproduction of thyroid hormones (e.g., Graves' disease, toxic nodules).

Euthyroid States: Normal thyroid function, with underlying issues such as goitre or nodules.

Data Analysis: Data were analysed using IBM® SPSS software version 27 (Chicago, IL, United States of America). Sociodemographic characteristics and distribution of thyroid dysfunction are presented as frequency (n) and percentages (%). Comparisons of mean values of biochemical parameters were performed using the independent-samples t-test. Pearson correlation was used to assess the associations between anthropometric indices and biochemical parameters. A p-value of ≤ 0.05 was considered statistically significant.

RESULTS

Table 1:
Sociodemographic Characteristics of Study Participants

Personal Characteristics	Category	Group n (%)	
		Cases	**Controls**
Age (years)	18-25	36 (80)	31 (69)
	26-34	5 (11)	8 (18)
	35-40	4 (9)	6 (13)
	Total	45 (100)	45 (100)
Education	Primary	2 (4)	1 (2)
	Secondary	3 (7)	5 (11)
	Tertiary	40 (89)	39 (87)
	Total	45 (100)	45 (100)
Marital status	Single	38 (84)	36 (80)
	Married	7 (16)	9 (20)
	Total	45 (100)	45 (100)
Occupation	Student	37 (82)	37 (82)
	Civil Servant	3 (7)	6 (13)
	Trader	3 (7)	1 (2)
	Unemployed	2 (4)	1 (2)
	Total	45 (100)	45 (100)

Table 2:
Comparison of Biochemical Parameters and Anthropometric indices between Groups

Biochemical Parameters	Cases (Mean±D)	Control (Mean±SD)	Mean Difference	t	df	p-value
TC (mmol/L)	3.620 ± 0.813	3.669 ± 0.736	-0.0489	-0.299	88	0.766
TG (mmol/L)	0.933 ± 0.566	0.900 ± 0.438	0.0333	0.313	88	0.755
HDL-C (mmol/L)	1.449 ± 0.332	1.484 ± 0.332	0.0356	1 -0.505	88	0.615
LDL-C (mmol/L)	1.755 ± 0.832	1.787 ± 0.603	-0.0321	-0.209	88	0.835
TSH (m/u/mL)	2.402 ± 2.042	2.642 ± 1.176	-0.2400	-0.864	88	0.390
fT4 (ng/dL)	3.756 ± 2.403	2.536 ± 1.935	1.2200	1.2200	88	0.009
fT3 (pg/mL)	2.040 ± 2.042	2.429 ± 2.055	-0.3889	-0.901	88	0.370
PRL (ng/mL)	31.313 ± 21.271	18.127 ± 12.255	13.1867	3.603	88	0.001
Anthropometric Indices						
HGT	163.56 ± 9.55	163.54 ± 9.77	0.03	0.012	88	0.991
WGT	22.83 ± 6.09	23.83 ± 6.09	-1.00	-0.725	88	0.471
BMI	42.02 ± 22.42	43.02 ± 22.42	-1.00	-0.197	88	0.844
WC	51.02 ± 25.91	52.02 ± 25.91	-1.00	-0.170	88	0.865
HC	94.02 ± 34.50	96.02 ± 35.50	-2.00	-0.305	88	0.761
WHR	0.85 ± 0.21	0.86 ± 0.22	-0.01	-0.264	88	0.793
WHgtR	0.50 ± 0.12	0.51 ± 0.12	-0.01	-0.165	88	0.869
SBP	125.89 ± 16.03	122.72 ± 15.80	3.17	0.739	88	0.462
DBP	81.20 ± 10.44	80.04 ± 10.50	1.16	0.487	88	0.627

Key: TC: Total Cholesterol, TG: Triglycerides, HDL-C: High Density Lipoprotein Cholesterol, LDL-C: Low Density Lipoprotein Cholesterol, TSH: Thyroid Stimulating Hormone, fT4: free T4, fT3: free T3, PRL: Prolactin, Hgt: Height, Wgt: Weight, BMI: Body Mass Index, WC: Waist Circumference, HC: Hip Circumference, WHR: Waist to Hip Ratio, WHgtR: Waist to Height Ratio, SBP: Systolic Blood Pressure, DBP: Diastolic Blood Pressure

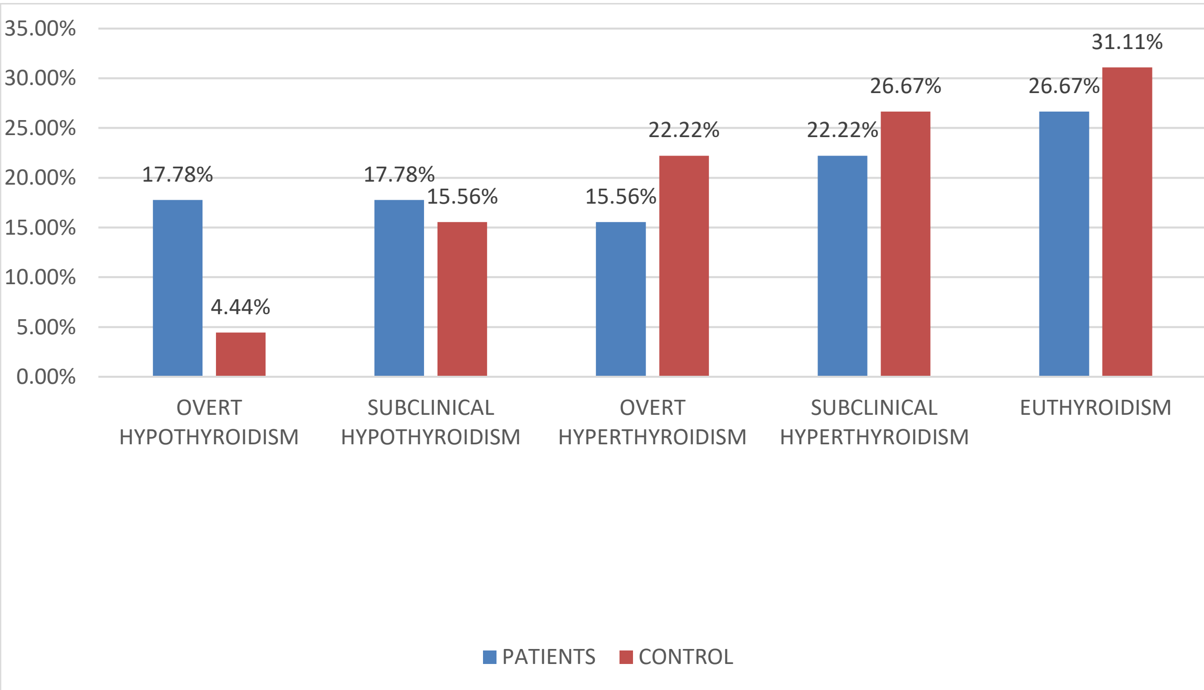

Figure 1:
Distribution of Thyroid Dysfunctions among Groups

Table 4:
Correlation of Anthropometric Indices with Biochemical Parameters among Cases

	WGT	HGT	BMI	WC	HC	WHR	WHgtR	SBP	DBP	TC	TG	HDL-C	LDL-C	TSH	fT4	fT3
HGT	0.32*	1														
BMI	0.89**	-0.10	1													
WC	0.35*	0.25	0.27	1												
HC	0.28	0.24	0.20	0.98**	1											
WHR	0.32*	-0.07	0.40**	0.30*	0.13	1										
WHgtR	0.37*	0.01	0.41**	0.52**	0.48**	0.22	1									
SBP	0.13	-0.18	0.24	0.17	0.20	-0.03	0.16	1								
DBP	0.18	0.10	0.16	0.00	-0.06	0.09	0.15	-0.08	1							
TC	0.12	-0.14	0.19	-0.06	-0.12	0.23	0.14	-0.19	0.04	1						
TG	0.36*	0.08	0.35*	0.36*	0.30*	0.43**	0.37*	-0.03	0.38*	0.31*	1					
HDL-C	-0.30*	0.14	-0.36*	-0.05	0.01	-0.40**	-0.14	0.21	0.09	-0.01	-0.26	1				
LDL-C	0.12	-0.22	0.20	-0.17	-0.24	0.25	0.05	-0.27	-0.12	0.90**	0.08	-0.34*	1			
TSH	0.24	0.19	0.19	-0.20	-0.26	0.22	-0.17	-0.15	0.18	.305*	0.11	0.13	0.25	1		
fT4	0.03	0.16	-0.01	0.66**	0.69**	0.12	0.44**	0.08	-0.23	-0.09	0.21	-0.09	-0.14	-0.20	1	
fT3	-0.09	-0.10	-0.06	-0.35	-0.37	0.01	0.11	-0.11	-0.11	-0.04	-0.05	0.00	-0.03	-0.01	-.314*	1
PRL	0.22	0.24	0.15	0.51**	0.54**	0.06	0.05	0.23	-0.01	-0.38**	0.14	0.02	-0.43**	-0.13	0.41**	-0.10

Key: TC: Total Cholesterol, TG: Triglycerides, HDL-C: High Density Lipoprotein Cholesterol, LDL-C: Low Density Lipoprotein Cholesterol, TSH: Thyroid Stimulating Hormone, fT4: free T4, fT3: free T3, PRL: Prolactin, Hgt: Height, Wgt: Weight, BMI: Body Mass Index, WC: Waist Circumference, HC: Hip Circumference, WHR: Waist to Hip Ratio, WHgtR: Waist to Height Ratio, SBP: Systolic Blood Pressure, DBP: Diastolic Blood Pressure

Table 3:
Frequency of Biochemical Parameters

Biochemical Parameters	Group	Concentration	Frequency (%)
TC (mmol/L)	Cases	Low	4.40
		Normal	95.60
	Control	Low	4.30
		Normal	95.70
TG (mmol/L)	Cases	Normal	84.40
		High	15.60
	Control	Normal	95.70
		High	4.30
HDL-C (mmol/L)	Cases	Normal	51.10
		High	48.90
	Control	Normal	45.70
		High	54.30
LDL-C (mmol/L)	Cases	Low	24.40
		Normal	71.10
		High	4.50
	Control	Low	17.40
		Normal	82.60
TSH (m/u/mL)	Cases	Low	4.40
		Normal	86.70
		High	8.90
	Control	Low	4.30
		Normal	89.10
		High	6.60
fT4 (ng/dL)	Cases	Low	4.40
		Normal	37.80
		High	57.80
	Control	Normal	60.90
		High	39.10
fT3 (pg/mL)	Cases	Low	60.00
		Normal	20.00
		High	20.00
	Control	Low	47.80
		Normal	26.10
		High	26.10
PRL (ng/mL)	Cases	Normal	35.60
		High	64.40
	Control	Normal	71.70
		High	28.30

Key: TC: Total Cholesterol, TG: Triglycerides, HDL-C: High Density Lipoprotein Cholesterol, LDL-C: Low Density Lipoprotein Cholesterol, TSH: Thyroid Stimulating Hormone, fT4: free T4, fT3: free T3, PRL: Prolactin

DISCUSSION

Majority of our study participants were aged 18-25 years, single and students of tertiary institutions (see table 1). The age range deployed (18-40 years) in our study is similar to that used in cross-sectional studies by Ajmani *et al*. (2016); Thakur *et al*. (2020); Islam and Islam (2025); Sethi *et al*. (2025); Godria *et al*. (2025) which assessed thyroid function in women with menstrual irregularities but dissimilar to the study of Bahar *et al*. (2011), which recruited married women within the age range of 14-70 years in a study which assessed subclinical hypothyroidism using only clinical symptoms without measurement of thyroid hormones. The finding of predominantly single women may be attributed to the fact that younger, unmarried women might be more concerned about fertility-related issues and thus more likely to seek help for menstrual irregularities.

Table 5:
Correlation of Anthropometric Indices with Biochemical Parameters among Controls

	BW	HGT	BMI	WC	HC	WHR	WHgtR	SBP	DBP	TC	TG	HDL-C	LDL-C	TSH	fT4	fT3
HGT	0.26*	1.00														
BMI	0.88**	-0.15	1.00													
WC	.253*	0.08	0.21*	1.00												
HC	.221*	0.08	0.18	0.98**	1.00											
WHR	0.07	-0.18	0.14	0.19	0.03	1.00										
WHgtR	0.34**	-0.13	0.43**	0.56**	0.54**	0.04	1.00									
SBP	0.11	-0.10	0.18	0.15	0.17	-0.01	0.13	1.00								
DBP	0.13	0.06	0.09	0.04	0.01	0.05	.238*	-0.04	1.00							
TC	0.10	-0.05	0.14	-0.01	-0.05	0.12	0.16	-0.14	0.11	1.00						
TG	0.25*	0.03	0.258*	0.34**	0.30**	0.21*	.284**	-0.02	0.15	0.26*	1.00					
HDL-C	-0.18	0.04	-0.14	-0.02	0.03	-0.27**	-0.01	0.14	0.13	0.22*	-0.16	1.00				
LDL-C	0.10	-0.08	0.13	-0.11	-0.16	0.18	0.07	-0.22*	0.00	0.89**	0.06	-0.18	1.00			
TSH	0.19	0.15	0.16	0-.25*	-0.28**	0.13	-0.15	-0.12	0.02	0.17	-0.02	0.11	0.13	1.00		
fT4	0.03	0.02	0.05	0.75**	0.76**	0.08	0.54**	0.09	-0.06	-0.03	0.20	0.01	-0.10	0-.25*	1.00	
fT3	0.03	-0.05	0.03	-0.20	-0.22*	0.07	0.15	-0.09	-0.02	-0.03	0.00	-0.06	-0.02	0.11	-0.24*	1.00
PRL	0.13	0.07	0.09	0.56**	0.57**	0.04	0.23*	0.22*	0.04	-0.19	0.14	0.06	-.265*	-0.18	0.49**	-0.15

Key: TC: Total Cholesterol, TG: Triglycerides, HDL-C: High Density Lipoprotein Cholesterol, LDL-C: Low Density Lipoprotein Cholesterol, TSH: Thyroid Stimulating Hormone, fT4: free T4, fT3: free T3, PRL: Prolactin, Hgt: Height, Wgt: Weight, BMI: Body Mass Index, WC: Waist Circumference, HC: Hip Circumference, WHR: Waist to Hip Ratio, WHgtR: Waist to Height Ratio, SBP: Systolic Blood Pressure, DBP: Diastolic Blood Pressure

Hyperthyroidism is linked to abnormal menstrual patterns, including oligomenorrhea and amenorrhea, while hypothyroidism is known to contribute to heavy and prolonged menstruation (Verma *et al*., 2022). In this study, the prevalence of overt hypothyroidism (17.78%) and subclinical hypothyroidism (17.78%), accounted for about 35.56% of hypothyroidism cases found among premenopausal women when compared to controls (20%) which is consistent with the reports of Islam and Islam (2025); Sethi *et al*. (2025) and Godria *et al*. (2025) of a higher prevalence of hypothyroidism compared to hyperthyroidism among women of reproductive age diagnosed with menstrual irregularities. Our findings differ from the report of Gelen et al. (2023), which reported a higher prevalence of hyperthyroidism among patients in comparison with controls.

We also observed increased prevalence of euthyroidism among controls compared with cases (31.11% vs. 26.67%) (see figure 1) but hypoprolactinaemia was more prevalent among premenopausal women with menstrual irregularities compared to controls (64.4% vs 28.3%, p=0.001) (see table 3) which is similar to the findings of Bahar *et al*., (2011) which reported that the duo of hyperprolactinemia and thyroid dysfunctions can disrupt the hypothalamic-pituitary-ovarian axis which often results to anovulation and infertility.

Although estrogen in females tends to increase HDL-C levels (Palmisano *et al*., 2018), we found low HDL-C levels among our study participants. Our study also found elevated levels of TG among cases while LDL-C and TC values remained within normal limits (see table 2). The hypertriglyceridemia observed among cases may be attributed to the fact that, the primary function of subcutaneous fat is triglyceride storage and females tend to accumulate more subcutaneous fat compared to males (Palmisano *et al*., 2018) hence explaining the positive correlation observed between the elevated TG levels, waist and hip circumference and BMI among cases in the study. Our finding is similar with the report of Wietlisbach *et al*. (2013).

We found no significant difference in the anthropometric indices (SBP, DBP, BMI, WC, HC, WHR and WHgtR) between cases and control. The finding is debatable due to the small sample size of the pilot study. However, a positive correlation between WGT and BMI, BMI and WC, WHR and WHgtR were observed among cases. Significant positive correlations were found between fT4 and WC ($r=0.66$, $p<0.01$) and fT4 and HC ($r=0.69$, $p<0.01$), suggesting that higher thyroxine levels may be associated with obesity in women. This finding is consistent with the report of Kim *et al*. (2019), who reported that hyperthyroid conditions can lead to weight gain, particularly in the abdominal area, due to changes in metabolism and fat distribution.

Conclusion

Women aged 18-40 years should be screened for metabolic risk factors such as HC, WC, BMI, TG and fT4, as indicators for subcutaneous fat-related menstrual irregularities. Whether this present finding can be generalized to a larger population of premenopausal women will be investigated in the main study.

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