TIBBIYOT
TA'LIMI & INNOVATSIYALARI

O'ZBEKISTON RESPUBLIKASI
19 20
TOSHKENT TIBBIYOT AKADEMIYASI

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- 14.00.00 - Tibbiyot fanlari;
- 14.00.01 - Akusherlik va ginekologiya;
- 14.00.02 - Morfologiya;
- 14.00.03 - Endokrinologiya;
- 14.00.04 - Otorinolaringologiya;
- 14.00.05 - Ichki kasalliklar;
- 14.00.06 - Kardiologiya;
- 14.00.07 - Gigiena;
- 14.00.08 - Oftal'mologiya;
- 14.00.09 - Pediatriya;
- 14.00.10 - Yuqumli kasalliklar;
- 14.00.11 - Dermatologiya va venerologiya;
- 14.00.12 - Tibbiy reabilitologiya;
- 14.00.13 - Nevrologiya;
- 14.00.14 - Onkologiya;
- 14.00.15 - Patologik anatomiya;
- 14.00.16 - Normal va patologik fiziologiya;
- 14.00.17 - Farmakologiya va klinik farmakologiya;
- 14.00.18 - Psixiatriya va narkologiya;
- 14.00.19 - Klinik radiologiya;
- 14.00.20 - Tibbiy genetika;
- 14.00.21 - Stomatologiya;
- 14.00.22 - Travmatologiya va ortopediya;
- 14.00.23 - Hamshiralik ishini tashkil etish;
- 14.00.24 - Sud tibbiyoti;
- 14.00.27 - Xirurgiya;
- 14.00.28 - Neyroxirurgiya;
- 14.00.41 - Xalq tabobati;
- 14.00.35 - Bolalar xirurgiyasi;
- 14.00.34 - Yurak-qon tomir xirurgiyasi

№10-SON

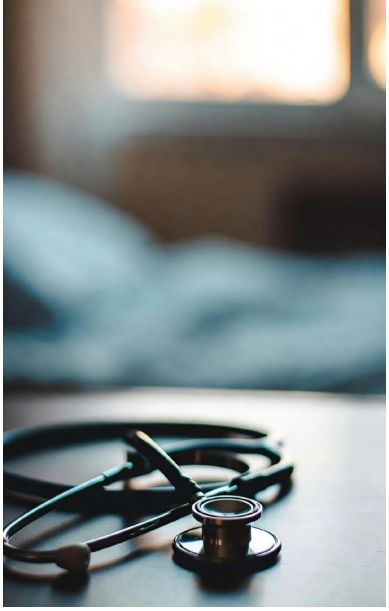
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Litsenziya raqami: №745444













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ilmiy elektron jurnali O‘zbekiston Respublikasi Axborot va ommaviy kommunikatsiyalar agentligi (AOKA) tomonidan 2024-yil 9-oktabrdan boshlab c-5669651 raqami ostida rasmiy ro‘yxatdan o‘tkazilgan.

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MUNDARIJA

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OLIGOMENORRHEA AND AMENORRHEA IN POLYCYSTIC OVARY SYNDROME: A RETROSPECTIVE ANALYSIS OF CLINICAL-METABOLIC PHENOTYPES

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Annotatsiya. Dolzarbligi. Tuxumdonlar polikistozi sindromida (TPS) menstrual buzilishlar, insulinrezistentlik va gormonal o‘zgarishlar o‘zaro bog‘liq bo‘lishi mumkin. Oligomenoreya va amenoreya klinik fenotiplarining metabolik farqlarini baholash amaliy ahamiyatga ega. Maqsad. TPS bo‘lgan ayollarda oligomenoreya va amenoreya guruhlarini klinik-metabolik va gormonal ko‘rsatkichlar bo‘yicha taqqoslash. Material va usullar. Retrospektiv tahlilga TPS tashxisi qo‘yilgan 79 nafar ayol kiritildi. Oligomenoreya 44 nafar, amenoreya esa 34 nafar bemorda qayd etildi. Yosh, tana vazni indeksi (TVI), glyukoza, insulin, HbA1c, HOMA-IR, FSG, LG, prolaktin, umumiy testosteron va LG/FSG nisbati baholandi. Natijalar. Oligomenoreya va amenoreya guruhlari o‘rtasida TVI, glyukoza, insulin, HbA1c, HOMA-IR, FSG, LG va prolaktin bo‘yicha statistik ahamiyatli farqlar aniqlanmadi. LG/FSG nisbati oligomenoreya guruhida 2,29 (1,74–2,98), amenoreya guruhida esa 1,96 (1,58–2,75) ni tashkil etdi (p=0,302). HOMA-IR ≥2,5 bo‘lgan bemorlar ulushi mos ravishda 54,5% va 50,0% ni tashkil etdi (p=0,820). Xulosa. TPS bo‘lgan ayollarda oligomenoreya va amenoreya guruhlari asosiy metabolik hamda gormonal ko‘rsatkichlar bo‘yicha statistik ahamiyatli farq aniqlanmadi. LG/FSG nisbati qo‘shimcha gormonal marker sifatida baholanishi mumkin.

Kalit so‘zlar: tuxumdonlar polikistozi sindromi, oligomenoreya, amenoreya, HOMA-IR, LG/FSG, insulinrezistentlik.

Аннотация. Актуальность. При синдроме поликистозных яичников (СПКЯ) менструальные нарушения часто сочетаются с метаболическими и гормональными изменениями. Сравнение олигоменореи и аменореи позволяет уточнить особенности клинических фенотипов СПКЯ. Цель исследования. Оценить клинико-метаболические и гормональные особенности у женщин с СПКЯ при олигоменорее и аменорее. Материал и методы. Проведён ретроспективный анализ данных 79 женщин с СПКЯ. Олигоменорея выявлена у 44 пациенток, аменорея — у 34. Оценивались возраст, индекс массы тела (ИМТ), глюкоза, инсулин, HbA1c, HOMA-IR, ФСГ, ЛГ, пролактин, общий тестостерон и соотношение ЛГ/ФСГ. Результаты. Между группами олигоменореи и аменореи не выявлено статистически значимых различий по ИМТ, глюкозе, инсулину, HbA1c, HOMA-IR, ФСГ, ЛГ и пролактину. Соотношение

ЛГ/ФСГ составило 2,29 (1,74–2,98) при олигоменорее и 1,96 (1,58–2,75) при аменорее (p=0,302). Доля пациенток с HOMA-IR ≥2,5 составила 54,5% и 50,0% соответственно (p=0,820). Заключение. В исследованной выборке олигоменорея и аменорея при СПКЯ не различались по основным метаболическим и гормональным показателям. Соотношение ЛГ/ФСГ может использоваться как дополнительный показатель гормонального фенотипа.

Ключевые слова: синдром поликистозных яичников, олигоменорея, аменорея, HOMA-IR, ЛГ/ФСГ, инсулинорезистентность.

Abstract. Background. Menstrual dysfunction in polycystic ovary syndrome (PCOS) may be associated with metabolic and hormonal abnormalities. Comparing the clinical phenotypes of oligomenorrhea and amenorrhea may help characterize metabolic differences of practical relevance. Objective. To compare clinical, metabolic, and hormonal parameters in women with PCOS presenting with oligomenorrhea and amenorrhea. Materials and methods. A retrospective analysis included 79 women diagnosed with PCOS. Oligomenorrhea was recorded in 44 patients and amenorrhea in 34 patients. Age, body mass index (BMI), fasting glucose, insulin, HbA1c, HOMA-IR, FSH, LH, prolactin, total testosterone, and the LH/FSH ratio were assessed. Results. No statistically significant differences were found between the oligomenorrhea and amenorrhea groups in BMI, glucose, insulin, HbA1c, HOMA-IR, FSH, LH, or prolactin. The LH/FSH ratio was 2.29 (1.74–2.98) in the oligomenorrhea group and 1.96 (1.58–2.75) in the amenorrhea group (p=0.302). The proportions of patients with HOMA-IR ≥2.5 were 54.5% and 50.0%, respectively (p=0.820). Conclusion. In women with PCOS, oligomenorrhea and amenorrhea did not differ significantly with respect to the main metabolic and hormonal parameters. The LH/FSH ratio may be assessed as an additional hormonal marker.

Keywords: polycystic ovary syndrome, oligomenorrhea, amenorrhea, HOMA-IR, LH/FSH ratio, insulin resistance.

INTRODUCTION

Polycystic ovary syndrome (PCOS) is one of the most common endocrine-metabolic disorders among women of reproductive age. Its clinical presentation includes menstrual cycle disturbances, hyperandrogenism, ovulatory dysfunction, and metabolic abnormalities of varying severity [1,2]. Contemporary international recommendations regard PCOS not only as a disorder of the reproductive system but also as a complex syndrome that may lead to metabolic, cardiovascular, psycho-emotional, and reproductive consequences throughout a woman's life [1]. Therefore, the assessment of patients with PCOS should include a comprehensive analysis not only of the menstrual cycle and ultrasound findings but also of hormonal and metabolic phenotypes. One of the most important clinical manifestations of PCOS is menstrual cycle dysfunction. Oligomenorrhea and amenorrhea represent clinical manifestations of different degrees of ovulatory dysfunction and may be associated with impaired reproductive health, increased infertility risk, and long-term metabolic consequences [2,3].

In recent years, the severity of menstrual dysfunction has been investigated as a simple clinical marker for assessing metabolic risk in PCOS. Some studies have shown that amenorrhea or prolonged menstrual intervals may be associated with a higher risk of insulin resistance, prediabetes, dyslipidemia, and metabolic syndrome [3,4]. However, this association has not been consistently confirmed across all studies because PCOS phenotypes may differ according to age, body mass index, degree of hyperandrogenism, and ethnic and population characteristics [5,6].

LITERATURE REVIEW

Insulin resistance is considered one of the key metabolic components in the pathogenesis of PCOS. Hyperinsulinemia may enhance androgen synthesis in ovarian theca cells, reduce the level of sex hormone-binding globulin, and thereby aggravate hyperandrogenism and ovulatory dysfunction [1,7]. Therefore, the assessment of HOMA-IR, fasting insulin, glucose, and HbA1c is clinically relevant in women with PCOS. Recent studies emphasize that metabolic abnormalities in PCOS cannot be explained solely by obesity; insulin resistance and disturbances of glucose metabolism may also occur in some normal-weight patients [7,8]. This highlights the need to study menstrual phenotypes alongside metabolic parameters in PCOS. Although the clinical distinction between oligomenorrhea and amenorrhea is clear, differences in their metabolic and hormonal profiles cannot be considered fully established. Some authors regard amenorrhea as a relatively more severe clinical manifestation of PCOS and suggest that insulin resistance and cardiometabolic risk markers may be higher in this group [3,4].

Other studies have reported that metabolic differences among PCOS phenotypes are more closely related to hyperandrogenism and body mass index, whereas menstrual dysfunction itself is not always an independent metabolic predictor [5,6]. Therefore, comparing oligomenorrhea and amenorrhea as distinct clinical-metabolic

phenotypes is of practical relevance. The balance of gonadotropins, particularly the LH/FSH ratio, also deserves attention in PCOS. In classical approaches, an increased LH/FSH ratio has been regarded as one of the characteristic neuroendocrine features of PCOS; however, contemporary recommendations do not endorse this parameter as an independent diagnostic criterion [1,9]. Nevertheless, the LH/FSH ratio may be useful for the additional characterization of ovulatory dysfunction, hyperandrogenism, and certain PCOS phenotypes. In recent years, differences in the LH/FSH ratio between obese and normal-weight PCOS phenotypes, as well as its potential value as an additional marker reflecting neuroendocrine imbalance, have been discussed [9,10]. The heterogeneity of PCOS clinical phenotypes, the variable expression of menstrual disturbances, and the unequal manifestation of metabolic risk markers indicate the need for an individualized approach to the assessment of this syndrome.

In Uzbekistan in particular, local clinical data comparing women of reproductive age with PCOS and oligomenorrhea versus amenorrhea in terms of HOMA-IR, insulin, glucose, HbA1c, gonadotropins, prolactin, testosterone, and the LH/FSH ratio remain limited. Such an analysis may help determine the extent to which menstrual phenotypes reflect metabolic burden and identify which parameters deserve greater attention in clinical practice. In the present study, the clinical phenotypes of oligomenorrhea and amenorrhea in reproductive-age women diagnosed with PCOS were compared on the basis of anthropometric, metabolic, and hormonal parameters. In addition, the LH/FSH ratio, which had not previously been calculated, was determined separately, and its association with menstrual phenotypes was assessed. The scientific and practical significance of the study lies in determining whether the type of menstrual dysfunction in women with PCOS consistently reflects the degree of metabolic risk.

RESEARCH METHODOLOGY

The study was conducted as a retrospective observational analysis. Clinical, anthropometric, hormonal, and metabolic parameters of 79 reproductive-age women diagnosed with polycystic ovary syndrome (PCOS) were included in the analysis. Data were evaluated on the basis of patients' medical records and laboratory test results. The main focus of the study was to compare two clinical manifestations of menstrual cycle dysfunction in women with PCOS: oligomenorrhea and amenorrhea. In the total sample, oligomenorrhea was recorded in 44 patients, amenorrhea in 34 patients, and dysmenorrhea in 1 patient. For the two-group statistical comparison, the 78 patients with oligomenorrhea or amenorrhea were analyzed separately. The case of dysmenorrhea was not included in the between-group statistical comparison because of its very small number. The inclusion criteria were reproductive age, a documented diagnosis of PCOS, specification of the type of menstrual cycle disorder, and availability of the main clinical and laboratory parameters. Patients with incomplete key data required for the analysis, as well as cases involving a type of menstrual disorder that did not correspond to the two-group comparison, were excluded from the separate statistical analysis. The following parameters were assessed: age, body mass index (BMI), fasting blood glucose, fasting insulin, glycated hemoglobin (HbA1c), HOMA-IR, follicle-stimulating hormone (FSH), luteinizing hormone (LH), prolactin, and total testosterone. Body mass index was calculated as body weight divided by height squared and expressed in kg/m². The HOMA-IR index was used to assess insulin resistance. HOMA-IR was calculated using the following formula:

$$HOMA\text{-}IR = fasting\ insulin\ (\mu IU/mL) \times fasting\ glucose\ (mmol/L) / 22.5$$

Cases with HOMA-IR ≥2.5 were classified as having elevated HOMA-IR consistent with insulin resistance. In addition, the LH/FSH ratio was calculated to assess the relationship between gonadotropins. The LH/FSH ratio was determined by dividing the LH value by the FSH value:

$$LH/FSH = LH / FSH$$

This parameter was analyzed as an additional marker characterizing ovulatory dysfunction and neuroendocrine imbalance in PCOS. Cases with LH/FSH ≥2.0 were evaluated as a separate categorical variable. Statistical analysis was performed using descriptive and comparative methods. Quantitative variables were expressed as mean ± standard deviation and as median with interquartile range. Distribution characteristics were taken into account when evaluating between-group differences, and the Mann–Whitney U test was applied. Categorical variables were presented as counts and percentages and compared between groups using Fisher's exact test. Statistical significance was set at $p<0.05$. Associations between the LH/FSH ratio and the metabolic and androgen parameters were assessed using Spearman's rank correlation coefficient.

ANALYSIS AND RESULTS

Data from a total of 79 reproductive-age women diagnosed with polycystic ovary syndrome (PCOS) were analyzed. According to the type of menstrual cycle disorder, 44 patients had oligomenorrhea, 34 had amenorrhea, and 1 had dysmenorrhea. The oligomenorrhea and amenorrhea groups were selected for the

two-group statistical comparison; the single case of dysmenorrhea was excluded from the comparative analysis because of its low frequency. Thus, the main statistical analysis was based on data from 78 patients. In the overall sample, the mean age was 26.03 ± 3.83 years, and the median age was 26.00 (23.00–28.00) years. The mean body mass index (BMI) was 25.83 ± 4.10 kg/m², while the median was 26.05 (23.92–27.85) kg/m². The median fasting glucose level was 4.80 (4.40–5.17) mmol/L, the median insulin level was 11.20 (7.80–14.80) ***μIU***/mL, the median HbA1c level was 4.80 (4.50–5.00)%, and the median HOMA-IR was 2.53 (1.55–3.34).

Table 1.
Overall clinical, metabolic, and hormonal characteristics of the study participants

Parameter	n	Mean ± SD	Median (IQR)
Age, years	78	26.03 ± 3.83	26.00 (23.00–28.00)
BMI, kg/m²	78	25.83 ± 4.10	26.05 (23.92–27.85)
Fasting glucose, mmol/L	78	4.82 ± 0.46	4.80 (4.40–5.17)
Fasting insulin, ***μIU***/mL	78	12.34 ± 6.94	11.20 (7.80–14.80)
HbA1c, %	78	4.78 ± 0.47	4.80 (4.50–5.00)
HOMA-IR	78	2.66 ± 1.59	2.53 (1.55–3.34)
FSH, mIU/mL	78	5.68 ± 1.70	5.24 (4.52–6.78)
LH, mIU/mL	78	12.16 ± 4.68	12.12 (9.65–14.67)
LH/FSH ratio	78	2.42 ± 1.73	2.11 (1.61–2.93)
Prolactin	78	55.15 ± 145.36	16.25 (11.15–25.75)
Total testosterone	78	2.62 ± 1.54	2.95 (0.98–3.62)

Note: BMI — body mass index; HbA1c — glycated hemoglobin; HOMA-IR — homeostatic model assessment of insulin resistance; IQR — interquartile range.

When the oligomenorrhea and amenorrhea groups were compared, no statistically significant differences were found in age or BMI. The median age was 24.50 (23.00–28.00) years in the oligomenorrhea group and 26.50 (23.25–29.00) years in the amenorrhea group (p=0.178). The median BMI values were 25.90 (23.98–27.75) and 26.15 (23.75–28.20) kg/m², respectively (p=0.912). No significant between-group differences were observed in metabolic parameters. The median fasting glucose level was 4.80 (4.47–5.20) mmol/L in the oligomenorrhea group and 4.80 (4.40–5.10) mmol/L in the amenorrhea group (p=0.292). The median fasting insulin levels were 10.85 (6.88–14.70) and 11.55 (9.30–15.55) ***μIU***/mL, respectively (p=0.302). No statistically significant differences were found in HbA1c or HOMA-IR. The median HOMA-IR was 2.58 (1.48–3.19) in the oligomenorrhea group and 2.46 (1.75–3.44) in the amenorrhea group (p=0.496).

Table 2.
Comparison of clinical and metabolic parameters in the oligomenorrhea and amenorrhea groups

Parameter	Oligomenorrhea (n=44), median (IQR)	Amenorrhea (n=34), median (IQR)	p
Age, years	24.50 (23.00–28.00)	26.50 (23.25–29.00)	0.178
BMI, kg/m²	25.90 (23.98–27.75)	26.15 (23.75–28.20)	0.912
Fasting glucose, mmol/L	4.80 (4.47–5.20)	4.80 (4.40–5.10)	0.292
Fasting insulin, ***μIU***/mL	10.85 (6.88–14.70)	11.55 (9.30–15.55)	0.302
HbA1c, %	4.80 (4.50–4.93)	4.70 (4.50–5.07)	0.859
HOMA-IR	2.58 (1.48–3.19)	2.46 (1.75–3.44)	0.496
FSH, mIU/mL	5.20 (4.20–6.80)	5.75 (5.01–6.63)	0.200
LH, mIU/mL	12.30 (10.32–14.45)	10.70 (9.23–15.90)	0.632
LH/FSH ratio	2.29 (1.74–2.98)	1.96 (1.58–2.75)	0.302
Prolactin	17.10 (11.00–32.85)	14.95 (11.22–19.75)	0.281
Total testosterone	3.04 (1.86–3.78)	2.22 (0.78–3.18)	0.082

Note: Groups were compared using the Mann–Whitney U test. P<0.05 was considered statistically significant.

When gonadotropin and androgen parameters were compared, no statistically significant differences were observed between the groups in FSH, LH, the LH/FSH ratio, or prolactin. The median LH/FSH ratio was 2.29 (1.74–2.98) in the oligomenorrhea group and 1.96 (1.58–2.75) in the amenorrhea group; the difference was not statistically significant (p=0.302). Total testosterone levels were 3.04 (1.86–3.78) in the oligomenorrhea group and 2.22 (0.78–3.18) in the amenorrhea group, indicating a tendency toward higher values in the oligomenorrhea group, although the difference did not reach statistical significance (p=0.082). Analysis of categorical variables likewise revealed no statistically significant differences between the oligomenorrhea and amenorrhea groups. In the overall sample, 50/78 patients (64.1%) had a BMI ≥25 kg/m², while 11/78 (14.1%) had a BMI ≥30 kg/m². HOMA-IR ≥2.5 was observed in 41/78 patients, corresponding to 52.6% of the overall sample. This proportion was 24/44 (54.5%) in the oligomenorrhea group and 17/34 (50.0%) in the amenorrhea group (p=0.820). An LH/FSH ratio ≥2.0 was recorded in 24/44 (54.5%) patients with oligomenorrhea and 16/34 (47.1%) patients with amenorrhea (p=0.648).

Table 3.
Distribution of categorical metabolic and hormonal parameters by group

Parameter	Overall n (%)	Oligomenorrhea n (%)	Amenorrhea n (%)	p
BMI ≥25 kg/m²	50/78 (64.1%)	28/44 (63.6%)	22/34 (64.7%)	1.000
BMI ≥30 kg/m²	11/78 (14.1%)	7/44 (15.9%)	4/34 (11.8%)	0.747
HOMA-IR ≥2.5	41/78 (52.6%)	24/44 (54.5%)	17/34 (50.0%)	0.820
LH/FSH ≥2.0	40/78 (51.3%)	24/44 (54.5%)	16/34 (47.1%)	0.648

Note: Categorical variables were compared using Fisher's exact test.

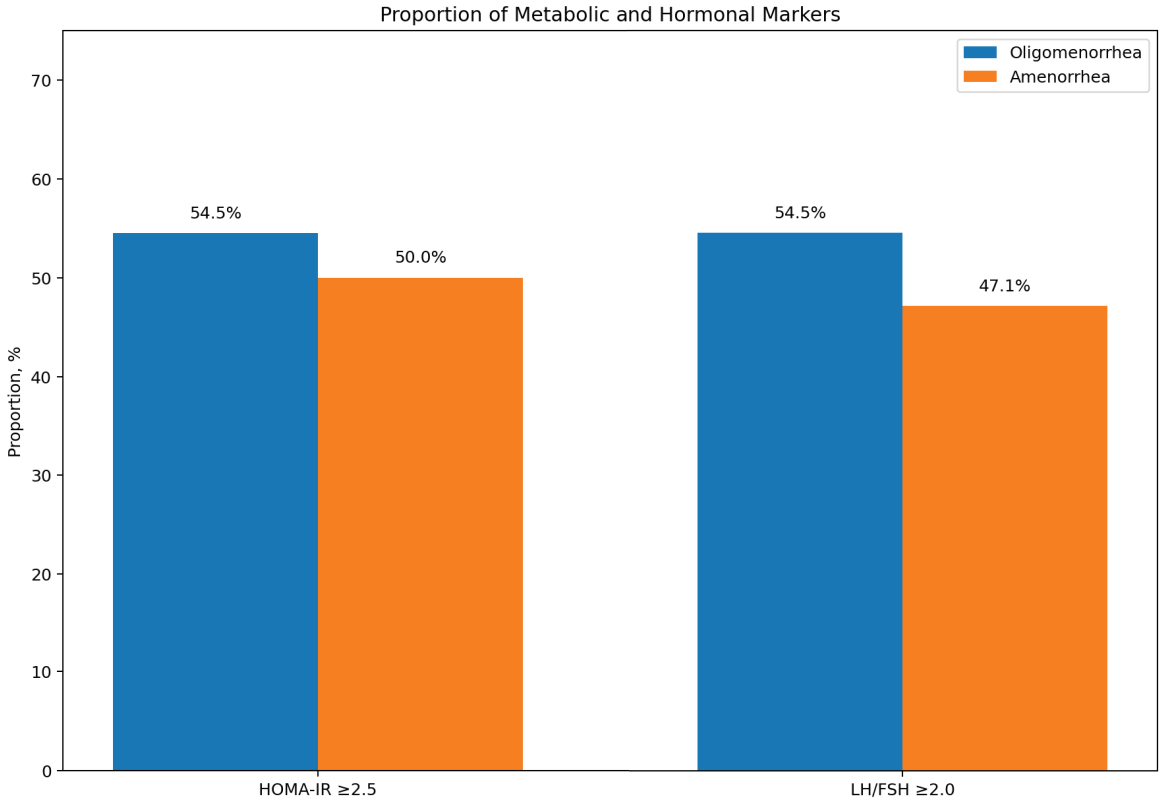


Figure 1. Distribution of the proportions with HOMA-IR ≥2.5 and LH/FSH ≥2.0 in the oligomenorrhea and amenorrhea groups

Note: In the oligomenorrhea group, the proportions with HOMA-IR ≥2.5 and LH/FSH ≥2.0 were both 54.5%.

In the amenorrhea group, the corresponding proportions were 50.0% and 47.1%, respectively. Analysis by BMI category showed that normal BMI (<25 kg/m²) was present in 35.9% of the overall sample, overweight

in 50.0%, and obesity in 14.1%. In the oligomenorrhea group, normal BMI was observed in 36.4%, overweight in 47.7%, and obesity in 15.9%; in the amenorrhea group, the corresponding proportions were 35.3%, 52.9%, and 11.8%.

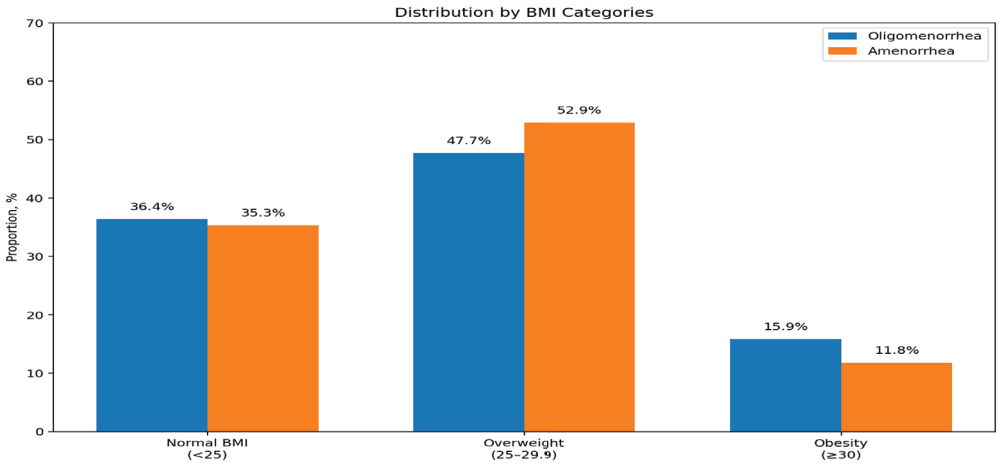


Figure 2. Distribution of BMI categories in the oligomenorrhea and amenorrhea groups
Note: Overweight was the most common category in both groups, accounting for 52.9% of the amenorrhea group and 47.7% of the oligomenorrhea group.

Spearman correlation analysis was performed to assess the associations between the LH/FSH ratio and metabolic and androgen parameters. The LH/FSH ratio showed no statistically significant correlation with HOMA-IR (rho = −0.106; p = 0.353), BMI (rho = 0.053; p = 0.644), insulin (rho = −0.068; p = 0.552), or total testosterone (rho = 0.062; p = 0.588).

Table 4.
Correlation of the LH/FSH ratio with metabolic and androgen parameters

Correlation	n	Spearman rho	p
LH/FSH and HOMA-IR	78	-0.106	0.353
LH/FSH and BMI	78	0.053	0.644
LH/FSH and insulin	78	-0.068	0.552
LH/FSH and total testosterone	78	0.062	0.588

Note: Spearman correlation analysis. p<0.05 was considered statistically significant.

Overall, the study results showed that the clinical phenotypes of oligomenorrhea and amenorrhea in women with PCOS did not differ markedly in anthropometric, metabolic, or major hormonal parameters. Amenorrhea was not confirmed to be associated with a clearly greater metabolic burden than oligomenorrhea. At the same time, the high proportion of patients with HOMA-IR ≥2.5 in both groups indicates the need for active screening for insulin resistance in patients with PCOS, regardless of the type of menstrual disorder. In this study, the clinical phenotypes of oligomenorrhea and amenorrhea in reproductive-age women with polycystic ovary syndrome (PCOS) were compared on the basis of metabolic and hormonal parameters. The analysis showed no statistically significant differences between the oligomenorrhea and amenorrhea groups in body mass index, fasting glucose, insulin, HbA1c, HOMA-IR, FSH, LH, prolactin, or the LH/FSH ratio. The proportion of patients with HOMA-IR ≥2.5 was also nearly identical in the two groups. These findings indicate that the clinical type of menstrual dysfunction in PCOS does not always fully reflect the severity of metabolic disturbances. PCOS is a clinically heterogeneous syndrome in which reproductive, metabolic, and psycho-emotional manifestations vary in severity among patients. A comprehensive review by Joham et al. emphasized that the pathogenesis of PCOS can be explained by the interaction of genetic predisposition, hypothalamic-pituitary dysfunction, hyperandrogenism, insulin resistance, and adipose tissue-related mechanisms [11]. From this perspective, although the presence of oligomenorrhea or amenorrhea indicates ovulatory dysfunction, menstrual phenotype alone may not be sufficient to assess the degree of metabolic disturbance as an independent indicator.

In our study, elevated HOMA-IR was not more frequent in the amenorrhea group than in the oligomenorrhea group. This finding does not fully support the view expressed in some publications that amenorrhea represents a metabolically more severe phenotype. However, recent studies comparing PCOS phenotypes have reported inconsistent results. Mansour et al. reported that the risk of insulin resistance may be higher in the classic complete PCOS phenotype, while also noting that findings related to HOMA-IR vary across studies depending on the selected HOMA-IR cut-off, BMI, ethnic differences, and diagnostic criteria [12]. Szkodziak et al. likewise showed that insulin resistance is not equally expressed across PCOS phenotypes and that metabolic risk is influenced not only by menstrual dysfunction but also by androgen levels, body composition, and cardiovascular risk markers [13]. The absence of a statistically significant difference in BMI between the groups in this study may partly explain the similarity of their metabolic parameters. Excess body weight, particularly visceral adiposity, is one of the major factors influencing insulin resistance in PCOS. In a study involving 632 women with PCOS, Morshed et al. found that patients with insulin resistance had a less favorable metabolic profile, whereas the frequency of menstrual disturbances did not differ markedly between insulin-resistant and insulin-sensitive groups [14]. This finding is relevant to our observations: although menstrual phenotype is clinically important, metabolic risk assessment requires separate evaluation of variables such as BMI, waist circumference, insulin, HOMA-IR, and lipid metabolism.

No statistically significant difference in the LH/FSH ratio was found between the groups. Although the median LH/FSH ratio was slightly higher in the oligomenorrhea group than in the amenorrhea group, the difference did not reach statistical significance. According to contemporary evidence, the LH/FSH ratio may be regarded as one of the classical hormonal features of PCOS, but it is insufficient as an independent diagnostic criterion. BMI, age, the timing of testing, ovulatory status, and the degree of hyperandrogenism may all influence this ratio. A 2024 meta-analysis by Feng et al. showed that some treatment approaches can reduce LH levels and the LH/FSH ratio, although the authors specifically noted the limited quality of the evidence and heterogeneity among studies [15]. This supports interpreting the LH/FSH ratio within the broader clinical and hormonal context rather than in isolation. In our study, total testosterone levels tended to be higher in the oligomenorrhea group than in the amenorrhea group, although the difference did not reach statistical significance. This observation is clinically noteworthy because menstrual dysfunction and hyperandrogenism in PCOS do not necessarily increase in parallel. In some patients, ovulatory dysfunction may be more strongly associated with metabolic and neuroendocrine mechanisms, whereas in others it may be more closely related to androgen excess. A meta-analysis by Ren et al. reported that various adjunctive treatment approaches may have beneficial effects on HOMA-IR and total testosterone, although the results for LH, FSH, and androgen markers showed substantial heterogeneity [16]. Therefore, the observed trend in testosterone may warrant further investigation, but confirmation would require a larger sample and additional measurements, such as the free androgen index, sex hormone-binding globulin (SHBG), and dehydroepiandrosterone sulfate (DHEAS). The similar proportions of patients with HOMA-IR ≥2.5 in the two groups represent one of the most important findings of this study. This suggests that insulin resistance in PCOS is not clearly differentiated by the type of menstrual disorder and that metabolic risk in women with oligomenorrhea may be no lower than in women with amenorrhea. A 2025 network meta-analysis by Bo et al. reported that pharmacological interventions in PCOS have varying effects on body weight, waist circumference, HOMA-IR, glucose, and certain hormonal parameters [17]. A meta-analysis by Melin et al. on insulin sensitizers likewise indicated that the choice of metabolic treatment in PCOS should be based on the individual metabolic profile [18]. These findings reinforce our conclusion that menstrual phenotype alone should not be used as a basis for limiting metabolic screening. The role of body weight also warrants separate consideration. A systematic review and meta-analysis of randomized trials by Scragg et al. showed that weight-loss interventions may improve HOMA-IR, the free androgen index, and menstrual frequency [19]. In a systematic review of anti-obesity medications, Goldberg et al. emphasized that evidence supporting pharmacological anti-obesity therapies in PCOS remains limited, although their effects on body weight and insulin resistance suggest that they may become an important therapeutic option in the future [20]. Because BMI was similar between the groups in our study, any metabolic differences between amenorrhea and oligomenorrhea may have been less pronounced.

In addition, ovulatory dysfunction in PCOS cannot be explained solely by insulin resistance. Anti-Müllerian hormone (AMH), follicular development, hypothalamic-pituitary rhythmicity, androgen excess, and changes in the intraovarian environment also affect the menstrual cycle. A 2024 systematic review and meta-analysis by Muslim et al. showed that the association between AMH and HOMA-IR was weak and statistically non-significant [21]. This suggests that reproductive and metabolic phenotypes may occur in parallel in PCOS but do not necessarily reflect one another fully. The scientific significance of the present study lies in comparing the clinical phenotypes of oligomenorrhea and amenorrhea within the same sample using metabolic and hormonal parameters, as well as calculating and separately assessing the LH/FSH ratio. The results indicate

that the assumption that amenorrhea automatically represents a more severe metabolic phenotype should be treated with caution. Conversely, elevated HOMA-IR may also occur frequently in patients with oligomenorrhea. Therefore, in clinical practice, women with PCOS require comprehensive evaluation of insulin, HOMA-IR, glucose metabolism, lipid profile, body weight, and androgen status, regardless of the type of menstrual disorder. This study has several limitations. First, its retrospective design does not allow cause-and-effect relationships to be established. Second, the numbers of patients in the amenorrhea and oligomenorrhea groups were relatively small, reducing the statistical power to detect modest differences. Third, waist circumference, lipid profile, free androgen index, AMH, and oral glucose tolerance test results were not included in the analysis. Fourth, there is no universally accepted HOMA-IR cut-off, and threshold values may differ across populations. Therefore, future studies should include larger samples, a prospective design, components of metabolic syndrome, AMH, the free androgen index, and lipid metabolism parameters. Overall, the results of this study showed that the clinical phenotypes of oligomenorrhea and amenorrhea in PCOS may not differ markedly in terms of metabolic and major hormonal parameters. Although the LH/FSH ratio may be useful as an additional hormonal marker, it is insufficient to be considered an independent marker of metabolic risk. The main clinical conclusion is that metabolic risk in women with PCOS should be assessed on the basis of individual laboratory and anthropometric parameters, regardless of the type of menstrual cycle disturbance.

CONCLUSION

The results of this retrospective analysis showed that the clinical phenotypes of oligomenorrhea and amenorrhea in women with polycystic ovary syndrome did not differ markedly in terms of metabolic or major hormonal parameters. The study did not confirm that amenorrhea, compared with oligomenorrhea, was associated with a clearly greater metabolic burden, higher body mass index, or a higher frequency of insulin resistance. No statistically significant differences were found between the oligomenorrhea and amenorrhea groups in BMI, fasting glucose, insulin, HbA1c, HOMA-IR, FSH, LH, prolactin, or the LH/FSH ratio. This suggests that the clinical type of menstrual cycle dysfunction in PCOS may not independently or sufficiently reflect the degree of metabolic risk. The high proportion of patients with HOMA-IR ≥2.5 in both groups indicates that insulin resistance is common among women with PCOS. Therefore, regardless of whether oligomenorrhea or amenorrhea is present, the assessment of fasting insulin and HOMA-IR may have clinical value in evaluating metabolic risk in patients with PCOS.

Although the LH/FSH ratio was relatively higher in the oligomenorrhea group, the difference between the groups was not statistically significant. Therefore, this parameter may be used as an additional hormonal marker in PCOS, but it should not be interpreted as an independent diagnostic criterion or a standalone marker of metabolic risk. Total testosterone levels tended to be higher in the oligomenorrhea group, but the difference did not reach statistical significance. This finding highlights the need for a broader assessment of the androgen profile, free androgen index, FSH, and other reproductive and metabolic markers in future studies of menstrual phenotypes in women with PCOS. Thus, the study findings indicate that metabolic risk assessment in women with PCOS should be based not solely on the type of menstrual disorder but on a comprehensive analysis of individual anthropometric, metabolic, and hormonal parameters. In clinical practice, both oligomenorrhea and amenorrhea should prompt consideration of metabolic screening, including assessment of insulin resistance.

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