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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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ALTERED LEVELS OF ANTI-MULLERIAN HORMONE AND HEPCIDIN AS POTENTIAL BIOMARKERS FOR POLYCYSTIC OVARY SYNDROME

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Abstract.

Background: Polycystic Ovary Syndrome (PCOS) is one of the most common endocrinopathies in women of reproductive age group.

Aim: to determine the relationship of Anti-Mullerian hormone (AMH) with hepcidin, ferritin, serum iron and interleukin-6 among PCOS women.

Methods: A total of 60 PCOS women enrolled in the study, whose ages ranges were between 15-45 years old versus control group (30 healthy volunteer females with regular menstrual cycles aged between 15 to 45 years). All PCOS patients and healthy control underwent full physical examination and anthropometric measurements. Blood samples were collected from each woman for measurement of AMH, and hepcidin. The study showed that the Lowest mean of hepcidin was observed among PCOS women (13.27±1.46 ng/ml) as compared to the control group of non-PCOS women (98.76±2.88 ng/ml). The mean SD of AMH in PCOS women was (7.63±3.66 ng/ml), which was significantly higher than the control group with a mean SD of (2.09±1.11 ng/ml). Based on the study findings, women with PCOS had significantly higher average serum iron levels compared to the control group (223.5±57.3 and 129.144.9 g/dl), serum ferritin levels were significantly elevated in women with PCOS (279.9±44.9 and 189.5 57.3 ng/ml). The mean level of hepcidin was (14.77±1.31 ng/ml) in overweight PCOS women, which was elevated significantly than in PCOS women with normal BMI (12.18±1.58 /ml). The study found a negative correlation of serum hepcidin with each iron, ferritin and AMH among PCOS women.

Key words. PCOS, anti-mullerian hormone, hepcidin, ferritin, iron, interleukin-6.

Introduction.

Polycystic Ovarian Syndrome (PCOS) is a common female gynaecological endocrinopathy disorder that affects women between the ages of 18 to 45 years. It is characterized by a range of signs and symptoms that include androgen excess, ovulatory dysfunction, and disruptions to the hypothalamic–pituitary–ovarian (HPO) axis function [1-3]. PCOS is diagnosed by the appearance of at least two of the following criteria: increased androgenic hormones, irregular or absent ovulation, and enlarged ovaries comprising over 12 follicles [4].

It has lifelong implications with increased risk for obese and insulin-resistant, obese, and insulin-sensitive, normal-weight and insulin-resistant, and non-insulin-resistant [5]. Women with PCOS may present typical metabolic abnormalities such as insulin resistance (IR) and visceral obesity at a young age. Long-term exposure to these abnormalities throughout fertile life may exacerbate the adverse effects and expose these women to higher risks of metabolic syndrome (MetS), cardiovascular diseases (CVDs) and type II diabetes mellitus (T2DM) [6].

The cause of high production of anti-Mullerian hormone (AMH) in antral follicles of PCOS is currently unknown but there is evidence to support a role played by androgens. Indeed, a positive correlation between serum androgen and AMH levels has been reported and the production of androgens could be an intrinsic defect of thecal cells in PCOS [7]. Some investigators have suggested that increased AMH levels result from the stimulatory effect of androgens in early follicular growth, and others have concluded that AMH can be utilized as a diagnostic marker for ovarian hyperandrogenism [8].

Ferritin is an intracellular storage protein that is essential for the regulation of iron homeostasis. Concentrations of serum ferritin are being used as a biomarker to estimate the levels of body iron stores [9]. Iron is a strong pro-oxidant and high levels of it in the body are associated with an increased level of oxidative stress, which elevates the risk of T2DM and CVD. Whereas mildly elevated body iron stores are associated with impaired glucose tolerance [10].

Hepcidin regulates the body's iron levels, which is important in host defence. The serum hepcidin levels increase during inflammation and infection which is independent of iron levels. The IL-6 plays a major role in this issue [11,12]. The study aimed to determine the relationship between the AMH with hepcidin among PCOS women.

Patients and Methods.

A Case-control study is carried out in Kirkuk City from the 10th of November 2022 to the 10th of March 2023. The number of PCOS women under study was 60 women whose ages were between 15-45 years old. These patients were admitted to the obstetrics and gynaecology unit at Gynecological and Pediatric Hospital in Kirkuk City. PCOS was diagnosed based on the presence of two of the following Rotterdam criteria:

Oligo and/or anovulation, clinical and/or Biochemical signs of hyperandrogenism, and Polycystic ovaries in ultrasound, meaning the presence of 12 or more follicles measuring 2-9 mm in diameter in each ovary and/or ovarian volume of more than 10 cm^3.

In addition, the control group consisted of 30 healthy volunteer females with regular menstrual cycles aged between 15 to 45 years. All PCOS patients and healthy control underwent full physical examination and anthropometric measurements including weight, and height, and were asked to complete a general questionnaire. Body Mass Index (BMI) was calculated by using the formula: weight (kg)/height ($meters^2$)

Patients with metabolic or endocrinology disorders including thyroid disorder, diabetes, hypertensive, and hyperprolactinemia, and excluded from the study by specific laboratory tests. Subjects with medication like ovulation induction agents, antiandrogens, antidiabetic, antiobesity, hormonal drugs and current or previous use were also excluded. Approval

permission was presented to the director of Kirkuk Health Directorate / Gynecological and Pediatric Hospital in Kirkuk City. Five ml of blood sample was taken by vein puncture from each subject enrolled in this study (women were in 2-5 days of menstrual cycle). Blood samples were added to gell tubes, after blood clotting, centrifuged at 3000 rpm for 15 minutes then the clot was removed and remained re-centrifuged at 3000 for 10 minute and the obtained serum were aspirated using a mechanical micropipette and transferred into clean test tubes which labelled and stored at -20ºC for measurement of AMH, hepcidin by Enzyme-linked immunosorbent assay (ELISA), and serum ferritin, by immunofluorescence and serum iron by manual biochemistry kits.

Results.

The study showed that Women with PCOS were characterized by increased BMI (Body Mass Index) and were associated with various health conditions such as hirsutism, acne, menstrual cycle disturbance, and alopecia. In total, 60 patients were diagnosed with PCOS. Patients with Alopecia included 17 patients (28.33%) and 30 patients (71.67%) (Table 1).

Table 2 displays the hepcidin levels in two studied groups. In the patient group consisting of PCOS women, the mean ± SD hepcidin level was 13.27 ± 1.46 ng/ml. In contrast, the control group of non-PCOS women exhibited a mean ± SD hepcidin level of 98.76 ± 2.88 ng/ml. Notably, the hepcidin levels were significantly lower in PCOS women compared to non-PCOS women, as indicated by a p-value of 0.0001.

According to Table 3, the study revealed that the mean ± SD of AMH in PCOS women was 7.63 ± 3.66 ng/ml, which was significantly higher than the control group with a mean ± SD of 2.09 ± 1.11 ng/ml. The difference between the two groups was statistically significant, as indicated by a p-value of 0.0001.

Based on the study findings, women with PCOS had significantly higher average serum iron levels compared to the control group (223.5±57.3 and 129.1±44.9 g/dl, respectively). Additionally, the study demonstrated that serum ferritin levels were significantly elevated in women with PCOS (279.9±44.9 ng/ml) compared to the control group (189.5.6±57.3 ng/ml) (Table 4).

Table 5 shows that the mean level of hepcidin was (14.77±1.31 ng/ml) in overweight PCOS women, which was elevated significantly than in PCOS women with normal BMI (12.18±1.58 /ml) (P=0.006).

The study showed that the Mean±SD of AMH in PCOS women with BMI>25 (kg/m2) was (8.27±3.03 ng/ml) was significantly higher than in PCOS women with normal BMI (7.01±2.91 ng/ml) at P. value 0.001 (Table 6).

In addition, the study found a negative correlation of serum hepcidin with each iron, ferritin, and AMH among PCOS women. However, the study did not find any significant correlations between AMH and ferritin, or between serum iron and AMH (Table 7).

Discussion.

The finding that patients with PCOS have reduced serum hepcidin concentrations compared to healthy controls, as observed by Tawfeq et al. [1], suggests a potential link between PCOS and altered iron metabolism. Several other studies also found that patients with PCOS had serum hepcidin concentrations reduced than healthy controls [2,3]. Moreover, Sarhat et al. [4], in a recent study indicated a notable reduction in the serum levels of hepcidin PCOS group compared to the

Table 1. *Clinical data of patients' group.*

Parameters		No.	%
Age	<30 year	34	56.67
	≥30 year	26	43.33
	Total	60	100
BMI (kg/m^2)	≤25	17	28.33
	25-29.9	30	50
	≥30	13	21.67
	Total	60	100
Hirsutism	Absent	7	11.67
	Present	53	88.33
	Total	60	100
Acne	Absent	9	15.00
	Present	51	85.00
	Total	60	100
Menstrual cycle disturbance	Regular	7	11.67
	Irregular	53	88.33
	Total	60	100
Family history of PCOS	No	6	10.00
	Yes	54	90.00
	Total	60	100
Alopecia	Yes	17	28.33
	No	30	71.67
	Total	60	100

Table 2. *Mean levels of hepcidin in PCOS women and the control group.*

Hepcidin (ng/ml)	Studied groups	
	Patients group	Control group
No.	60	30
Mean±SD	13.27±1.46	98.76±2.88
Minimum	10.77	23.55
Maximum	17.27	78.77
p value= 0.0001		

Table 3. *The level of AMH in blood serum.*

AMH (ng/ml)	**Studied groups**	
	Patients group	**Control group**
No.	60	30
Mean±SD	7.63±3.66	2.09±1.11
Minimum	1.32	1.03
Maximum	13.56	2.98
P-value: 0.0001		

Table 4. *Comparison between studied groups regarding serum iron and ferritin levels.*

Parameters	Studied groups		P-value
	Patient group	Control group	
S. iron (g/dl)	223.5±57.3	129.1±44.9	0.001
S. Ferritin (ng/ml)	279.9±44.9	189.5.6±57.3	0.001

Table 5. *Distribution of hepcidin levels according to BMI in patients' group.*

Hepcidin (ng/ml)	Pateints group	
	BMI≤25 (kg/m^2)	BMI>25 (kg/m^2)
No.	17	43
Mean	12.18±1.58	14.77±1.31
P-value= 0.006		

Table 6. *Distribution of AMH levels according to BMI in the PCOS group.*

AMH (ng/ml)	PCOS (patients group)	
	BMI ≤ 25 (kg/m^2)	BMI > 25 (kg/m^2)
No.	17	43
Mean	7.01±2.91	8.27±3.03
p value= 0.001		

Table 7. *Correlation between hepcidin and different parameters of PCOS group.*

Sample 1	**Sample 2**	**r**	**Correlation**	**p Value**
Hepcidin	S. iron	-0.55	Negative	0.01
Hepcidin	AMH	-0.866	Negative	0.001
Hepcidin	S. Ferritin	-0.753	Negative	0.001

healthy control group and suggested that hepcidin level may be a reliable diagnostic measure for PCOS cases. The current findings also came in agreement with the results of previous studies carried out by Sarhat et al. and his group, as well as Ćwiertnia et al. [5,6]. In addition, Hossein Rashidi et al. [7], also found a significant decrease (P≤0.05) in the concentrations of hepcidin in PCOS women compared to the healthy control group. Hepcidin is a key hormone involved in the regulation of iron homeostasis. It acts by inhibiting iron absorption from the intestines and promoting iron sequestration within cells, thereby limiting its availability for utilization. In normal circumstances, hepcidin levels are regulated in response to iron status, inflammatory signals, and erythropoietic demands [1]. The lower serum hepcidin concentrations observed in patients with PCOS could have several implications. Firstly, reduced hepcidin levels may lead to increased iron absorption, potentially resulting in higher iron levels in the body. This could contribute to iron overload or excess iron accumulation in tissues, although further research is needed to explore this possibility in PCOS [2,3]. Secondly, altered hepcidin levels in PCOS may be associated with disrupted iron utilization. Iron is essential for various physiological processes, including red blood cell production and cellular metabolism. Altered hepcidin levels could impact iron availability for these processes, potentially leading to anaemia or impaired cellular function [4].

The underlying mechanisms contributing to reduced hepcidin levels in PCOS are not yet fully understood. However, it has been hypothesized that the dysregulation of androgens and insulin signalling, which are both characteristic features of PCOS, may play a role. Androgens and insulin have been shown to influence hepcidin expression and iron metabolism in experimental studies [8]. The study's findings support the hypothesis that AMH levels are significantly higher in women with PCOS compared to the control group. In agreement with these findings, Yetim et al. [9] findings proved a high level of AMH was recorded among PCOS women and suggested that AMH can be used as a biomarker for the diagnosis of PCOS. In a recent study, Tunc et al. [10] found that AMH level was significantly higher in the PCOS women than in the control group. Alfatlawi (2017) [11] also AMH showed a significant statistical increase between PCOS patients and the control group P<0.05. The exact mechanisms underlying this relationship are not fully understood. However, it is believed that the excess production of androgens (male hormones) in conditions like PCOS can lead to disrupted follicular development, resulting in anovulation. This disruption may contribute to higher levels of AMH [12]. Also, another study reports similar results that PCOS had higher levels of AMH than control [13]. Muharam et al. [14] suggested that the women with PCOS have high levels of AMH in comparison with the control group AMH level was markedly increased in the PCOS group and these results agree with our results. In PCOS, there is a disruption in this follicular development process. Multiple follicles start to grow but do not fully mature or ovulate. These immature follicles accumulate in the ovaries, leading to an increased number of small, undeveloped follicles. It is in these small antral follicles that AMH is primarily produced. AMH is secreted by the granulosa cells surrounding the follicles and acts as a suppressor of follicle-stimulating hormone (FSH) secretion from the pituitary gland [15]. The higher number of small follicles in PCOS contributes to elevated AMH levels in the bloodstream. Therefore, the increased production of AMH in PCOS is closely linked to the excessive growth of preantral and small antral follicles, which are characteristic of the condition. Elevated AMH levels are often used as a diagnostic marker for PCOS and can provide insights into the ovarian reserve and follicular activity in affected individuals [16]. Measuring serum AMH levels has become a useful tool in diagnosing PCOS and assessing ovarian reserve. The elevated AMH levels in PCOS indicate increased follicular activity and the presence of a larger pool of developing follicles in the ovaries. It's important to note that while elevated AMH levels are commonly associated with PCOS, they are not exclusive to this condition. Other factors, such as age and certain ovarian conditions, can also contribute to elevated AMH levels. Therefore, clinical judgment and consideration of other diagnostic criteria are necessary when evaluating an individual for PCOS [17].

According to the study, the average Serum iron and ferritin level in women with PCOS was significantly higher than that of the control group. Mathew et al. [18], also indicated that the average serum iron level in women with PCOS was significantly higher than that of the control group and serum ferritin was elevated significantly in PCOS women than those in the control group and found that these biochemical indicators may be a reliable diagnostic measure for PCOS cases. Ferritin, the cellular storage protein for iron, serves as a biomarker for estimating the levels of iron stored in the body [19]. Several factors potentially contribute to the elevation of serum ferritin levels

in women with PCOS, including the iron-sparing effect caused by the prolonged menstrual cycle and hyperinsulinism [20]. Meanwhile, higher insulin may facilitate intestinal absorption and deposition of iron in tissue, with IR leading to higher levels of ferritin [21]. Several studies indicated a relationship between PCOS and iron levels in the body, as increased insulin in PCOS women excesses iron storage in the body and raise ferritin levels because the insulin stimulates the intestines to absorb iron, and this indicates an indirect relationship between hepcidin levels and PCOS [22,23].

The increase in serum ferritin levels observed in PCOS patients suggests a potential dysregulation in iron metabolism and storage. Elevated ferritin levels could indicate higher iron stores, which may be associated with underlying hormonal imbalances, insulin resistance, or other factors involved in PCOS pathogenesis [24]. In line with the current findings, previous studies have also reported that the mean level of hepcidin was significantly elevated in overweight PCOS women compared to PCOS women with a normal BMI [25]. Another study reported that the mean level of hepcidin was significantly elevated in overweight PCOS women and this elevation in hepcidin levels suggests a potential association between BMI and hepcidin regulation in PCOS [26]. The specific mechanisms underlying this relationship are not yet fully understood. However, adipose tissue-derived factors and chronic inflammation associated with overweight, or obesity may influence hepcidin production and iron metabolism [27]. Another study indicated that excess adipose tissue, especially in the visceral region, can secrete pro-inflammatory cytokines that may affect hepcidin synthesis and chronic inflammation has been linked to alterations in iron homeostasis, potentially leading to changes in hepcidin levels [4].

Furthermore, factors such as insulin resistance and hormonal imbalances, commonly observed in PCOS and often associated with overweight or obesity, may also contribute to the dysregulation of hepcidin levels. The current findings align with the existing body of literature, suggesting that overweight PCOS women exhibit higher levels of hepcidin compared to those with a normal BMI [28]. The exact mechanisms underlying the relationship between BMI and AMH levels in PCOS are not fully understood. However, it was hypothesized that factors associated with excess adiposity, such as chronic inflammation, insulin resistance, and hormonal imbalances, may influence AMH production [29]. Obesity is defined as abnormal or excessive fat accumulation that presents a risk to human health and has been linked to alterations in reproductive hormones and ovarian dysfunction. Adipose tissue, particularly visceral fat, can secrete various bioactive substances, including hormones and inflammatory cytokines, which may influence AMH levels [30]. This dysregulation of iron metabolism may contribute to the higher iron stores often observed in PCOS [31]. While the study by Hossein Rashidi et al. [7], didn't show negative relation of serum hepcidin with iron, or ferritin, in PCOS women, which contrasts Variations in study design, methodology, and participant characteristics may contribute to the differences in findings. It is important to note that the relationship between hepcidin and serum iron levels in PCOS is still an area of active research, and there may be variations in findings among different studies. Factors such as sample characteristics, methodologies, and variations in PCOS phenotypes may contribute to the inconsistencies. These parameter measurements could be applied to the disease status of the patients even during obstetric emergencies [32], however, the limitation is that the endogenous cellular milieu is affected by cell quasi-equilibrium environment at cellular surrounding environments[33,34].

Conclusion.

Low levels of hepcidin accompanied by high levels of iron, ferritin and AMH were observed in PCOS women as compared with healthy women. More research is needed to elucidate the underlying mechanisms and establish the clinical significance of reduction hepcidin concentrations in PCOS women.

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