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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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ASSOCIATION BETWEEN INFERTILITY AND SERUM LEVELS OF ANTI-MÜLLERIAN HORMONE, FOLLICLE-STIMULATING HORMONE, LUTEINIZING HORMONE, AND PROLACTIN ACCORDING TO VITAMIN D SUPPLEMENTATION STATUS

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Abstract.

Introduction: Hormonal disturbances are associated with infertility in women, and they can often be treated through lifestyle modifications and dietary supplements. **Aim:** This study aimed to determine the correlations between infertility and serum levels of anti-Müllerian hormone (AMH), gonadotrophins, and prolactin according to vitamin D supplementation status. **Materials and Methods:** The current study was conducted on 103 women aged 19-37 years (29 healthy women as a control group and 74 women diagnosed with infertility). Serum levels of the following hormones were examined using enzyme-linked immunosorbent assay: prolactin, luteinizing hormone (LH), follicle-stimulating hormone (FSH), and anti-Müllerian hormone (AMH) in all participating women. **Results:** We found that women with infertility had significantly higher levels of FSH and LH hormones compared to the control group. Interestingly, women who took vitamin D supplements had significantly lower serum levels of AMH compared to untreated women. Additionally, no significant variations were observed in the serum levels of LH and prolactin between untreated infertile women and women taking vitamin D. **Conclusions:** Our findings demonstrate a disturbance in reproductive hormonal levels between healthy and infertile women. Among women with infertility, vitamin D supplementation was associated with lower serum AMH levels, while no statistically significant differences were observed in LH or prolactin levels compared with untreated women, possibly due to other factors or health conditions that affect hormone regulation.

Key words. Infertility, prolactin, luteinizing hormone, follicle-stimulating hormone, Vitamin D; Anti-Müllerian.

Introduction.

Infertility is a prevalent condition that significantly affects personal health and quality of life, and also has a significant social and economic impact on societies [1]. According to the World Health Organization, around 110 million women worldwide suffer from infertility [2]. Infertility can be caused by several underlying conditions, including endometriosis, chromosomal defects, fallopian tube disorders, ovulation problems, and unexplained infertility. Furthermore, untreated sexually transmitted infections caused by Neisseria gonorrhoeae and Chlamydia trachomatis can affect the female reproductive system [3]. In general, polycystic ovarian syndrome is the most common non-ovulatory cause of female infertility, while ovulation abnormalities are the most common cause [4]. Hormonal causes of infertility in females include non-reproductive endocrine glands (pancreas, adrenal glands, and thyroid gland) and non-endocrine organs (kidneys and liver), as well as disorders of the reproductive system (hypothalamic-pituitary-ovarian axis). Reproductive hormones are metabolised and eliminated by these non-endocrine organs [5]. However, the normal feedback mechanism of the hypothalamic-pituitary-ovarian axis is disrupted if its function is altered, leading to dysregulation of oocyte maturation, impaired ovulation, and eventually infertility. Interestingly, anovulation is a sign of an endocrine or metabolic imbalance, which can lead to infertility and menstruation problems. It is an indicator of hormone-induced infertility [6].

Anti- Müllerian hormone (AMH) is a glycoprotein belonging to the transforming growth factor-β family, and is produced by granulosa cells in antral follicles. During follicle growth, AMH production gradually decreases and becomes indistinguishable in follicles larger than 8 mm. Recently, fertility screening for women has come to rely on serum levels of AMH as a reliable indicator of ovarian function, enabling targeted infertility therapy [7]. Ovarian reserve and the number of small follicles are related to AMH hormone levels [8]. It appears that the level of AMH hormone fluctuates slightly during the menstrual cycle, and the number of small follicles is relatively constant. The level of AMH hormone generally decreases with age, indicating a decrease in the number of ovarian follicles and the onset of menopause [9].

Primordial follicles cannot end early in a woman's life because the hormone AMH inhibits their growth [10]. Because women with infertility have two to three times as many small follicles (2–5 mm) compared to healthy women, their concentration of AMH hormone increases, and it appears that the concentration of AMH hormone plays a role in the pathophysiology of both anovulation and infertility [11]. Elevated levels of AMH hormone inhibit follicular growth in the antral phase, as well as inhibiting the selection of the dominant follicle by reducing the antral follicles' sensitivity to FSH. In addition, AMH inhibits the aromatase enzyme, which reduces follicular oestradiol synthesis, and this may lead to a malfunction in the process of selection of the dominant follicle [12].

Obesity and nutrition may affect AMH production, as some studies have found that obese women have lower levels of AMH, suggesting an inverse relationship between BMI and AMH, while other studies have found no relationship between BMI, AMH, and dietary factors [13-15]. The current study investigates the correlations between vitamin D supplementation and the serum levels of AMH, gonadotrophins, and prolactin in women diagnosed with infertility, depending on BMI.

Materials and Methods.

The multicenter cross-sectional study was conducted on 103 women aged 19 to 37 years (29 healthy women as a control group, 31 untreated women diagnosed with infertility, and 43 infertile women taking vitamin D supplements). The control group consisted of healthy females attending clinics for routine gynaecological exams, had normal menstrual cycles, and did not exhibit any biochemical or clinical signs of hyperandrogenism (hirsutism or irregular menstruation). The women were of premenopausal age, had been diagnosed with infertility according to the approved criteria, and had not taken oral contraceptives for at least three months. Infertile women in the vitamin D supplementation group (n = 43) received vitamin D supplements at a dose of 50,000 IU per week for an average of five months before blood sampling. Blood samples were collected from Al-Hayat Private Hospital and private women's clinics from October 2024 to August 2025 with ethical reference code (PREC-26-6-19).

The doctor measured the patient's weight, height, and BMI in the clinical laboratory. After an overnight fast of 10 to 12 hours, a venous blood sample was taken from the patient on the second or third day of the menstrual cycle during the early follicular phase. The serum was then separated using a centrifuge at a speed of 4000 rpm for three minutes. The enzyme-linked immunosorbent assay (ELISA) was used to measure the serum levels of 25-hydroxyvitamin D [25(OH)D], prolactin, luteinizing hormone (LH), follicle-stimulating hormone (FSH), and anti-Müllerian hormone (AMH) in all participating women.

Results.

As shown in Figure 1, a total of 74 women diagnosed with infertility and 29 healthy women were enrolled in the study. The mean age was 26.36 ± 6.411 years in the control group, 27.94 ± 7.62 years in the untreated women, and 29.51 ± 7.153 years in the group of treated women with vitamin D supplements. The majority of women, 79%, were between 20 and 31 years old among infertile women, and 71% among healthy women. The mean BMI was 28.77 ± 4.875 kg/m² in the untreated infertile women and 28.10 ± 4.839 kg/m² in the vitamin D-treated women, compared with 27.48 ± 6.699 kg/m² in the healthy control group. Except for the duration of infertility and number

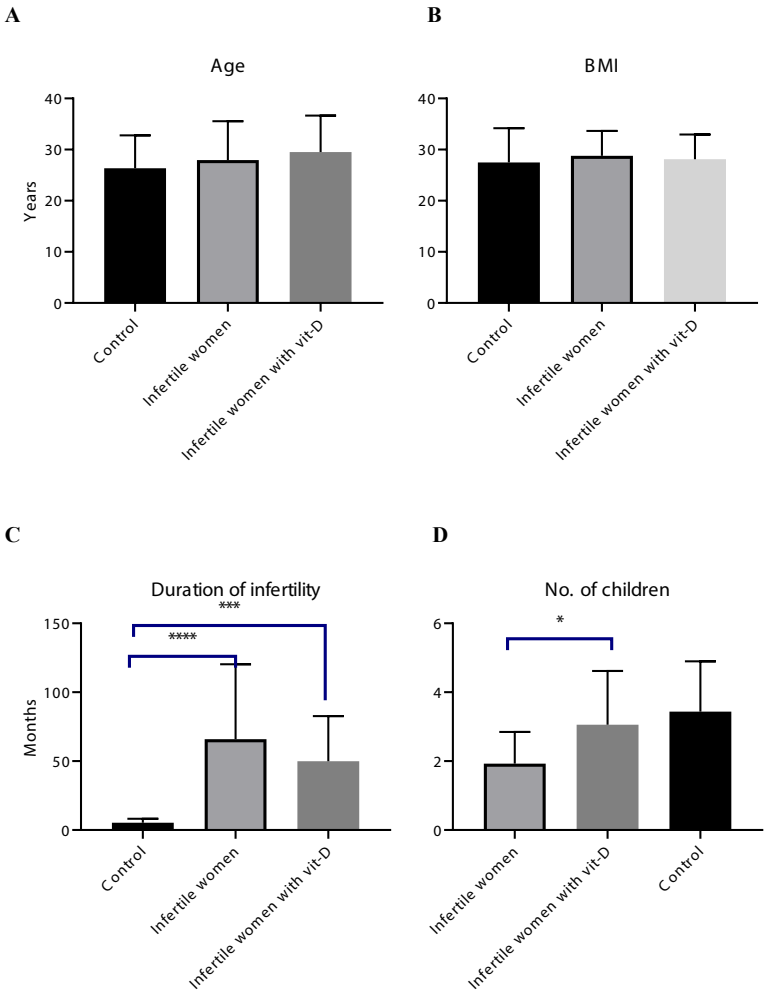


Figure 1. *Demographic characteristics of the healthy, infertile, and vitamin D-treated women. (A) Age, (B) BMI, (C) Duration of infertility, and (D) No. of children.*

*BMI: body mass index. The values represent the mean ± SD. *Represents a significant difference compared to healthy women in the control group (*p<0.05, ***p<0.001, ****p<0.0001), as determined by the Kruskal-Wallis test followed by Dunn's multiple-comparison test.*

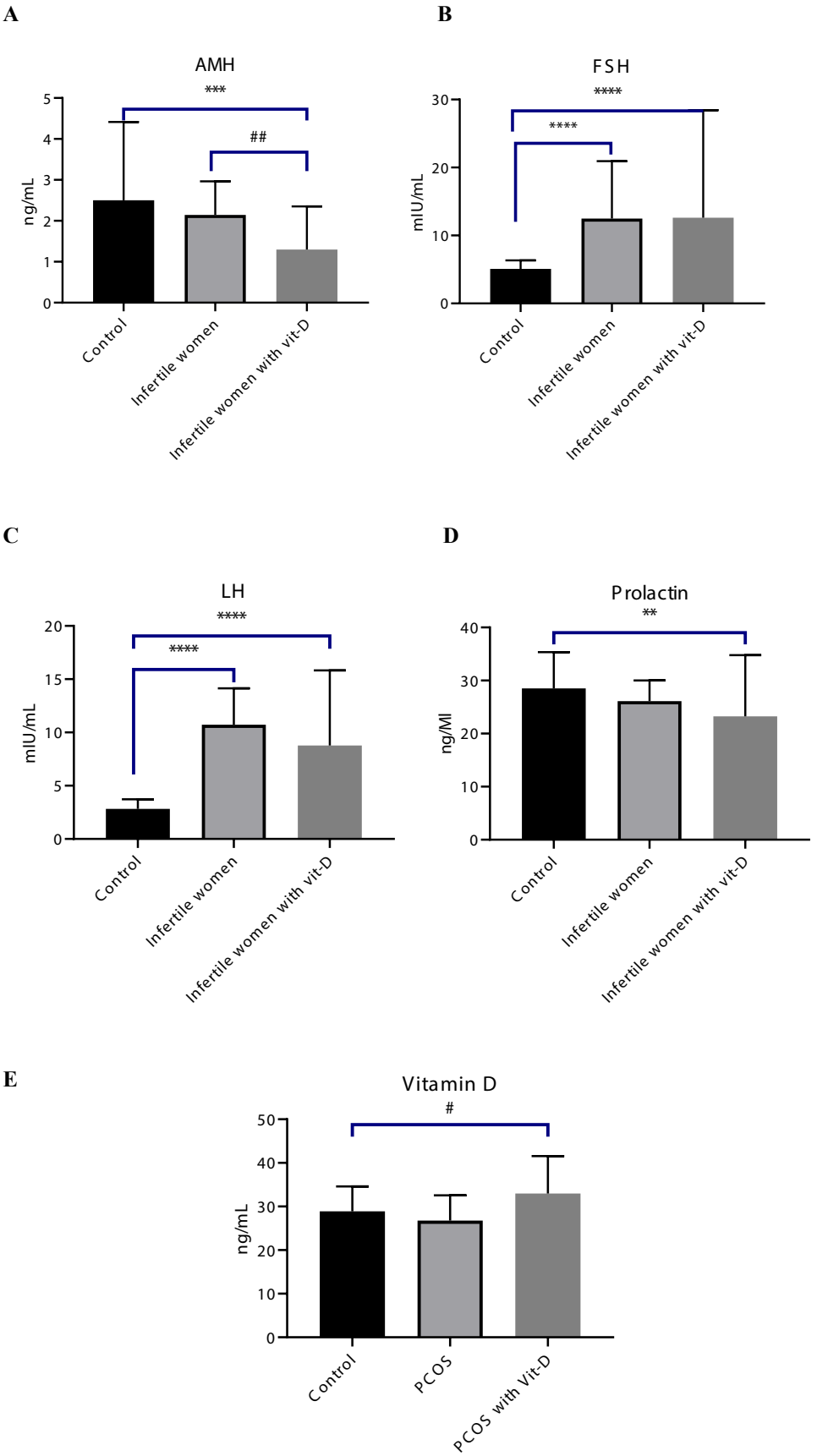


Figure 2. *Evaluation of (A) AMH, (B) FSH, (C) LH, (D) Prolactin, and (E) 25(OH)D. AMH: anti-müllerian hormone. FSH: follicle-stimulating hormone. LH: luteinizing hormone. The values represent the mean ± SD. *Represents a significant difference compared to healthy women in the control group (**p<0.01, ***p<0.001, ****p<0.0001), while # indicates a significant difference compared with infertile women (##p<0.01) as determined by the Kruskal-Wallis test followed by Dunn's multiple-comparison test.*

Table 1. *Demographic characteristics of the control, treated, and untreated women.*

Parameters	Control (n=29)	Infertile women (n=31)	Infertile women with vitamin D (n=43)
Age (in years)	26.36 ± 6.411	27.94 ± 7.620	29.51 ± 7.153
Body mass index (Kg/m^2)	27.48 ± 6.699	28.77 ± 4.875	28.10 ± 4.839
Number of children	3.438 ± 1.459	1.929 ± 0.9169*	3.059 ± 1.560
Duration of infertility (months)	5.370 ± 2.829	65.94 ± 54.34****	49.95 ± 32.70***

*The values represent the mean ± SD. *Represents a significant difference compared to healthy women in the control group (*p<0.05, ***p<0.001, ****p<0.0001), as determined by the Kruskal-Wallis test followed by Dunn's multiple-comparison test.*

Table 2. *Serum AMH, FSH, LH, 25(OH)D, and prolactin levels in the treated and untreated infertile women.*

Parameters	Control (n=29)	Infertile women (n=31)	Infertile women with vitamin D (n=43)
AMH (ng/mL)	2.504 ± 1.911	2.142 ± 0.8225	1.299 ± 0.54$^{***\#\#}$
FSH (mIU/mL)	5.081 ± 1.265	12.50 ± 8.444****	12.62 ± 6.724****
LH (mIU/mL)	2.818 ± 0.9111	10.72 ± 3.423****	8.783 ± 2.035****
Prolactin (ng/mL)	28.52 ± 6.840	26.11 ± 3.921	23.27 ± 8.50**
25-hydroxyvitamin D (ng/mL)	28.50 ± 5.784	27.19 ± 6.083	31.63 ± 8.837$^{\#}$

*AMH: anti-müllerian hormone. FSH: follicle-stimulating hormone. LH: luteinizing hormone. The values represent the mean ± SD. *Represents a significant difference compared to healthy women in the control group (**p<0.01, ***p<0.001, ****p<0.0001), while \# indicates a significant difference compared with infertile women (\#p<0.05, \#\#p<0.01) as determined by Kruskal-Wallis test followed by Dunn's multiple-comparison test.*

of children in infertile women, no statistically significant variations were observed in the reported demographic and anthropometric parameters between the study groups, as shown in Table 1.

Investigation of serum anti-Müllerian hormone, follicle-stimulating hormone, luteinizing hormone, prolactin, and 25(OH)D levels.

As shown in Figure 2, the hormonal levels of FSH and LH were significantly higher in infertile women than in the healthy group. No significant variations were found in serum AMH and prolactin levels between healthy and untreated infertile women. Women taking vitamin D supplements had significantly lower serum AMH levels than the untreated women. However, serum LH and prolactin levels were not significantly lower in women taking vitamin D compared to untreated women (Table 2).

Discussion.

The current study revealed that vitamin D supplementation status was associated with significantly lower serum AMH levels among infertile women compared with untreated women. Interestingly, infertile women showed significantly higher levels of FSH and LH, with non-significantly lower levels of AMH, compared to the healthy control group. Interestingly, AMH is inversely related to FSH and positively related to LH in infertile women. Furthermore, a positive correlation was found between FSH and LH. These correlations were confirmed by other researchers [16-18]. Findings reported by Barbakadze et al. also suggested that AMH negatively correlated with FSH in infertility [19]. Serum levels of AMH are more closely related to ovarian reserve than FSH and have a strong correlation with the number of pre-antral follicles [20]. Elevated FSH levels are attributed to reduced ovarian reserve in infertile women, while low AMH levels are attributed to a reduced number of pre-antral follicles. Therefore, a high level of FSH and a low level of AMH indicate a decrease in ovarian reserve, and consequently, a decrease in fertility potential [21]. The above-mentioned results indicate that serum levels of AMH and FSH can be used as reliable markers of declining ovarian reserve, and therefore ovarian aging.

The results of the current study showed elevated levels of LH, the ovulation hormone, in the serum of infertile women. This result is consistent with the findings of other studies [22].

Elevated LH levels may be due to premature ovarian insufficiency in infertile women, which renders the ovaries unable to produce hormones effectively as a result of impaired production of LH and FSH hormones, leading to menstrual cycle disturbances [23].

Fertility and disorders of the female reproductive system are directly linked to follicular development, which is greatly affected by vitamin D. Several studies have evaluated the effect of vitamin D supplementation on serum levels of AMH, FSH, LH, and prolactin in women with certain diseases [24,25]. The current study showed that infertile women treated with vitamin D had significantly lower levels of AMH compared to untreated women, with LH levels being only subtly reduced.

AMH hormone is a glycoprotein hormone linked to inhibin and activin. It is a member of the transforming growth factor-β family, which plays a significant role in the formation of ovarian follicles [26]. AMH reduces the sensitivity of follicles to FSH. Therefore, it is a potential indicator of the role of AMH in FSH sensitivity and follicle growth [27,28]. However, the effect of vitamin D on both FSH and AMH remains unclear. Similarly, experimental research on this relationship is unclear [26,29,30]. Ovarian reserve, follicle growth, and ovarian steroidogenesis may all be affected by vitamin D. Consequently, the study by Szafarowska et al. showed no correlation between AMH and 25(OH)D levels in women with PCOS, but they did find an association between AMH and polymorphisms of the VDR gene [31]. However, another study revealed that infertility is not affected by vitamin D deficiency or by single nucleotide polymorphism of the VDR gene [32]. A prospective cohort study of infertile women undergoing in vitro fertilisation revealed that women with high levels of 25(OH)D had a four times higher success rate of IVF than women with low levels of 25(OH)D [33]. Furthermore, another prospective study showed that the in

vitro fertilisation results are affected by vitamin D levels without affecting oocyte quality or quantity [34]. According to several studies, vitamin D affects fertilisation, embryo implantation, and follicular development. To determine the precise function and mechanisms of action of vitamin D in fertility results, more experimental data are needed [35]. However, the fact that ovarian reserve is primarily related to the quality and quantity of latent primordial follicles, which cannot be fully explained by serum AMH, FSH, and LH levels, is a potential limitation of our study. Interestingly, another limitation of the current study is that the infertile women were not stratified according to the underlying cause of their infertility. Various causes of infertility, including polycystic ovary syndrome, tubal infertility, diminished ovarian reserve, and unexplained infertility, may affect reproductive hormone levels and thus can confound observed correlations between vitamin D supplementation status and hormonal parameters. However, to establish ovarian reserve, these biochemical indicators were used as alternative factors.

Conclusion.

The present study demonstrated differences in reproductive hormone profiles between healthy and infertile women. In women with infertility, vitamin D supplementation was associated with lower serum AMH levels and higher serum 25(OH)D levels, with no significant variations observed in LH or prolactin levels compared with untreated infertile women. However, further prospective longitudinal studies are needed to clarify the role of vitamin D in the pathophysiology of infertility, given the lower 25(OH)D levels in infertile women compared to healthy fertile women.

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Conflict of Interest.

No conflict of interest

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Аннотация.

Введение: Гормональные нарушения связаны с женским бесплодием, и зачастую их можно скорректировать путем изменения образа жизни и приема биологически активных добавок. **Цель:** Целью данного исследования было выявление взаимосвязи между бесплодием и уровнем в сыворотке крови антимюллерова гормона (АМГ), гонадотропинов и пролактина с учетом приема препаратов витамина D.

Материалы и методы: В исследовании приняли участие 103 женщины в возрасте от 19 до 37 лет (контрольная группа — 29 здоровых женщин, основная группа — 74 женщины с диагнозом «бесплодие»). У всех участниц методом иммуноферментного анализа определяли уровень следующих гормонов в сыворотке крови: пролактина, лютеинизирующего гормона (ЛГ), фолликулостимулирующего гормона (ФСГ) и антимюллерова гормона (АМГ).

Результаты: Было установлено, что у женщин с бесплодием уровни ФСГ и ЛГ были значительно выше по сравнению с контрольной группой. Примечательно, что у женщин, принимавших препараты витамина D, уровень АМГ в сыворотке крови был существенно ниже, чем у женщин, не получавших данную добавку. Кроме того, не было выявлено значимых различий в уровнях ЛГ и пролактина между женщинами с бесплодием, не принимавшими витамин D, и теми, кто его принимал.

Выводы: Полученные данные свидетельствуют о различиях в гормональном профиле репродуктивной системы у здоровых женщин и женщин с бесплодием. У женщин с бесплодием прием витамина D ассоциировался с более низким уровнем АМГ в сыворотке крови, тогда как статистически значимых различий в уровнях ЛГ и пролактина по сравнению с женщинами, не принимавшими витамин D, обнаружено не было; это может быть обусловлено влиянием других факторов или состояний здоровья на регуляцию гормонального фона.

რეზიუმე.

შესავალი: ჰორმონული დარღვევები ქალებში უნაყოფობას უკავშირდება; მათი მკურნალობა ხშირად შესაძლებელია ცხოვრების წესის შეცვლითა და საკვები დანამატების მიღებით.

მიზანი: კვლევის მიზანი იყო უნაყოფობასა და შრატში ანტიმიულერული ჰორმონის (AMH), გონადოტროპინებისა და პროლაქტინის დონეებს შორის კავშირის დადგენა, D ვიტამინის დანამატების მიღების ფაქტორის გათვალისწინებით.

მასალები და მეთოდები: კვლევა ჩატარდა 19-დან 37 წლამდე ასაკის 103 ქალის მონაწილეობით (29 ჯანმრთელი ქალი საკონტროლო ჯგუფში და 74 ქალი უნაყოფობის დიაგნოზით). ყველა მონაწილე ქალის შრატში განისაზღვრა შემდეგი ჰორმონების დონეები ფერმენტული იმუნოსორბციული ანალიზის (ELISA) მეთოდით: პროლაქტინი, ლუტეინიზებელი ჰორმონი (LH), ფოლიკულმასტიმულირებელი ჰორმონი (FSH) და ანტიმიულერული ჰორმონი (AMH).

შედეგები: დადგინდა, რომ უნაყოფობის მქონე ქალებში FSH-ისა და LH-ის დონეები მნიშვნელოვნად მაღალი იყო საკონტროლო ჯგუფთან შედარებით. აღსანიშნავია, რომ იმ ქალებში, რომლებიც იღებდნენ D ვიტამინის დანამატებს, AMH-ის დონე შრატში მნიშვნელოვნად დაბალი იყო მათთან შედარებით, ვინც დანამატებს არ

იღებდა. ამასთანავე, არ გამოვლენილა მნიშვნელოვანი განსხვავება LH-ისა და პროლაქტინის დონეებში უნაყოფო ქალებს შორის, იმის მიხედვით, იღებდნენ თუ არა ისინი D ვიტამინს.

დასკვნები: კვლევის შედეგები მიუთითებს განსხვავებაზე რეპროდუქციული ჰორმონების დონეებში ჯანმრთელ და უნაყოფო ქალებს შორის. უნაყოფობის მქონე ქალებში D ვიტამინის დანამატების მიღება დაკავშირებული იყო შრატში AMH-ის დაბალ დონესთან, მაშინ როდესაც LH-ისა და პროლაქტინის დონეებში სტატისტიკურად მნიშვნელოვანი განსხვავება არ დაფიქსირებულა დანამატების არამიღების ჯგუფთან შედარებით; ეს შესაძლოა განპირობებული იყოს სხვა ფაქტორებით ან ჯანმრთელობის მდგომარეობით, რომლებიც გავლენას ახდენს ჰორმონალურ რეგულაციაზე.