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ORIGINAL

HEALTHCARE IN SPORTS: IMPACT OF COVID-19 INFECTION ON OVARIAN RESERVE AND MENSTRUAL CYCLE AMONG FEMALE ATHLETES IN TURKEY

Ufuk Atlıhan

Çankaya Medical Center, İzmir, Turkey
0000-0002-2109-1373
Email: cfl.ufuk@gmail.com

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Abstract

The natural hormonal changes in women's bodies during the beginning of their menstrual and ovarian cycles substantially impact their performance in Olympic sports. This study investigates the effect of the menstrual and ovarian cycles on Turkish female athletes' performance and activity levels. In addition, the effects of COVID-19 on the ovarian and menstrual cycles of female athletes have been reported. The investigation was undertaken by collecting samples from 138 female athletes between 20 and 43. The inquiry involves collecting data on female athletes in Turkey from hospitals between March 2019 and December 2021 and analyzing reproductive and menstrual cycle tests. According to the research, the menstrual cycle has less of an impact on the athletic performance of female athletes than the ovarian cycle. Women's athletic performance is dramatically diminished at the beginning of the ovarian cycle. In addition, it was observed that COVID-19 substantially affected various natural phenomena in female athletes, including their ovarian and menstrual cycles. The study's results demonstrated that COVID-19 infection dramatically affects women's reproductive cycle. In addition, the production of follicle-stimulating hormones in women was shown to be reduced after infection with COVID-19, whereas the FSH was released in large amounts before the commencement of COVID-19 infection; this had a significant impact on the performance of female athletes in Turkey.

1. INTRODUCTION

This study focuses on the engagement of women in sports as well as the effect of the women's ovarian and menstrual cycles on their athletic talents, focusing on Turkish women athletes. Turkey is a country that believes in gender inequality and that the physical activity capacity of females is lower than that of males; as a result, the participation of Turkish women in sports,

education, and other physical activities is significantly lower than that of men [1]. In recent years, however, the participation of Turkish women in various fields of life has increased, and it is assumed that women participate equally in the physical activities of the country, e.g., as athletes and members of sports NGOs. Women's participation in educational fields has also increased. However, research is still required for Turkish female athletics.

Ovarian and menstrual cycles are the naturally occurring cycles responsible for the health of women's reproductive systems, and these cycles can be influenced by women's sleep-wake cycles. Yet, the disruption of the hormone's secretion during women's sleep-wake cycles has no substantial effect on their ovarian and menstrual cycles [2]. Current research [3] has elucidated the menstrual and ovarian cycles. The ovarian cycle in women begins due to any physiological changes caused by the onset or release of neo-endocrine hormones. It should be noted that the menstrual cycle and ovulation are the two major concepts that mimic inflammatory reactions in women [4]. During the beginning of the ovarian cycle, a protein known as C-reactive protein (CRP) is released, and its quantity in the blood serum reaches a peak with the beginning of follicular waves. A rise in the concentration of CRP triggers the release of progesterone hormone in the body at a high concentration, which shows that the ovarian cycle in women is similar to the inflammatory process that occurs during the body's immunological response. The beginning of a woman's menstrual cycle happens when ovarian cycle implantation does not occur. The menstrual cycle refers to a phase at the end of the ovarian cycle in which the level of progesterone hormone decreases during the final days of the ovarian cycle, resulting in the regeneration and development of endometrial tissue [5].

Moreover, progesterone is anti-inflammatory, i.e., it suppresses the inflammatory action and is therefore secreted by the body in the final stages of the ovarian cycle to initiate the menstrual cycle in women. The performance of female athletes is considerably affected by physiological and psychological relaxation of female athletes. Still, the performance of female athletes is significantly affected by the physiological changes that occur with the commencement of the ovarian or monthly cycle [6]. Current research has demonstrated that the virus can impact numerous physiological systems, including the respiratory, cardiovascular, musculoskeletal, neurological, and reproductive systems. Despite the extensive research on COVID-19, many issues and concerns remain unsolved. Undoubtedly, whether COVID-19 infection impacts ovarian reserve is one of them. Infected young women may experience ovarian damage due to alterations in menstrual cycles and reproductive hormones, according to one study [5, 7]. However, the impact of COVID-19 on the menstrual and ovarian cycle of female athletes has not yet been studied in depth. This study aims to investigate the impact of COVID-19 on the menstrual and ovarian cycles of female athletes in Turkey.

2. LITERATURE REVIEW

The World Health Organization (WHO) has established that the name of the coronavirus infection is "Coronavirus Disease 2019" (abbreviated as COVID-19) and that the name of the virus is "SARS-CoV-2" [8]. Previous

studies demonstrated that the infectious agent of the viral illness was nearly 96% similar to the virus identified in bats [9]. Coronavirus is a family of viruses capable of harming the respiratory system and the gastrointestinal tract of people and animals, which is a leading cause of pneumonia and has proven lethal if untreated [10]. SARS-CoV and MERS-CoV are coronavirus infections that infect humans; bats and camels are responsible for transmitting these viruses to humans, indicating that coronavirus is an animal-transmitted disease [11]. In addition, these illnesses occur in various persons due to environmental changes, thereby affecting both the agent and the recipient. It has been observed that the coronavirus not only transmits through animal contact but also through the droplets of coughing or sneezing of an infected person with coronavirus if that person is within 1m to 1.5m of a healthy person, and experimental analysis has shown that the virus after the sneezing of a diseased person remains in the air as an aerosol for nearly three hours [12] and can also transfer by touching. The most typical signs of coronavirus are fever, dry cough, and exhaustion. However, the disease symptoms may occasionally not manifest, resulting in an asymptomatic infected individual [13]. The menstrual cycle is a sign of the development of ovarian reserve in females, and ovarian reserve can be altered by factors originating from the ovarian pituitary, viral illnesses such as coronavirus, drug-induced stress, or hypothalamus injury [14].

The female menstrual cycle is divided into sub-phases, including follicular and luteal sub-phases, which have been categorized according to the variation of progesterone and estrogen hormones [15]. The female athletes susceptible to the coronavirus had a major impact on their menstrual cycle [16], as indicated by studies conducted on female athletes afflicted with COVID-19. The research was conducted on female athletes. The results suggested that one out of every five female athletes was susceptible to the coronavirus and that the illness disrupted their menstrual cycles, causing them to feel mentally unpleasant. It has been demonstrated that female athletes infected with coronavirus had a disturbance in the duration of the menstrual cycle. The diseased female either had a delayed onset of the menstrual cycle or experienced a prolonged and sometimes shorter period of the menstrual cycle.

SARS-CoV 2 is a stage of COVID-19 that consists of a spike protein (S protein) that acts on the angiotensin-converting enzyme in various human body tissues. According to this research, coronavirus significantly impacts various human systems, including the onset of the menstrual cycle, ovarian reserve, and circadian rhythm [17]. Moreover, the female reproductive system may be affected by COVID-19 due to angiotensin-converting enzymes in female reproductive system tissues. The research conducted on female athletes ill with coronavirus and also at the stage of the ovarian reserve in their reproductive cycle revealed that the female athletes who were susceptible to the COVID-19 infection were feeling very uneasy physiologically and psychologically because the release of the follicle-stimulating hormone was prolonged in the female athletes without coronavirus, but the females ill with the coronavirus were unable to release the follicle-stimulating hormone. In the context of this study, it may be inferred

that coronavirus-infected females have a disordered ovarian cycle, which may affect their fertility.

To summarize the literature review regarding the effect of COVID-19 on the menstrual cycle and ovarian reserve of female athletes, the researcher has demonstrated that females infected with coronavirus have a disturbed menstrual cycle and that the ovarian reserve is also difficult for the reproductive system of such diseased female athletes because the spike protein of the SARS-CoV 2 attacks the angiotensin-converting enzyme, which is present on the lining of the ovaries. Due to these changes in the onset of menstruation and ovarian reserve, Turkish female athletes were found to be physically and mentally unstable, eventually affecting their athletic performance.

3. MATERIALS AND METHODS

138 women between 20 and 43 were enrolled in the study. From March 2019 through December 2021, patient information was retrieved from hospital data. The female athletes' reproductive function tests for follicle-stimulating hormone, luteinizing hormones, estradiol, and anti-Mullerian hormone, as well as their menstrual cycle data, were conducted during the earlier stages of the menstrual cycle.

3.1. Exclusion Criteria

We did not include patients under eighteen in our research because our focus is on the menstrual and ovarian cycles of female athletes. In addition, females with ovarian pathology, women with ovarian surgery, pregnant or breastfeeding females, females with a history of any chronic disease or malignancy, females undergoing hormone replacement due to birth control pills or infertility, and females with a history of chemotherapy or radiotherapy were not included in the research. The search strategy eliminated women who had received coronavirus immunizations and non-athletic women. In addition, non-native female turkeys were excluded from the research methodology employed.

3.2. Inclusion Criteria

This study focuses on women between the ages of nineteen and twenty-three who are susceptible to the commencement of the menstrual cycle and are also at the onset of the ovarian cycle. In addition, the study has only concentrated on athletic women who dwell in Turkey. The female athletes are susceptible to coronavirus infection, have experienced menstrual cycle and ovarian reserve disruptions, and are Turkish nationals only.

According to real-time reverse transcriptase polymerase chain reaction [19], the term COVID-19 refers to a type of infection with a positive result when testing the throat of a symptomatic patient with swabs and analyzing a sample of a throat swab using polymerase chain reaction. In addition, COVID-19 has been separated into two distinct stages of illness, including mild and severe illnesses, as stated by the American Thoracic Society or the Infectious

disease society of America [20]. Coronavirus causes a moderate sickness characterized by fever or chills, cough, shortness of breath and difficulty breathing, exhaustion, muscular or body aches, headache, loss of taste and smell, and sore throat. In addition, the symptoms associated with the severe disease stage of coronavirus include trouble breathing, continuous and persistent chest pain or pressure, inability to wake up, and bluish lips and face, i.e., the patient will have bluish lips and face.

Considering the conversations mentioned above and queries, we collected samples from 138 Turkish female athletes who had previously submitted applications. At the early stages of the follicular hormone release phase, their ovarian reserve was also evaluated, and data regarding the regularity of their menstrual cycles were also collected. In addition, we collected information on the ovarian reserve tests and menstrual cycles of several Turkish female athletes to create a control group for use in the research technique. The data for the control group were collected from female athletes who applied to our research program within six months of contracting the COVID-19 virus. Pre-COVID-19 infection data were separated from post-COVID-19 infection data to perform the research. Following this, the temporal variation between the duration of pre-COVID-19 and post-COVID-19 infection was also recorded, and the data were subsequently reviewed and interpreted in the results section. The recorded results of the patients included their age, gender, pregnancy status, number of children, the state of the menstrual cycle before and after COVID-19, and the medical history of Turkish female athletes was gathered and recorded for research reasons.

Obtaining blood samples from the veins of females in the early stages of their menstrual cycle and the onset of follicular hormone release factor and the follicle-stimulating hormone, anti-Mullerian hormone, luteinizing hormone, and the concentration of estradiol using the enzyme-linked human immunosorbent assay, which includes the detection of follicular hormone release factor and follicle-stimulating hormone, anti-Mullerian hormone, lute Immediately following the collection of samples from twenty- to twenty-three-year-old Turkish female athletes, all samples were analyzed in the same laboratory. As the final step in the research methodology conducted on the female athletes of Turkey, the collected data were divided into two groups: the female athletes with pre-COVID-19 disease and the female athletes with post-COVID-19 infection. SPSS was then used to analyze the data collected from the Turkish female athletes statistically.

4. RESULTS

Given the focus of our research is limited to female athletes between the ages of twenty and twenty-three, it was necessary to collect data only from female athletes in Turkey. A descriptive statistical analysis of the targeted participants was calculated and documented to understand the initial research outcome. In the descriptive analysis of the female athletes, the maximum, minimum, mean, and standard deviation were used to measure the descriptive variables. At the same time, many other figures and percentages were utilized to calculate the interpretations of the categorical variables. The descriptive analysis findings are given in table 1.

Table 1: Results of the descriptive statistics for the measurement variables of the female athletes

	N	Minimum	Maximum	Mean	Standard Deviation
Age	138	20,00	43,00	29,73	5,18
BMI	138	18,60	36,10	22,59	1,87
The period between assessments (months)	138	5,00	28,00	11,57	3,50
Pre-Covid AMH value	138	,44	4,10	1,84	,80
Pre-Covid FSH value	138	3,15	11,20	7,10	1,68
Pre-Covid LH value	138	3,85	12,60	6,90	1,63
Pre-Covid Estradiol value	138	26,60	79,90	48,04	9,85
Post-Covid AMH value	138	,32	3,74	1,62	,74
Post-Covid FSH value	138	3,45	11,80	7,28	1,78
Post-Covid LH value	138	3,69	13,60	7,08	1,87
Post-Covid Estradiol value	138	28,60	67,60	43,74	8,29

According to the results interpreted in the first table, the mean age of the participants was about 29.73±5.18, and the mean value of the Body Mass Index was 22.59±1.87. The average time period that was utilized between evaluations was 11.57±3.5. Pre-COVID-19 anti-Mullerian hormone value was 1.84±0.80, the value of follicle-stimulating hormone was 7.10±1.68, luteinizing hormone had a value of 6.90±1.63, and the value of estradiol concentration was 48.04±9.85.

On the other hand, the value of anti-Mullerian hormone was 1.62±0.74, the value of follicle-stimulating hormone was 7.28±1.78, the value of luteinizing hormone was 7.08±1.87, and the value of estradiol concentration was 43.74±8.29 after the female athletes of Turkey were ill with COVID-19. A descriptive statistical result of the female athletes after COVID-19 is illustrated in table 2:

Table 2: Results of the descriptive statistics for categorical variables of female athletes in Turkey

		N	Percentage
Gravida	0	48	34,8
	1	58	42,0
	2	25	18,1
	3	7	5,1
Parity	0	54	39,1
	1	56	40,6
	2	23	16,7
	3	5	3,6
History of anti-viral treatment	No	115	83,3
	Yes	23	16,7
Smoking habit	No	98	71,0
	Yes	40	29,0
Severe COVID history	No	134	97,1
	Yes	4	2,9
Pre-COVID Oligo menorrhea complaint	No	128	92,8
	Yes	10	7,2
Pre-COVID Poly menorrhea complaint	No	128	92,8
	Yes	10	7,2
Post-COVID Oligo menorrhea complaint	No	119	86,2
	Yes	19	13,8
Post-COVID Poly menorrhea complaint	No	118	85,5
	Yes	20	14,5

According to the results and values calculated and interpreted in table-2, 42.0% of all female athletes had a history of one pregnancy, and 40.6% of these women also had one delivery. According to the computed data, 83.3% of the female participants in this study did not have a medical history of anti-viral treatment. Also, it was revealed that 71% of female athletes did not enjoy

smoking. Likewise, 97.1% of the female athlete participants had no history of serious sickness associated with COVID-19, and 92.8% had no history of Oligo menorrhea or polymenorrhea before COVID-19. Following COVID-19, these rates were observed to be 86.2% and 85.5%, respectively. Hence, there is a corresponding rise in Oligo menorrhea and Poly menorrhea symptoms following COVID-19 infection.

Before beginning the hypothesis tests within the scope of the study, the Kolmogorov-Smirnov Test was used to analyze the normal distribution of the data. After executing the test for the formation of the hypothesis regarding the effect of COVID-19 on the menstrual cycle and ovarian reserve of female athletes in Turkey, it was determined that all of the data acquired throughout the research methodology followed the normal distribution, i.e., $p>0.05$. According to the context of the gathered data, parametric hypothesis tests were conducted. The T-test was preferred for the comparison of pre-COVID-19 and post-COVID-19 independent groups. Also, the change in anti-Mullerian hormone levels before and after COVID-19 was studied.

Table 3: Results of the normal distribution analysis

Measurement	Descriptive Statistics			Differences between measurements					
	N	Mean	Standard Deviation	Mean	Standard Deviation	Standard Error	t	Df	p
Pre-COVID AMH	138	1,84	0,80	0,21	0,120	0,010	21,073	137	0,000
Post-COVID AMH	138	1,62	0,74						

The values of AMH before and after COVID-19 infection showed a statistically significant difference. They elaborated that the value of AMH has decreased post-COVID-19, i.e., $p<0.05$, as illustrated in table 3.

Table 4: The change in FSH values before and after COVID-19 in female athletes

Measurement	Descriptive Statistics			Differences between measurements					
	N	Mean	Standard Deviation	Mean	Standard Deviation	Standard Error	T	Df	p
Pre-COVID FSH Value	138	7,10	1,68	-0,17	0,33	0,028	-6,242	137	0,000
Post-COVID FSH Value	138	7,28	1,78						

The values of FSH before and after COVID-19 infection in female athletes indicated a statistically significant difference, and there was an increase in FSH value throughout the post-COVID-19 infection period ($p<0.05$), as shown in Table 4.

After that, it was determined if the mean value of AMH and FSH in female athletes in Turkey before and after COVID-19 differed statistically when the researcher accounted for the smoking behaviors of the female athletes, as detailed in table 5 below.

Table 5: Comparison of Smoking habits in female athletes in Turkey

Measurement	Smoking Habit	N	Mean ± Standard Deviation	T	P
Pre-COVID-19 AMH Value	No	98	1,86±0,79	0,591	0,555
	Yes	40	1,78±0,82		
Pre-COVID-19 FSH Value	No	98	7,04±1,68	-0,670	0,504
	Yes	40	7,25±1,69		
Post-COVID-19 AMH Value	No	98	1,65±0,74	0,796	0,427
	Yes	40	1,54±0,75		
Post-COVID-19 FSH Value	No	98	7,22±1,77	-0,610	0,543
	Yes	40	7,42±1,82		

The mean values of anti-Mullerian hormone and follicle-stimulating hormone before and after COVID-19 infection in female athletes did not differ statistically significantly ($p>0.05$) about the smoking behaviors of the individuals.

A comprehensive examination of whether or not the mean levels of AMH and FSH in female athletes before and after COVID-19 infection altered statistically as a result of the participants' usage of anti-viral medication is presented in table 6 below.

Table 6: Comparison of Anti-viral Use

Measurement	Anti-viral Use	N	Mean ± Standard Deviation	T	P
Pre-COVID AMH Value	No	115	1,89±0,78	1,809	0,073
	Yes	23	1,56±0,83		
Pre-COVID FSH Value	No	115	6,99±1,54	-1,738	0,084
	Yes	23	7,65±2,22		
Post-COVID AMH Value	No	115	1,68±0,74	2,140	0,034
	Yes	23	1,32±0,73		
Post-COVID FSH Value	No	115	7,15±1,61	-1,879	0,062
	Yes	23	7,91±2,39		

When the researcher considers the anti-viral use of female athletes, only the post-COVID-19 AMH result is statistically different ($p<0.05$). Hence, the mean value of post-COVID-19 AMH for participants with no history of anti-viral treatment is statistically greater than for female athletes who use anti-viral medication. Pre-COVID-19 AMH and pre-/post-COVID-19 FSH characteristics do not indicate a statistically significant difference in anti-viral medication utilization.

In addition, an examination was conducted to determine if the mean values of AMH and FSH before and after COVID-19 infection altered statistically in light of the severe COVID-19 infection history of the female participants, as shown in Table 7 below.

Table 7: Comparison of Severe COVID-19 History of female athletes

Measurement	Severe COVID-19 History	N	Mean ± Standard Deviation	T	P
Pre-COVID AMH Value	No	134	1,85±0,77	0,905	0,367
	Yes	4	1,48±1,61		
Pre-COVID FSH Value	No	134	7,05±1,63	-1,997	0,048
	Yes	4	8,74±2,67		
Post-COVID AMH Value	No	134	1,63±0,72	0,976	0,331
	Yes	4	1,26±1,46		
Post-COVID FSH Value	No	134	7,21±1,70	-2,660	0,009
	Yes	4	9,56±3,01		

According to the computed and interpreted statistical analysis results, there was a significant difference between the pre-COVID-19 and post-COVID-19 FSH values of the female athlete participants regarding the history of severe COVID-19 infection ($p<0.05$). Similarly, the pre-COVID-19 and post-COVID-19 FSH mean values of female athletes with a history of severe COVID-19 infection are elevated. In contrast, the AMH values before and after COVID-19 infection do not differ significantly based on whether or not the subject has a history of severe COVID-19 infection ($p>0.05$).

5. Discussion

The COVID-19 virus continues to infect individuals worldwide. Despite numerous clinical research on COVID-19 infection, it is still unclear whether it affects female athletes' reproductive function in Turkey. Nonetheless, the results of this study will significantly contribute to the decrease of females' worry and anxiety over the association between COVID-19 infection and ovarian reserve and menstrual cycle. According to our research findings, the effect of COVID-19 on the ovarian reserve is significantly detrimental. Serum variations in AMH, FSH, LH, and estradiol concentrations are believed to result from severe oophoritis or a multi-system inflammatory process caused by COVID-19 in Turkish female athletes. On the other hand, it is hypothesized that the interval between tests conducted on female athletes may also influence the concentration of the AMH and FSH hormones, depending on their natural processes. AMH is also demonstrated to be one of the most penetrating and first biomarkers of ovarian reserve [21].

Regarding the current research on female athletes, a significant difference was noticed between the AMH serum concentration values of patients evaluated pre- and post-COVID-19 infection periods. A similar study determined that serum AMH concentrations in COVID-19 disease did not differ between study groups. Similarly, it was explained that there were no significant differences between the study groups regarding the concentrations of sex hormones in female athletes in Turkey, including the follicle-stimulating hormone, luteinizing hormone, estradiol concentration, progesterone concentration, and testosterone. Thus, it was concluded that the COVID-19 virus did not affect ovarian reserve or sex hormone concentration [22]. Similar to the present investigation, a previous Turkish study concluded that there was no significant variation between female athletes' pre- and post-COVID-19 AMH concentrations [7]. In a separate study, the serum concentration of AMH in 78 female patients with COVID-19 (including 17 patients with a severe COVID-19 history) was compared to the serum concentration of AMH in 51 healthy females, and it was discovered that the AMH values were significantly lower in patients with infection.

Similarly, it has been reported [23] that COVID-19 infection may harm female athletes' ovarian reserve and endocrine function. Likewise, one study suggests that the COVID-19 virus infects human cells with the aid of angiotensin-converting enzyme 2 (ACE-2) [7]. According to a previous animal study, ovarian granulosa cells contain angiotensin-converting enzyme-2, and it has been established that the COVID-19 virus may harm the ovaries and diminish ovarian reserve [20]. According to this study, a considerable number of female patients with COVID-19 disease should have decreased AMH serum values. Correspondingly, in our study conducted on female athletes in Turkey, a significant difference was seen between the AMH serum concentrations of female patients tested before COVID-19 and the AMH serum concentrations of female athletes after COVID-19. According to a second study, reduced serum concentrations of AMH are connected with psychological stress and anxiety in females. The HPO axis regulates the menstrual cycle, easily interrupted by psychological stress, infectious disease,

medications, and organ dysfunctions [24]. According to research examining the influence of COVID-19 on menstrual status, menstrual volume decreases, menstrual cycle duration increases, and amenorrhea increases [25].

Before COVID-19 infection was investigated in this study, the oligo and polymenorrhea histories of 138 patients were examined. After the COVID-19 infection, the history of oligo menorrhea and poly menorrhea in the same patient group, female athletes in Turkey, was reexamined. The results suggested a proportional increase in oligomenorrhea and polymenorrhea complaints among female athletes in Turkey.

The limitations of prior similar studies were considered in the description and design of this study, which is conducted on female athletes in Turkey. This research aims to assess the ovarian reserve of female athletes during recovery. Hence, serum sex hormone concentrations, i.e., Six months following the recovery of COVID-19-infected patients, FSH, AMH, LH, and estradiol concentrations were elevated. After COVID-19, the ovarian reserve of female athletes whose ovarian reserve was evaluated before COVID-19 was also analyzed and compared. This research has several drawbacks. In the study population, only 4 patients out of 138 females had a history of severe COVID-19 disease. This prevented a direct comparison between the severe and non-severe COVID-19 illness groups. Due to the study's evaluation of young female athletes of reproductive age, the group of female patients with severe COVID-19 infection was quite small. The sample size was small, which may not have been sufficient for a robust statistical analysis. In all studies, female athlete patients did not have serum progesterone, testosterone, or prolactin concentrations in the hospital database before the onset of COVID-19 disease; consequently, they could not be evaluated in this study, and evaluation of the long-term effects of COVID-19 must be centered on other variables. Autopsy or biopsy samples from the ovaries of female athletes should, if possible, be analyzed to determine the presence and long-term damage of the COVID-19 virus in the ovary. Further study is required.

The COVID-19 virus has a deleterious effect on the ovarian reserve of female patients, according to our current research with female athletes in Turkey. Modifications that occur at the beginning of the menstrual cycle may also be associated with increased immunological response and inflammation, as well as psychological and physiological stress and anxiety caused by COVID-19 disease. In the ongoing procedure, the permanence of these menstrual status changes should be questioned. However, although menstrual irregularity was observed in more patients following COVID-19 infection, the changes in the menstrual cycle are not statistically significant, according to the current findings.

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