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EVALUATION OF MENSTRUAL CYCLE CHANGES AMONG WOMEN IN SHAHREKORD DURING THE COVID-19 PANDEMIC

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Abstract

The COVID-19, a global pandemic, has affected populations worldwide and caused various health issues. This study aimed to evaluate the effects of COVID-19 on changes in the menstrual cycle.

Materials and methods. *In this cross-sectional study included 314 women aged 18 to 45 residing in Shahrekord City, Iran, between 2022 and 2023. A researcher-designed questionnaire was used to collect data on demographic characteristics, vaccination history, COVID-19 infection history, and menstrual cycle patterns. Data was gathered via social media. After collection, the data were entered into SPSS version 22 and analyzed using descriptive and analytical statistical methods.*

Results and discussion. *Among patients, 62.7% of participants reported no change in menstrual bleeding volume after contracting COVID-19. In comparison, only 23% of individuals reported an increase or decrease in their bleeding volume after the infection. Regarding duration of menstruation, 71.3% of participants had no change in the duration of their menstruation after contracting COVID-19. There was also a significant difference in the volume of menstrual bleeding (P=0.005), duration of menstruation (P=0.006), spotting (P=0.013), interval between cycles (P=0.0001), menstrual pain (P=0.001), and premenstrual symptoms (P=0.0001).*

Conclusion. *The findings of the present study show that the severity of COVID-19 is significantly associated with alteration in the menstrual cycle.*

Keywords: *Menstruation, menorrhagia, COVID-19, vaccine, shahrekord*

Introduction

The COVID-19 pandemic is the result of a virus belonging to the Coronaviridae family, a group of single-stranded RNA viruses. This coronavirus, the seventh known member of its family, typically infects animals such as birds and mammals, often resulting in mild respiratory illnesses like the common cold in humans. However, certain coronaviruses can lead to severe outbreaks in human populations [*Ahmed SF et al., 2020*]. COVID-19 symptoms can range from mild to severe and can

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vary widely among individuals. Common symptoms include fever, persistent cough, muscle aches or myalgia, tachycardia and headache. Some patients may also experience gastrointestinal issues such as diarrhea, nausea, and vomiting. Respiratory symptoms are prevalent, often manifesting as cough, dyspnea, chest pain, and sputum production. Other symptoms may include sore throat, nasal congestion, rhinorrhea, and fatigue. Additionally, it may result in anosmia and ageusia. In more severe cases, it may lead to hemoptysis (coughing up blood), skin rashes, and neurological symptoms, including impaired consciousness and seizures [*Wang Y et al., 2020; Hassan SA et al.,2020*]. In addition, COVID-19 imposes heavy healthcare costs on the society, mainly related to hospital beds per day [*Gholipour K et al., 2023*]. Some studies suggest that women who contracted COVID-19 have experienced changes in their menstrual cycles, including a worsening of premenstrual symptoms, higher levels of irregular periods, amenorrhea, and an increase in menorrhagia [*Lebar V et al., 2022; Sharp GC et al., 2022*]. Moreover, women with COVID-19 have experienced more ovarian injury, such as a reduction in ovarian reserve and reproductive endocrine function [*Ding T et al., 2021*]. Recently, public concerns have emerged about potential disruptions to menstrual cycles due to COVID-19 vaccines, contributing to issues related to menstrual health, vaccine hesitancy, and anxieties about the possible effect of the vaccine on fertility [*Payne LA et al., 2024; Sualeh M et al., 2022*]. Some women have reported menstrual irregularities following vaccination, such as menorrhagia, frequent bleeding episodes (metrorrhagia or polymenorrhea), and even postmenopausal bleeding. One possible underlying factor may be vaccine-induced thrombocytopenia [*Merchant H,2021*]. Despite the ongoing publication of new research on COVID-19, the limited studies addressing the relationship between COVID-19 and menstrual health highlights a significant gap in medical research in this area. Hence, the current study was designed to determine menstrual cycle changes in women of Shahrekord City during the COVID-19 pandemic in 2021-2022.

Materials And Methods

Study design and population: This research was carried out using a cross-sectional study design. The target population included women aged 18 to 45 with natural menstrual cycles, residing in Shahrekord, Iran, from 2022 to 2023. The inclusion criteria specified that participants had to be women aged between 18 and 45 who were not currently taking hormonal medications, thyroid drugs, or oral contraceptives. Additionally, if vaccinated, participants must have received at least two doses of the same vaccine. Women with no prior history of hematologic disorders, polyps, or similar health issues were eligible for the study. On the other hand, the exclusion criteria ruled out pregnant or breastfeeding women, those with a history of corticosteroid use, individuals diagnosed with diabetes, smokers, and women with known mental health disorders.

Sample size and sampling method: To estimate a proportion in a cross-sectional study, the sample size can be determined using the following formula:

$$n=\frac{Z^2\times P\times(1-P)}{d^2}$$

Where: Confidence Level (Z): 95%, so Z = 1.96
Estimated Proportion (*p*): if unknown, use *p* = 0.5
Margin of Error (d): 5% (0.05)

The final sample size would be approximately 384. However, due to a slightly higher margin of error or different assumptions for *p*, a total of 314 participants were ultimately included in the study. The sampling method was convenience sampling.

Data collection method and questionnaire: A preliminary questionnaire was designed and tested in a pilot study with 50 eligible participants (who were excluded from the main study). After analyzing the responses, faculty members from obstetrics, social medicine, and infectious diseases revised the questionnaire by removing, modifying, or adding specific questions. The revised questionnaire was then reviewed for face validity by three faculty members and tested for reliability. Face validity was confirmed by the same three faculty members. Reliability was assessed using the split-half method (Guttman split-half coefficient). The reliability coefficient was 0.8, indicating very good internal consistency.

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STUDY PROCEDURE: Following approval from the Research and Technology Deputy and after obtaining the necessary permits, eligible women aged 18 to 45 were recruited according to inclusion criteria. The electronic questionnaire was created on Porsline. To ensure inclusion criteria were met, exclusion criteria were embedded within the questionnaire; responses that met any exclusion criteria were excluded during data analysis. The finalized, researcher-designed questionnaire contained 40 questions, covering demographic information, vaccination history, COVID-19 infection history, and menstrual cycle characteristics. It was distributed online via social media platforms such as WhatsApp and Instagram. Prior to participation, individuals received an explanation of the purpose of the study and the questionnaire content. During data analysis, 99 participants were excluded due to incomplete responses or meeting exclusion criteria. After collecting all responses, those not meeting inclusion criteria (e.g., those using hormonal or thyroid medications, age outside 18-45, or having certain health histories) were also excluded. The remaining data were entered into SPSS version 26 for descriptive and analytical statistical analysis.

Data analysis: The data were analyzed using SPSS software (version 26). Continuous variables were presented as mean ± standard deviation, while categorical variables were expressed as frequencies and percentages. The chi-square test was used, with a significance level of $P < 0.05$.

TABLE 1.

Frequency distribution of marital status, occupation, education level, contraception method, and pregnancy history among the study participants

Variable		Frequency	Percentage
Marital Status	Married	235	74.8
	Single	71	22.6
	Widowed	2	0.6
	Divorced	6	1.9
Occupation	Self-employed	34	10.8
	Housewife	164	52.2
	Employee	75	23.9
	Student	41	13.1
Level of Education	University Education	184	58.6
	High School Diploma	80	25.5
	Below High School	50	15.9
Contraceptive Method	No contraception (not sexually active)	77	24.5
	Intrauterine device	15	4.8
	Natural	112	35.7
	Condom	88	28.0
	Tubal ligation	22	7.0
Number of Pregnancies	0	110	35.0
	1	80	25.5
	2	79	25.2
	3	40	12.7
	4 or more	5	1.6

RESULTS AND DISCUSSION

A total of 314 women participated, with a mean age of 21.32 ± 15.7 years. In this study, 74.8% of participants were married, 22.6% were single, and the rest were either divorced or widowed. The majority of participants (52.2%) were housewives, and 58.6% had a university-level education. Most of the women (35.7%) used natural methods of contraception, and 35% had no history of pregnancy (Table 1).

In this study, 92.7% of the participants had received the COVID-19 vaccine. Regarding COVID-19 infection, 44.6% of the participants were infected before receiving the vaccine, 25.8% after receiving the vaccine, and 29.6% had been infected in both situations. Concerning the frequency of COVID-19 infection, the majority of participants had been infected only once (46.5%), while the rest had been infected two or more times. The severity of infection among participants was categorized as mild in 28.3%, moderate in 47.1%, severe in 6.4%, a combination of mild and moderate in 15.3%, and a combination of moderate and severe in 2.9% (Table 2).

Based on the findings in Table 3, 62.7% of participants reported no change in menstrual bleeding volume after contracting COVID-19, while only 23% of individuals reported either an increase or decrease in their bleeding volume after the infection. Regarding duration of menstruation, 71.3% of participants reported no change in duration of menstruation after contracting COVID-19. Spotting after COVID-19 infection was reported by only 12.4% of participants. In this study, 66.9% of individuals had no change in the menstrual cycle interval after contracting COVID-19, while 16.9% reported a variation in cycle length. Menstrual pain

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TABLE 2.

Frequency distribution of variables related to COVID-19 vaccination status, infection timing, infection frequency, and severity of illness

Variable		Frequency	Percentage
Vaccine received	Yes	291	92.7
	No	23	7.3
Infection	Yes (before vaccination)	140	44.6
	Yes (after vaccination)	81	25.8
	Both (before and after)	93	29.6
Frequency of infection	Once	146	46.5
	Twice	116	36.9
	Three times	25	8.0
	More than three times	27	8.6
Severity of infection	Mild	89	28.3
	Moderate	148	47.1
	Severe (hospitalized)	20	6.4
	Mild and Moderate	48	15.3
	Moderate and Severe	9	2.9

after COVID-19 infection remained unchanged for 65.3% of participants, whereas 20.1% reported an increase in pain. Symptoms before menstruation were unchanged for 58.3% of participants, while 28.6% reported an increase in premenstrual symptoms. Regarding menstrual changes, 30.9% of participants experienced changes in their menstrual cycle after contracting COVID-19 and receiving the vaccine. Regarding menstrual complications, 47.5% of participants stated that they developed menstrual issues after their first COVID-19 infection. In this study, 31.2% of participants believed that changes in their menstrual cycle were associated with the severity of COVID-19 infection.

Regarding the relationship between menstrual disorders and the severity of COVID-19, as shown in Table 3, there is a significant difference in various menstrual characteristics following COVID-19 infection, based on the severity of the disease. These include volume of menstrual bleeding (P=0.005), duration of menstruation (P=0.006), spotting (P=0.013), interval between menstrual cycles (P=0.0001), menstrual pain (P=0.001), and premenstrual symptoms (P=0.0001).

This study was designed to determine menstrual cycle changes in women of Shahrekord City during the COVID-19 pandemic during 2021-2022. COVID-19 infection was associated with significant changes in menstrual characteristics, including bleeding volume, duration of menstruation, and incidence of spotting, interval between cycles, menstrual pain, and premenstrual symptoms. In this regard, the study by *Taşkaldıran I et al., 2020* showed that out of 241 women with COVID-19, 86 (35.7%) reported experiencing various changes in their menstrual patterns during the first three cycles following the infection. They also reported a range of menstrual irregularities, which varied in type and severity among participants. Some women reported shortened or delayed menstrual cycles, while others experienced heavier or lighter bleeding [*Taşkaldıran I et al., 2020*]. *Phelan N et al., 2021* also reported the changes in women's menstrual cycles, such as increased menstrual bleeding, more painful periods compared to pre-pandemic levels, and missed cycles that had not occurred before the infection. In *Muhaidat N et al., 2022*, delayed cycles were reported in 19.6% of patients, and shortened cycles in 15.2%. Additionally, 33% of patients experienced heavier bleeding, and 11.4% reported longer menstrual durations [*Muharam R et al., 2022*]. The occurrence and pattern of menstrual changes observed in our study align with findings reported in recent studies. Various mechanisms may contribute to menstrual changes following COVID-19 infection, with stress being one of the underlying mechanisms [*Vigil P et al., 2004*]. It has been shown that COVID-19 is a significant source of stress, anxiety, and depression [*Czepczor-Bernat K et al., 2021; Khan SM et al., 2022*]. Studies have also demonstrated that the changes in female hormone levels are associated with health behaviors, obesity, and stress [*Mazza E et al., 2024*]. Stress can cause menstrual irregularities by disrupting the hypothalamic-pituitary-gonadal (HPG) axis, which may lead to impaired ovulation and hormonal imbalances [*Vigil P et al., 2004; Kundakovic M and Rocks D, 2022*]. Additionally, prior research has demonstrated that stress can interfere with the luteinizing hormone (LH) surge that typically occurs prior to ovulation, which disrupts the normal ovulatory process and contributes to menstrual irregularities. Disturbances in hormonal regulation may lead to a range of reproductive health issues, further highlighting the impact of stress on the menstrual cycle [*Kalantaridou et al, 2022; Kundakovic M and Rocks D,*

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2022]. Moreover, one potential cause of menstrual irregularities is the direct physiological effect of the virus itself. The coronavirus gains entry into cells by binding to the Angiotensin-converting enzyme 2 (ACE2) receptor, which was initially believed to be present solely in the respiratory system. However, subsequent research has revealed that the virus also affects the ovaries and endometrium. The ACE2 receptors in the ovaries are essential for the proper maturation of follicles and the process of ovulation, suggesting that viral interference with these receptors could disrupt normal reproductive function and contribute to menstrual disturbances [*Stanley KE et al., 2020*]. Evidence has demonstrated that cytokines such as interleukin-6, interleukin-8, and tumor necrosis factor-alpha (TNF-α) – key mediators of the inflammatory response in COVID-19 - can induce

TABLE 3. Frequency distribution of self-reported menstrual changes following COVID-19 infection

Variable	Count	%	COVID-19 severity (%) count					P-value*
			Mild	Severe	Mild and moderate	Moderate and Severe	Moderate	
Menstrual bleeding volume after COVID-19 infection								
No Change	197	62.7	(34.5%) 68	(6.1%) 12	(13.2%) 26	(0.5%) 1	(45.7%) 90	0.005
Increased	36	11.5	(16.7%) 6	(13.9%) 5	(22.2%) 8	(5.6%) 2	(41.7%) 15	
Decreased	36	11.5	(13.9%) 5	(5.6%) 2	(11.1%) 4	(8.3%) 3	(61.1%) 22	
Variable	45	14.3	(22.2%) 10	(2.2%) 1	(22.2%) 10	(6.7%) 3	(46.7%) 21	
Duration of menstruation after COVID-19 infection								
No Change	224	71.3	(34.4%) 77	(5.8%) 13	(13.8%) 31	(1.3%) 3	(44.6%) 100	0.006
Increased	21	6.7	(14.3%) 3	(14.3%) 3	(9.5%) 2	(9.5%) 2	(52.4%) 11	
Decreased	34	10.8	(8.8%) 3	(8.8%) 3	(14.7%) 5	(5.9%) 2	(61.8%) 21	
Variable	35	11.1	(17.1%) 6	(2.9%) 1	(28.6%) 10	(5.7%) 2	(45.7%) 16	
Spotting after COVID-19 infection								
Yes	39	12.4	(5.1%) 2	(10.3%) 4	(23.1%) 9	(2.6%) 1	(59%) 23	0.013
No	275	87.6	(31.6%) 87	(5.8%) 16	(14.2%) 39	(2.9%) 8	(45.5%) 125	
Interval between menstrual cycles after COVID-19 infection								
No Change	210	66.9	(37.1%) 78	(4.3%) 9	(13.3%) 28	(1.9%) 4	(43.3%) 91	0.0001
Increased	29	9.2	(10.3%) 3	(20.7%) 6	(10.3%) 3	(3.4%) 1	(55.2%) 16	
Decreased	22	7.0	(9.1%) 2	(13.6%) 3	(18.2%) 4	0	(59.1%) 13	
Variable	53	16.9	(11.3%) 6	(3.8%) 2	(24.5%) 13	(7.5%) 4	(52.8%) 28	
Pain during menstruation after COVID-19 infection								
No Change	205	65.3	(36.1%) 74	(5.9%) 12	(12.2%) 25	(1.5%) 3	(44.4%) 91	0.001
Increased	63	20.1	(9.5%) 6	(9.5%) 6	(23.8%) 15	(7.9%) 5	(49.2%) 31	
Decreased	8	2.5	(37.5%) 3	(12.5%) 1	0	0	(50%) 4	
Variable	38	12.1	(15.8%) 6	(2.6%) 1	(21.1%) 8	(2.6%) 1	(57.9%) 22	
Premenstrual symptoms after COVID-19 infection								
No Change	183	58.3	(41%) 75	(6%) 11	(11.5%) 21	(2.2%) 4	(39.3%) 72	0.0001
Increased	90	28.6	(10%) 9	(5.6%) 5	(16.7%) 15	(4.4%) 4	(63.3%) 57	
Decreased	5	1.6	(20%) 1	(20%) 1	0	0	(60%) 3	
Variable	36	11.5	(11.1%) 4	(8.3%) 3	(33.3%) 12	(2.8%) 1	(44.4%) 16	
Timing of menstrual changes								
After COVID-19 infection	73	23.2	(19.2%) 14	(6.8%) 5	(15.1%) 11	(1.4%) 1	(57.5%) 42	0.000
After vaccination	22	7.0	(36.4%) 8	(4.5%) 1	(13.6%) 3	0	(45.5%) 10	
Both	97	30.9	(10.3%) 10	(6.2%) 6	(22.7%) 22	(8.2%) 8	(52.6%) 51	
No changes experienced	122	38.9	(37.1%) 78	(4.3%) 9	(13.3%) 28	(1.9%) 4	(43.3%) 91	
Occurrence of menstrual disturbances after COVID-19 infections								
No disturbances	144	45.8	(45.1%) 65	(6.3%) 9	(10.4%) 15	0	(38.2%) 55	0.000
after first infection	149	47.5	(16.1%) 24	(6%) 9	(16.8%) 25	(4.7%) 4	(56.4%) 84	
after second infection	21	6.7	0	(9.5%) 2	(38.1%) 8	(9.5%) 2	(42.9%) 9	

*Notes: * - Chiquare Test*

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a procoagulant state. This dysregulations of the coagulation cascade may contribute to alterations in menstrual patterns, including changes in bleeding volume, subsequent to infection [*Madaan S et al., 2022*]. Moreover, ovarian damage, such as reduced ovarian reserve and reproductive hormonal imbalances, has been observed in women with COVID-19. However, no significant differences in menstrual timing, menstrual bleeding volume, menstrual cycle phases, or history of dysmenorrhea between women with severe and non-severe COVID-19 [*Ding T et al., 2021*]. A systematic review revealed that alterations in menstrual volume and cycle length have been observed as consequences of COVID-19 infection, with the cycle length changes being the most frequently reported menstrual irregularity. Women primarily reported reduced menstrual volume and longer cycle durations. The results also suggest that the severity of COVID-19 is not associated with changes in the menstrual patterns [*Lebar V et al., 2022*]. In this study, 92.7% of the participants had received the COVID-19 vaccine. Regarding menstrual changes, 30.9% of participants experienced changes in their menstrual cycle after contracting COVID-19 and receiving the vaccine. Changes in the menstrual cycle following COVID-19 vaccination have been reported to occur at even higher rates in other studies. For example, in the study by Taskaldıran et al., 15% of participants experienced changes in their menstrual patterns after vaccination, with this figure rising to 43.3% after the second dose. Various changes were reported, with the most common being delayed menstruation [*Taşkaldıran I et al., 2022*]. Menstrual changes following COVID-19 vaccination may also be attributed to immune processes [*Muharam R et al., 2022; Mazza E et al., 2024*]. One limitation of our study was the lack of investigation into the long-term effects of COVID-19 and vaccination on the menstrual cycle, as well as the absence of data on potential confounding factors, such as mood disorders and metabolic conditions.

Conclusion

The results of this study indicate that the severity of COVID-19 infection was associated with significant changes in menstrual characteristics, including bleeding volume, duration of menstruation, and incidence of spotting, interval between cycles, menstrual pain, and premenstrual symptoms. These findings highlight the importance of recognizing the broader social and psychological effects of the pandemic on women's health, emphasizing the need for greater clinical attention and supportive interventions in this area.

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