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The Impact of the COVID-19 Pandemic on Menstrual Cycle in Saudi Females in Jeddah City

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Abstract

Objectives: This study aimed to determine the impact of COVID-19 on the menstrual cycle of Saudi females in Jeddah City.

Materials and Methods: In this cross-sectional study, we conducted a total of 421 online surveys and phone call interviews with participants between 19 and 45 years of age, living in Jeddah City, Saudi Arabia, who were not pregnant, and had no gynecological problems or abnormalities. Interviews and surveys were conducted between January to April 2022, and the data were analyzed using SPSS version 23.

Results: Most responders were single and had a normal body mass index (BMI). During the COVID-19 pandemic, the majority (75.8%) did not have heavy, unpleasant periods (54.6%), or missed periods (54.6%, 78.1%, respectively). The majority reported changes observed in terms of premenstrual symptoms (PMS) (61.5%), and libido/sex drive remained unchanged for most (88.1%). Of those who reported heavy periods (n = 125), 18.4% (n = 23) reported changes. Of the 239 females who did not experience pain before COVID-19, nine (3.8%) reported experiencing it during the pandemic.

Conclusions: There were significant changes in the menstrual period of women in terms of bleeding, heavy and painful periods, and small differences in psychological challenges during the COVID-19 pandemic.

Keywords: Menstrual cycle, COVID-19 pandemic, Psychological changes

Introduction

December 2019 radically changed the world notably in terms of its effect on public health. This was the time when the novel virus, which will soon be named COVID-19, began to emerge in Wuhan, China (1,2). Lockdowns and quarantines have been implemented by governments in large parts of the world due to the alarming rates of infection and mortality caused by the virus. COVID-19 continues to affect the world today, leading to conditions like kidney problems, acute respiratory distress syndrome (ARDS), gastrointestinal issues, pneumonia, and myocardial dysfunction (3). COVID-19 also detrimentally affects immunity, causing a rise in interleukin (IL)-6, IL-8, other cytokines, and tumor necrosis factor-alpha (TNF-α) levels as it may also lead to modification on hypothalamic–pituitary–gonadal axis (4). Based on the World Health Organization (WHO), as of January 2023 there are now a total of over 659 million cases of COVID-19 infection and 6.6 million global mortality (5).

While COVID-19 has produced several health risks in the population, the impact of declaring it a pandemic has also affected other areas of concern—one of which is gynecological and reproductive health (6). Perhaps no other more salient concern other than the menstrual period during this COVID-19 pandemic. The menstrual cycle is defined as the period during which secondary sex characteristics start to develop and the function to sexually reproduce is achieved (7). The changes during the menstruation period are both physical and psychological, including the growth of breasts and pubic hair as well as an increase in height (7). Several factors that can affect menstruation include nutrition, genetics, maturation of the hypothalamic-pituitary-ovarian axis, and the person's body weight (8). It can also be influenced by the body's hormonal changes, weight gain, and stress (9).

Vaccination against COVID-19 is on the roll across different countries. However, as the COVID-19 pandemic continues, there are also some women who are hesitant to take the vaccines. Hence, to further encourage unvaccinated women to have protection against the virus, studies on the effect of vaccines on their menstrual cycle can be conducted. While studies have been conducted in some parts of the world, our study aimed to specifically focus on Saudi women to evaluate COVID-19's influence on the menstrual cycle among Saudi females in Jeddah City by estimating the incidence of these changes, as well as by describing the changes that occurred during the premenstrual period.

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Key Messages

- During the COVID-19 pandemic, there have been significant changes in women's menstrual periods in terms of regularity, bleeding, pain, and minor differences in psychological challenges.

Materials And Methods

Study Design

This cross-sectional study was conducted between January and April 2022. This study aimed to determine how the COVID-19 pandemic affected the menstrual cycle in Saudi females in Jeddah. This study specifically estimated the occurrence of menstrual cycle variations after COVID-19 and described the changes that occurred during the menstrual cycle. We followed the STROBE guidelines in reporting this cross-sectional study.

Study Population

The study included female Saudi participants residing in Jeddah City, aged 19 to 45, who regularly monitored their periods and had no known uterine abnormalities at the time of the study or before the pandemic. Exclusion criteria were applied, which included pregnant individuals, those living outside the city, non-Saudi individuals, and individuals with uterine abnormalities.

To recruit participants, a specific sampling strategy was employed. Potential participants were identified through various sources such as local health clinics, community centers, and social media platforms. Invitations to participate in the study were extended to eligible individuals through personalized messages or advertisements. The details of the recruitment process, including the specific methods used and the number of potential participants approached, were documented to assess the representativeness of the sample.

Furthermore, information regarding the response rate and reasons for non-response was collected and analyzed to evaluate the sample's representativeness. This data helped identify any potential biases or limitations in the sample composition and allowed for a comprehensive understanding of the study population.

Study Tool

The questionnaire used in this study consisted of 48 items and was developed as an online survey using Google Forms. The questionnaire encompassed various aspects related to demographics, menstrual cycle characteristics, and psychological issues. The demographic section of the questionnaire included items such as age, marital status, number of children, weight, height, and information about contraceptive use. These demographic variables provide important context and potential confounders for analyzing the relationship between menstrual cycle changes and other factors. The subsequent questions focused on menstrual cycle characteristics, specifically the length of the cycle in days and its quality. Participants were asked to provide information on the regularity of their cycles and report any changes in the amount of bleeding, pain experienced during menstruation, and instances of missed periods. These questions aimed to estimate the incidence of menstrual cycle changes after the COVID-19 outbreak. In addition to menstrual cycle-related items, the questionnaire also included questions pertaining to psychological issues such as depression, anxiety, and stress. These items were included to assess the potential impact of psychological factors on menstrual cycle change.

Validation and Reliability

To ensure the questionnaire's validity and reliability, a thorough validation process was conducted. Content validity was established by reviewing relevant literature and consulting with experts in the field. Their input helped ensure that the questionnaire items covered the necessary domains and were appropriate for the study objectives. Reliability of the questionnaire was assessed through a pilot study involving a sample of participants. Internal consistency was evaluated using statistical measures such as Cronbach's alpha to assess the interrelatedness and consistency of the questionnaire items. This process helped identify and eliminate any redundant or poorly performing items, ensuring the reliability of the questionnaire. The questionnaire was developed in both English and Arabic to accommodate participants from different language backgrounds and enhance inclusivity. Overall, the validation and reliability processes employed in the development of the questionnaire aimed to ensure its accuracy and consistency in measuring the intended constructs related to menstrual cycle changes and psychological issues.

Data Collection Procedure

The data collection procedure for this study involved obtaining patient information from the Directorate of Health Affairs of Jeddah city.

Informed consent was obtained from the participants using two methods. Firstly, written consent was obtained through text messages, where participants were provided with a clear explanation of the study's purpose and procedures and were asked to provide their consent by replying with a confirmation. Secondly, verbal confirmation of consent was obtained through phone interviews. During these interviews, trained personnel contacted the participants and verbally confirmed their willingness to participate in the study, ensuring additional clarity and understanding of the study's objectives. The duration of each interview was taking around 10 to 15 minutes.

To maintain patient confidentiality, the authors took measures to protect patient privacy. Identifiers such as names, phone or fax numbers, medical record numbers, or

initials were omitted from the paper to ensure anonymity and protect the participants' identities.

Of the initial 421 participants, none withdrew from the study. However, it is important to note that there was no follow-up conducted with the participants after the initial data collection.

Sampling Bias

In this study, a convenience sampling method, specifically a non-probability sampling method, was utilized. As a result, there is a possibility of bias, as the sample may not accurately represent the entire population. It is plausible that participants who were more interested, educated, or easily accessible may have been more likely to participate in the study, introducing potential biases.

Statistical Analysis

Data were analyzed using IBM SPSS version 23 (IBM Corp., Armonk, NY, USA) and GraphPad Prism version 8 (GraphPad Software, Inc. California, USA). Categorical and nominal variables are represented using counts and percentages. Continuous variables were represented as mean and standard deviations. To analyze multiple population means in pairs, a pairwise comparison was performed to determine whether they were significantly different. A t-test was used to compare the averages of the two variables (for a single group) and to measure the differences between the values of the two variables for each case. The relationship between categorical variables was assessed using McNemar's test. In addition, one-way ANOVA with least significant difference (LSD) was used. Tests were performed under the assumption that the distribution was normal. *P* value of less than 0.05 was used to discard the null hypothesis.

Results

Demographics

A sample size of 421 with a 95% confidence level and 5% margin of error was computed using an online sample size calculator. In terms of demographics, as described in Table 1, the mean age was 24.26 ± 4.7, with the majority of participants aged 21–25 years (61.8%) and the fewest aged more than 30 years (11.6%). The sample's mean BMI was 23.18 ± 4.9, with most participants (57.0%) being of normal weight, 19.6% being overweight, 13.8% underweight, and 9.5% obese.

Most participants were single (86.5%) and a few (13.5%) were married at least once. The majority also did not have children (91.0%), while only 38 of the 421 had children (9.0%). In terms of contraceptive use, the majority of participants did not use (86.0%) while 10.9% were using combined oral contraceptive pills, 1.4%

Table 1. Socio-demographic Characteristics of the 421 Study Samples

Demographics		N	Min	Max	Mean	SD
Age		421	19	43	24.26	4.7
BMI*		419	15	45.3	23.18	4.9
					Count	%
Total					421	100
Age	≤20 years				61	14.5
	21-25 years				260	61.8
	26-30 years				51	12.1
	>30 years				49	11.6
BMI	Underweight				58	13.8
	Normal weight				239	57
	Overweight				82	19.6
	Obese				40	9.5
Marital status**	Single				364	86.5
	Married				57	13.5
Have children	Yes				38	9
	No				383	91
Use of contraceptives	Yes				59	14
	None				362	86
Method of contraceptives	Combined oral contraceptive pill				46	10.9
	Progesterone only pill				2	0.5
	Intrauterine System/Device (copper coil)				6	1.4
	Implant				5	1.2
	None				362	86
Method of recording the cycle	Diary				26	6.2
	Smartphone app				202	48
	Other method				71	16.9
	None				122	29

* BMI missing (n=2).
** Marital status: Married at least once (Married n=34, Separated/divorced n=20, Widowed n=3).

used an intrauterine device (copper coil), 0.5% used a progesterone-only pill, and 1.2% used an implant. Almost half of the respondents (48.0%) recorded their cycles using their smartphone applications, 29.0% used none, 16.9% used other methods, and 6.2% used a diary.

Menstrual Cycle and Experiences Before the COVID-19 Pandemic

Before the COVID-19 pandemic, participants' menstrual bleeding on average was 5.76±1.3 days and their average menstrual cycle interval was 29.31±3.2 days.

Most of the study participants had regular (61.3%) and did not have heavy (70.3%) or painful periods (56.8%), and did not miss any (76.5%) (Table 2).

More than half (50.6%) of the participants did not experience any psychological issues. To those who experienced these issues, Table 3 demonstrates that anxiety (28.3%), depression (22.3%), and low mood (26.4%) were the three most prevalent psychological difficulties among those who had these problems. It is important to note that the participants in this study may have a variety of psychological issues.

Changes during the COVID-19 Pandemic

During COVID-19, participants had an average of 5.7 ± 1.5 days of menstrual bleeding, and an average of 0.50 ± 1.3 missed periods as shown in Table 4.

Most participants in the current study during the COVID-19 pandemic did not have heavy (75.8%) or painful periods (54.6%), did not miss periods (78.1%), and premenstrual symptoms (PMS) was unchanged (61.5%). In terms of changes in libido/sex drive, there were no observed changes among the participants (88.1%). Overall, 74.1% of the participants did not notice any changes in their menstrual cycle (Table 4).

More than half of the participants (54.2%) reported no psychological issues during the pandemic. Regarding those who experienced these issues, Table 5 shows that the three most common psychological disorders among individuals who experienced these issues were anxiety (28.0%), low mood (27.1%), depression (26.1%), and significant stress (20.4).

Statistical analysis revealed a significant difference between the duration of menstrual bleeding before and during the COVID-19 pandemic ($P = 0.028$) (Table 6).

Table 2. Menstrual Cycle and Conditions Experienced Before the COVID-19 Pandemic

Before the COVID19 Pandemic	N	Min	Max	Mean	SD
Days of bleeding	421	2	10	5.76	1.3
Menstrual cycle interval	419	20	42	29.31	3.2
				Count	%
Total				421	100.0
Regular periods	Yes			258	61.3
	No			163	38.7
Heavy periods	Yes			125	29.7
	No			296	70.3
Painful periods	Yes			182	43.2
	No			239	56.8
Missed period	Yes often			25	5.9
	Yes occasionally			49	11.6
	No			322	76.5
	N/A			25	5.9

Note: Multiple response question please do not add up the counts and percentages. One participant may have more than one abnormalities in the cycle.

Table 3. Psychological States Before the COVID-19 Pandemic

Before the COVID19 Pandemic		Count	%
Total		421	100.0
Did the participant suffered from any of the following	Anxiety	119	28.3
	Depression	94	22.3
	Eating disorder	51	12.1
	Low mood	111	26.4
	Poor appetite	46	10.9
	Poor sleep	73	17.3
	Poor concentration	82	19.5
	Loneliness	56	13.3
	Illicit drug use	3	0.7
	Significant stress	92	21.9
	Nor of the above	213	50.6

Note: Multiple response question please do not add up the counts and percentages. One participant may have more than one abnormalities in the cycle.

Table 4. Menstrual Cycle and Conditions Experienced During the COVID-19 Pandemic

During the COVID19 Pandemic		N	Min	Max	Mean	SD
Days of bleeding on average		412	1	11	5.73	1.5
Number of missed periods		419	0	8	0.50	1.3
				Count		%
Total				421		100.0
Any change on the period	Yes			109		25.9
	No			312		74.1
Heavy period	Yes			102		24.2
	No			319		75.8
Painful period	Yes			191		45.4
	No			230		54.6
Missed period	Yes often			28		6.7
	Yes occasionally			44		10.5
	No			329		78.1
	N/A			20		4.8
Change in premenstrual symptoms (PMS)	PMS better			15		3.6
	PMS worse			100		23.8
	PMS unchanged			259		61.5
	N/A			47		11.2
Change in libido/sex drive	Increased libido			19		4.5
	Decreased libido			31		7.4
	Libido unchanged			371		88.1

Table 5. Psychological States During the COVID-19 Pandemic

During the COVID19 pandemic		Count	%
Total		421	100.0
Did the participant suffered from any of the following	Anxiety	118	28.0
	Depression	110	26.1
	Eating disorder	48	11.4
	Low mood	114	27.1
	Poor appetite	46	10.9
	Poor sleep	83	19.7
	Poor concentration	71	16.9
	Loneliness	57	13.5
	Illicit drug use	9	2.1
	Significant stress	86	20.4
	Nor of the above	228	54.2

Note: Multiple response question please do not add up the counts and percentages. One participant may have more than one abnormalities in the cycle.

Table 7 shows the heavy, painful, and missed periods for females before and during the COVID-19 pandemic. Of the 125 females who experienced heavy periods before COVID-19, 23 (18.4%) reported change during COVID-19. Furthermore, 239 females reported no painful period before COVID-19, however, nine (3.8%) of them observed a change during COVID-19. In terms of the missed period, out of the 74 who had it before COVID-19, only 72 (97.3%) experienced it during COVID-19. Statistical analysis showed significant differences before and during the COVID-19 pandemic in terms of heavy ($P<0.001$) and painful periods ($P=0.004$).

Discussion

The negative effects of stressful periods on health have long been strongly associated with the scholarly literature. As the COVID-19 pandemic has created social and personal distress, it is natural that there will be a research impetus about this. In this cross-sectional study, we found that almost half of the participants reported that they had not experienced psychological challenges, although anxiety, low mood, and depression were felt by a portion of them during the COVID-19 pandemic. Demir et al mentioned in their study how COVID-19, anxiety, and menstrual cycles may be interrelated. Although we did not attempt to establish the same claim, we found that there was a significant difference in the menstrual cycle of the participants during the COVID-19 pandemic (10).

The psychological distress caused by the COVID-19 pandemic has already been reported in the literature, such as in the study by Demir et al, which found a link between COVID-19, anxiety, and the menstrual cycle (10). Findings in the current study also reflect on some studies where there was a small difference in period delays

Table 6. Relationship of Variables Before and During the COVID-19 in Terms of Menstrual Bleeding

How many days of bleeding on average would you have during your period?	Before the COVID19	During the COVID19	Mean Differences	95% CI Difference		*P* Value
				Lower	Upper	
Total	5.68 ± 1.3	5.73 ± 1.5	-0.05 ± 0.4	-0.087	-0.005	0.028[a]

[a] Significant using paired samples t test at <0.05 level.

Table 7. Relationship of Variables Before And During the COVID-19 in Terms of Heavy Period, Painful Periods and Missed Period

Menstrual Cycle Criteria	Before COVID-19	No. (%)	During COVID-19	No. (%)	*P* value
Heavy periods	Yes	125 (100%)	Yes	102 (81.6%)	<0.001[a]
			No	23 (18.4%)[a]	
	No	296 (100%)	No	296 (100.0%)	
Painful periods	Yes	182 (100%)	Yes	182 (100.0%)	0.004[a]
	No	239 (100%)	Yes	9 (3.8%)[a]	
			No	230 (96.2%)	
Missed periods	Yes	74 (100%)	Yes	72 (97.3%)	0.500
			No	2 (2.7%)	
	No	322 (100%)	No	322 (100.0%)	

[a] Significant using McNemar test at <0.05 level.

and these changes could revert eventually, as in the study by Alvergne et al (11). However, in the study by Muhaidat et al, it was mentioned that COVID-19 had indeed impact on menstrual abnormalities (12). According to Phelan et al (13), there was a change in PMS and menorrhagia in women who contracted COVID-19. This statement may also reflect the results of our study regarding the regular period in which we found statistical significance.

Menstrual alterations during the COVID-19 pandemic have received worldwide research interest; however, more studies are needed to understand this area of concern. This has also been one of the implications of our study, considering that there is still a scarcity of research using Middle Eastern data in general, and Saudi women in particular. Significant differences between COVID-19 and menstrual cycles, as well as regularity, bleeding, pain, and heavy periods, were found in our study as well as in other studies using different samples. Medina-Perucha et al (14) obtained the same result in a Spanish sample of 17, 455 women, as did Ozimek et al (6) in their American sample of 210 female respondents.

Menstrual irregularities are associated with high-stress levels. Since the COVID-19 pandemic has altered people's lives, such as health issues and loss of loved ones and many others, several researchers believe that it has influenced menstrual cycles. A recent study found that respondents with a high perceived stress scale had significantly longer menstrual periods and heavier bleeding during menstruation than those with a moderate perceived stress scale (6).

Study Limitations and Directions for Future Research

Perhaps a good point for future research based on our findings is an exploration of the topic concerning less tapped areas that we used as variables, such as the effect of the COVID-19 vaccine on PMS and libido/sex drive changes. A follow-up of this study will also be useful in providing a background on the long-term effects of either the COVID-19 or COVID-19 vaccines.

A larger sample size may also be more appropriate to provide generalizability among Saudi women and perhaps replicate this study in every region to understand the concerns closely of the sample involved. In the study published by Saleh Alzahrani et al in 2023, it is estimated that 1066 participants are involved, and their sampling design used convenience sampling techniques and self-administered questionnaires that were spread on different social media platforms (15). Hence, for our future studies, we may adopt their sampling design.

Other inherent weaknesses of this study include self-report measures, especially those performed exclusively online, which may introduce methodological weaknesses such as accuracy and recall bias. It is important to acknowledge the potential for selection bias due to the reliance on online surveys and phone call interviews. Participants who had greater access to technology or were more willing to participate in remote data collection methods might have been overrepresented in the sample. However, efforts were made to mitigate this bias by employing a diverse recruitment strategy that targeted participants from various sources, including local health clinics, community centers, and social media platforms.

In addition, the majority of respondents in our study were single and did not use contraceptives, which may impact the generalizability of the findings to the broader population. Furthermore, several other important variables that were not included in this study, such as economic status, educational level, dietary habits, exercise, and personality traits, have the potential to influence the results. Future studies should consider incorporating these variables to provide a more comprehensive understanding of the relationship between psychological challenges and menstrual cycles.

To maintain brevity and simplicity, these variables were not included in the current study, although their significance in relation to the psychological challenges

and menstrual cycles under investigation was recognized. Acknowledging these limitations and considering them in future research would contribute to a more robust analysis of the topic. Therefore, it is recommended that future studies address these variables to provide a more holistic understanding of the factors influencing menstrual cycles and psychological challenges.

Moreover, future research should aim to address the limitations of the current study. For instance, alternative data collection methods that minimize recall bias and improve accuracy, such as prospective daily tracking of menstrual cycles, could be employed. Additionally, exploring the experiences of a more diverse sample in terms of relationship status and contraceptive use would enhance the generalizability of findings. It is also important to consider longitudinal designs to investigate the temporal relationship between psychological challenges and menstrual cycle changes.

Furthermore, future studies could explore the potential mechanisms underlying the observed associations. For example, investigating the role of hormonal fluctuations, stress levels, or lifestyle factors in mediating the relationship between psychological challenges and menstrual cycles would provide valuable insights. Additionally, qualitative research approaches, such as in-depth interviews or focus groups, could be employed to gain a deeper understanding of the lived experiences and subjective perspectives of individuals in relation to their menstrual cycles and psychological well-being.

Conclusions

This study provides preliminary evidence on the influence of the COVID-19 pandemic on Saudi females living in Jeddah City. There were significant changes in women's menstrual periods in terms of bleeding, pain, and heavy periods as well as small differences in some psychological challenges. These findings could add to the body of knowledge on the impact of the COVID-19 pandemic on the menstrual cycle, whether direct or indirect. A follow-up of this sample is highly recommended to find cues on the continuing impact of COVID-19 in general.

Authors' Contribution

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Writing–review & editing: Nedaa Mohammed Bahkali, Dana Suhail Sawan , Nabeel Salem Bondagji.

Conflict of Interests

Authors declare that they have no conflict of interests.

Ethical Issues

Approval was obtained from the Research Ethics Committee (REC) of the Faculty of Medicine, King Abdulaziz University, Ministry of Higher Education, Saudi Arabia (approval number 215/21), ensuring adherence to ethical guidelines including the Declaration of Helsinki 2013 for experiments involving humans. Informed consent was obtained from each participant, clearly outlining the study process and procedure. Confidentially measures were upheld, with data anonymized to protect participants identities.

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References

1. Chan JF, Lau SK, To KK, Cheng VC, Woo PC, Yuen KY. Middle East respiratory syndrome coronavirus: another zoonotic betacoronavirus causing SARS-like disease. Clin Microbiol Rev. 2015;28(2):465-522. doi:10.1128/cmr.00102-14
2. Chen N, Zhou M, Dong X, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet. 2020;395(10223):507-513. doi:10.1016/s0140-6736(20)30211-7
3. Gupta A, Madhavan MV, Sehgal K, et al. Extrapulmonary manifestations of COVID-19. Nat Med. 2020;26(7):1017-1032. doi:10.1038/s41591-020-0968-3
4. Mauvais-Jarvis F, Klein SL, Levin ER. Estradiol, progesterone, immunomodulation, and COVID-19 outcomes. Endocrinology. 2020;161(9):bqaa127. doi:10.1210/endocr/bqaa127
5. World Health Organization (WHO). WHO Coronavirus (COVID-19) Dashboard. Available from: https://covid19.who.int/. Accessed July 20, 2021.
6. Ozimek N, Velez K, Anvari H, Butler L, Goldman KN, Woitowich NC. Impact of stress on menstrual cyclicity during the coronavirus disease 2019 pandemic: a survey study. J Womens Health (Larchmt). 2022;31(1):84-90. doi:10.1089/jwh.2021.0158
7. Rao S, Pawar V, Badhwar VR, Fonseca MN. Medical intervention in puberty menorrhagia. Bombay Hosp J. 2004;46(2):1-6.
8. Edmonds DK. Gynecological disorders of childhood and adolescence. In: Dewhurst's Textbook of Obstetrics & Gynaecology. Wiley; 2007:364-368.
9. Stanton R, To QG, Khalesi S, et al. Depression, anxiety and stress during COVID-19: associations with changes in physical activity, sleep, tobacco and alcohol use in Australian adults. Int J Environ Res Public Health. 2020;17(11):4065. doi:10.3390/ijerph17114065
10. Demir O, Sal H, Comba C. Triangle of COVID, anxiety and menstrual cycle. J Obstet Gynaecol. 2021;41(8):1257-1261. doi:10.1080/01443615.2021.1907562
11. Alvergne A, Woon EV, Male V. Effect of COVID-19 vaccination on the timing and flow of menstrual periods in two cohorts. Front Reprod Health. 2022;4:952976. doi:10.3389/frph.2022.952976
12. Muhaidat N, Alshrouf MA, Azzam MI, Karam AM, Al-Nazer MW, Al-Ani A. Menstrual symptoms after COVID-19 vaccine: a cross-sectional investigation in the MENA region. Int J Womens Health. 2022;14:395-404. doi:10.2147/ijwh.s352167
13. Phelan N, Behan LA, Owens L. The impact of the COVID-19 pandemic on women's reproductive health. Front Endocrinol (Lausanne). 2021;12:642755. doi:10.3389/fendo.2021.642755
14. Medina-Perucha L, López-Jiménez T, Holst AS, et al. Self-reported menstrual alterations during the COVID-19 syndemic in Spain: a cross-sectional study. Int J Womens Health. 2022;14:529-544. doi:10.2147/ijwh.s354655
15. Saleh Alzahrani H, Ali Algashami S, Abdulaziz Alharkan A, Sultan Alotaibi N, Waseem Algahs N. The effect of COVID-19 vaccination on the menstrual cycle in female in Riyadh, Saudi Arabia. Saudi Pharm J. 2023;31(5):746-751. doi:10.1016/j.jsps.2023.03.015