


Menstrual Irregularities Post-COVID-19 Infection/Vaccination in Indian Population

Sreeja Moolamalla¹, Kavitha Bakshi², Vijayasree Medarametla³

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ABSTRACT

Introduction: Increased reporting of menstrual disturbances post-vaccination and inadequate inclusion of questions about menstruation in vaccine trials and disease progression studies have been the baseline for conducting this study. We aim to assess the influence of vaccines and COVID-19 infection on menstruation and identify patterns, if any, in cycles post-disease/vaccination.

Methods: A multicenter observational study was performed using a questionnaire-based survey via an online link. The participants who filled the survey were predominantly in the age group of 21–25 years (80%). Participants with prior menstrual irregularities were eliminated from the study.

Results: The prevalence of unusual menstrual cycles post-infection/vaccination was 21.7%. A total of 17.11% experienced changes post-vaccination and 22.8% of the infected individuals reported abnormalities post-COVID-19 disease. A substantial increase in dysmenorrhea was reported ($p < 0.001$) post-infection/vaccination. An increase in menstrual flow was observed in 14.9% post-vaccination and 23.9% post-infection.

Conclusion: Menstrual changes post-vaccination were insignificant; however, significant differences in menstruation were reported post-infection. The study strengthens the association between COVID-19 and menstruation and urges the inclusion of menstrual health in disease intervention studies.

Keywords: Abnormal bleeding, Coronavirus disease 2019, Coronavirus disease 2019 infection, Irregular menstruation, Menstrual irregularities, Vaccination.

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INTRODUCTION

In December 2019, a novel coronavirus disease 2019 (COVID-19) outbreak occurred in Wuhan, China. Since then, it has rapidly spread worldwide, becoming a major disaster affecting public health. Till 1 January 2022, 288,680,388 cases and a total of 5,455,377 deaths have been reported.¹ Moreover, COVID-19 patients have been reported to have multisystem complications in addition to respiratory symptoms, such as issues with the cardiovascular and digestive systems.² One possible mechanism might be that the pathogen that causes COVID-19, severe acute respiratory syndrome coronavirus (SARS-CoV-2), enters cells through its receptor, angiotensin-converting enzyme 2 (ACE2).³ This virus might therefore attack organs with high expression of ACE2. In a previous animal study, ACE2 expression has also been reported in ovarian granulosa cells,⁴ which provides background to question the effects of COVID-19 on the female reproductive system.

Moreover, post-vaccination for COVID-19 also has shown significant changes in menstrual cycles. Menstrual changes reported in various studies were diverse, ranging from increased bleeding to the cessation of bleeding. Women's health has long been neglected in biomedical research. The National Institute of Health mandated the inclusion of female subjects in clinical trials in 1993, yet sex is often overlooked as an experimental variable.⁵

Vaccines that were manufactured during the pandemic had questionable inclusion of menstruation in efficacy. Clinical trials provide an opportunity to report any changes in cycles; however, minor changes go unreported unless specifically asked.

Menstrual cycle timing is regulated by the hypothalamic–pituitary–ovarian axis, which can be affected by life, environment, and health stressors. The messenger RNA (mRNA) vaccines create a robust immune response or stressor, which could temporarily

^{1–3}Department of Obstetrics and Gynaecology, Mamata Medical College, Khammam, Telangana, India

Corresponding Author: Kavitha Bakshi, Department of Obstetrics and Gynaecology, Mamata Medical College, Khammam, Telangana, India, Phone: +91 9985237518, e-mail: bakshikavitha@gmail.com

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affect the hypothalamic–pituitary–ovarian axis if timed correctly.^{6–8} Our research is primarily based on identifying the prevalence of irregularities in menstrual cycles, supporting this hypothesis. Similar changes in menstruation such as decreased cycle length and dysmenorrhea were found in 53% of the population that got vaccinated for Typhoid, as reported by a medical doctor at the Presbyterian Hospital, New York in 1913. However, the cycles were regularized within six months post-vaccination.⁹ The concerns raised range from cycle and menses length changes to differences in menstrual-associated symptoms, unscheduled bleeding, and changes in the quality and quantity of menstrual bleeding post-COVID-19 vaccination.¹⁰ Unfortunately, clinical trials of the current COVID-19 vaccines did not collect menstrual cycle outcomes post-vaccination.^{11–14} The authors conducted the following study on the impact of the disease and vaccination on menstruation.

We assessed menstrual patterns in women belonging to the reproductive age group post-COVID-19 disease/infection to investigate the influence of vaccines on cycle length, dysmenorrhea, and other associated complaints.

METHODS

A multicenter observational study was performed on women in the menstruating age group. The authors circulated an easy-to-understand questionnaire titled "Menstrual Change Post-COVID Disease/Vaccination" to all women of reproductive age via an online link. The survey contained nearly 40 questions on demographic data, COVID-19 infection details (if infected), vaccination details, menstrual cycles post-vaccination/infection, past menstrual history, lifestyle, smoking, and alcohol consumption.

Inclusion criteria include (i) completion of 18 years of age and (ii) women of Indian origin. Exclusion criteria include (i) women with a history of prior hysterectomy or oophorectomy, (ii) pregnant or lactating women, and (iii) account of a diagnosis of ovarian dysfunction in the 6 months before the onset of disease: a manifestation of delayed menses, menstrual irregularities, or earlier menopause. We distributed the survey for responses for two weeks beginning on 5 January 2022.

The study was conducted under the guidelines of the ethical committee regulations with the institutional review board (IRB), No. IEC/83/21, granted by the ethics committee institute. The survey conducted anonymously did not require written consent from the participants.

The anonymous survey was analyzed using regular regression and post-stratification methods. Regression analysis was conducted to identify significant predictors in dysmenorrhea post-infection/vaccination. A $p < 0.05$ was considered statistically significant.

RESULTS

Patient Demographics

A significant number of participants were medical students and postgraduates who maintained records of their menstrual data using mobile applications. [Table 1](#) summarizes the demographic data of the participants. A total of 308 ($N = 418$; 73.7%) participants were aged 21–25 years, and 274 ($N = 418$; 65.6%) of them were students by profession, and 67 ($N = 418$; 16%) were working Health care professionals. Also, a total of 262 ($N = 418$; 62.7%) reported falling under the body mass index (BMI) of 18.5–24.9 and 72 ($N = 418$; 17.2%) in between 25.0 and 29.9. 377 ($N = 418$; 90.2%) of the participants were single and had no children. Polycystic ovarian disease (PCOD) was the most commonly associated condition presented in 47 ($N = 418$; 11.2%) women, and thyroid abnormalities were prevalent in 20 ($N = 418$; 4.8%) respondents in the study sample.

Menstrual History

Only the women with a regular menstrual history were included in the study. A total of 100 ($N = 418$; 23.9%) attained their menarche at the age of 12 years and 121 ($N = 418$; 28.9%) and 44 ($N = 418$; 10.5%) at the ages 13 and 11, respectively. All the women included in the study reported a standard cycle of 21–35 days duration, and no evidence of other gynecological conditions such as pre-menstrual syndrome or abnormal bleeding before COVID-19 infection or vaccination.

COVID-19 INFECTION AND VACCINATION DETAILS

A total of 168 ($N = 418$; 40.2%) women reported being infected by COVID-19 in the past or are currently infected. Duration of

Table 1: Demographic data

Age	
18–20	34 (8.1%)
21–25	308 (73.7%)
26–35	52 (12.4%)
>35	24 (5.7%)
BMI	
<18.5	50 (12%)
18.5–24.9	262 (62.7%)
25.0–29.9	72 (17.2%)
>30	34 (8.1%)
Occupation	
Student	274 (65.6%)
Health care professional	67 (16%)
Skilled professional	64 (15.3%)
Homemaker	13 (3.1%)
Participants with children	
Yes	41 (9.8%)
No	377 (90.2%)
Comorbidities	
Hypertension	7 (1.7%)
Diabetes mellitus	4 (1%)
Bronchial asthma	11 (2.6%)
Cardiovascular diseases	0 (0%)
Thyroid abnormalities	20 (4.8%)
Epilepsy	1 (0.2%)
Lung disease	1 (0.2%)
PCOD	47 (11.2%)
None	337 (80.6%)
Diet	
Vegan	5 (1.2%)
Vegetarian	80 (19.1%)
Mixed	333 (79.7%)
Alcohol consumption	
Yes	84 (20.1%)
No	334 (79.9%)
Smoking	
Yes	23 (5.5%)
No	395 (94.5%)

infection was 1–2 weeks in 98 ($N = 175$; 56%) participants. Fever and body aches were the most common symptoms during the infection period reported in 126 ($N = 172$; 73.3%) and 113 ($N = 172$; 65.7%) participants, respectively. A total of 143 ($N = 175$; 81.7%) participants relied on analgesics and 147 ($N = 175$; 84%) of them on vitamin supplementation for treatment. [Table 2](#) summarizes infection details.

A total of 415 ($N = 418$; 99.3%) of them were vaccinated against COVID-19 with 279 ($N = 414$; 67.4%) being administered with

Table 2: COVID-19 infection

	<i>n (%)</i>
Status of infection	
Infected	
Not infected	
Symptoms during infection	
Fever	126 (73.3%)
Shortness of breath	47 (27.3%)
Loss of smell/taste	105 (61%)
Body pains	113 (65.7%)
Diarrhea	27 (15.7%)
Soreness of throat	80 (46.5%)
Cold	3 (1.7%)
Cough	2 (1.2%)
Drugs	
Analgesics	143 (81.7%)
Vitamin supplementation	147 (84%)
Steroids	30 (17.1%)
Antiviral drugs	46 (26.3%)
Antibiotics	2 (1.1%)
Duration of infection	
<1 week	70 (40%)
1–2 weeks	98 (56%)
2–4 weeks	4 (2.3%)
>4 weeks	3 (1.7%)
Hospitalization	
Yes	6 (3.2%)
No	181 (96.8%)
Reinfection	
Yes	9 (4.9%)
No	175 (95.1%)

Table 3: Vaccination details

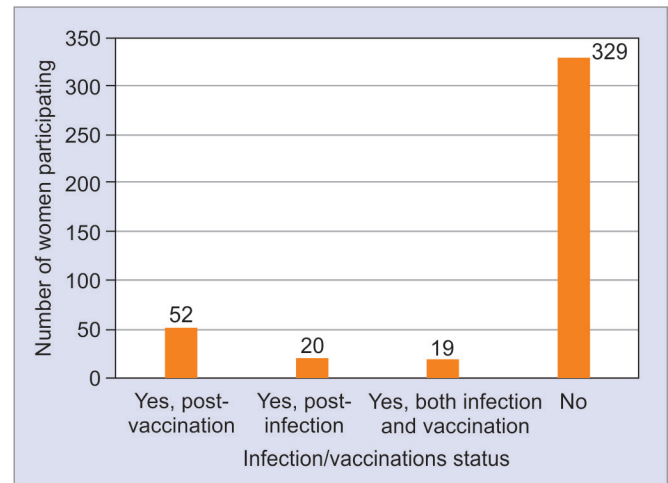
<i>Vaccination details</i>	<i>n (%)</i>
Vaccination status	
Yes	415 (99.3%)
No	3 (0.7%)
Vaccine type	
Covishield	279 (67.4%)
Covaxin	125 (30.2%)
Pfizer	5 (1.2%)
Sputnik	(0.5%)
Moderna	2 (0.5%)
Number of doses	
1	12 (2.9%)
2	385 (93.4%)
>2	15 (3.6%)
Complaints post-vaccination	
Soreness	56 (14.8%)
Fever	241 (63.6%)
Rash	20 (5.3%)
Body pain	279 (73.6%)
Fatigue	154 (40.6%)

Covishield vaccine and 125 ($N = 414$; 30.2%) with Covaxin vaccine. A total of 385 ($N = 412$; 93.4%) women have taken two vaccine doses, both indigenously manufactured vaccines in India. Body pains were the chief complaint post-vaccination ($N = 379$; 73.6%). [Table 3](#) summarizes vaccination details.

Menstrual Changes Post-COVID-19 Disease/Vaccination

We obtained a sample size of 418 after eliminating the participants who had menstrual irregularities in the past. A total of 91 ($N = 418$; 21.7%) women complained of menstrual irregularities post-infection or vaccination. A total of 71 ($N = 415$; 17.11%) women reported irregularities post-vaccination and 39 ($N = 171$; 22.8%) women reported changes post-infection. However, 19 ($N = 418$; 4.54%) women reported changes to both post-vaccination and infection as depicted in [Figure 1](#). [Table 4](#) represents changes post-infection and vaccination.

[Figure 2](#) contrasts the pain scales of the participants with dysmenorrhea charted pre- and post-COVID-19 vaccination/

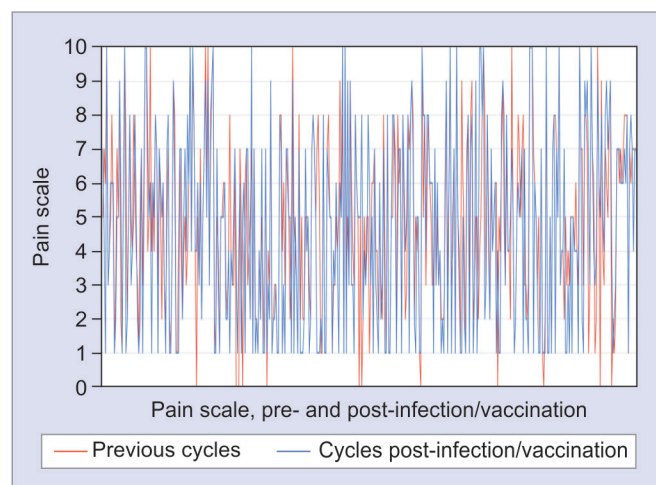
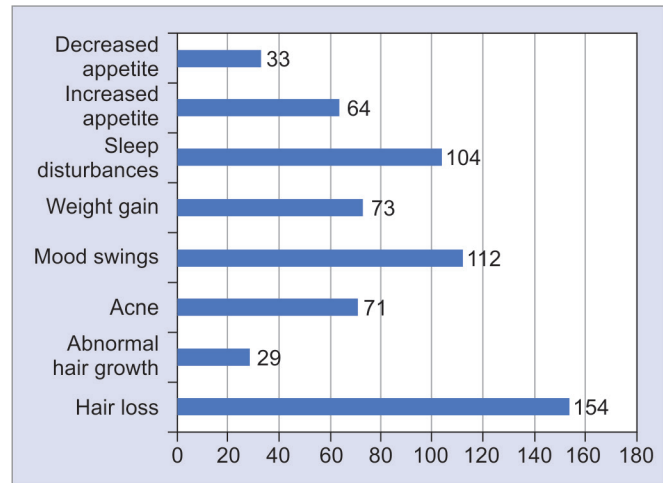
**Fig 1:** Menstrual irregularities post-COVID-19 infection/vaccination

infection. Pain during menstruation post-vaccination/infection had a mean of 5.01. Previous cycles had a mean of 4.67, which is attributed to the increased dysmenorrhea, which is significant when $p < 0.001$.

Abnormal findings, as depicted in [Figure 3](#), like hair loss was reported by 154 ($N = 418$; 36.8%) participants, mood swings by 112 ($N = 418$; 26.8%), weight gain by 73 ($N = 418$; 17.5%), acne by 71 ($N = 418$; 17%), and sleep disturbances by 104 ($N = 418$; 24.9%) women were reported post-vaccination/infection. A total of 64 ($N = 418$; 15.3%) participants recorded an increase in appetite, 33 ($N = 418$; 7.9%) a decrease in appetite and 321 ($N = 418$; 76.8%) women with no change in their appetite.

Table 4: Changes noted in post-COVID-19 infection/vaccination

Changes post-vaccination/infection	n (%)
Period of irregularity	
<3 months or cycles	57 (13.6%)
3–6 months or cycles	25 (5.98%)
>6 months or cycles	7 (1.67%)
Changes in menstrual flow	
Increased	62 (14.8%)
Decreased	35 (8.4%)
Normal/as usual	321 (76.8%)
Clots	
Yes	77 (18.4%)
No	287 (68.7%)
May be	54 (12.9%)
Mid cycle bleeding or spotting	
Yes	66 (15.7%)
No	352 (84.2%)
Associated abnormal findings	
Hair loss	154 (36.8%)
Abnormal hair growth on face, chest, etc.	29 (6.9%)
Acne	71 (17%)
Mood swings	112 (12.6%)
Weight gain	73 (17.7%)
None	121 (48%)
Sleep changes	
Undisturbed sound sleep	314 (75.1%)
Disturbed cycles	104 (24.9%)
Appetite changes	
Increased	64 (15.3%)
Decreased	33 (7.9%)
As usual	321 (76.8%)

**Fig 2:** Pain scale before and after-COVID-19 infection/vaccination**Fig 3:** Abnormal findings post-infection/vaccination

DISCUSSION

Significant Findings

This anonymous observational study was conducted to evaluate the effect of COVID-19 vaccines on menstrual health in a sample of more than 400 women aged between 18–55 years with regular past menstrual history. The prevalence of unusual menstrual cycles post-vaccination/infection was 21.7%. However, the cycles returned to normal within three cycles in 61.9 and 53.8% post-vaccination and infection respectively, suggesting that the changes were transient. There was a substantial increase in dysmenorrhea post-infection/vaccination ($p < 0.001$). All the menstrual changes were more apparent post-infection compared to post-vaccination like an increase in cycle length for more than a week in 14.2% post-vaccination and 19.2% post-infection. A total of 18.5% reported clots post-vaccination and 24.5% post-infection. Midcycle spotting/bleeding was reported by 16 and 20.4% of women post-vaccination and infection, respectively. However, changes in cycle length and flow post-vaccination were found to be insignificant ($p > 0.05$). Changes reported post-infection were found to be statistically significant ($p < 0.05$). Associated problems like hair loss were reported by 36.8% and mood swings by 26.8%.

Limitations

The observational study on the association between COVID-19 disease/vaccination and menstruation patterns could include various forms of bias. First, reporting bias as the data on menstrual flow, pre-menstrual syndrome, and dysmenorrhea is entirely subjective and depends on the efficient tracking of one's cycles regularly. Selection bias can also be introduced as the majority of the participants are well-informed adolescents, primarily associated with the healthcare industry. Thereby noticing minor irregularities in their menstruation patterns, the sample may not represent the majority of the population in a developing country like India. Although the study addresses the concerns and depicts the prevalence of menstrual irregularities post-COVID disease/vaccination, population-level significance cannot be obtained with a relatively small sample size.

Comparison

The current study is compared to the prospective analysis study conducted in the US on a cohort of 3,959 individuals and the

majority of the women included in the study are in the age group of 21–25 years who comprise 73.7% of the sample, whereas in the USA cohort,¹⁵ women in the age group of 25–35 years constitute 67.4% of the sample size. A total of 37.8% of the model belonged to 25–35 years in the USA web-based survey,¹⁶ and 35 was the mean age in the UK-based sample.¹⁷ A total of 62.7% of the participants had a normal weight/BMI in contrast to 45.3% of the sample being underweight or normal weight in the USA Cohort.¹⁵

A total of 100% of women were of South Asian (Indian) descent compared to 51.5% of women belonging to the White race in the USA cohort,¹⁵ 84.3% identifying as White in the USA web-based survey,¹⁶ and 95% were Whites in the UK-based sample.¹⁷ Similarly, the UK study concludes COVID-19 infection and smoking are the associated risk factors for menstrual irregularities. Only 5.5% were smokers in the current research; therefore, assessing the pattern of risk with smoking may not be substantial.

A total of 99.3% were vaccinated in the present study, whereas 100% were vaccinated in the UK-based sample.¹⁷ All the participants were fully vaccinated in the US web-based study,¹⁶ and the vaccinated cohort included 2,403 individuals in the US-based research.¹⁶ Covishield and Covaxin vaccines were predominantly administered in the Indian population, 67.4 and 30.2%, respectively, in contrast to 53% were administered with Oxford-AstraZeneca vaccine in the UK sample,¹⁷ 55% Pfizer in the US web-based survey, and 33.5% with Pfizer in the US cohort.¹⁵ A total of 93.4% have been administered two doses in the current study; however, 82% are administered only the first dose in the UK-based sample.¹⁷

A total of 21.7% of the participants reported irregular cycles in the present study; however, 17.11% of the sample reported menstrual changes post-vaccination in the current study similar to the UK-based research¹⁷ where menstrual disturbances occurred in 20% of the sample following vaccination. A total of 14.2% experienced increased cycle length beyond a week in the present study, while in the USA-based cohort study,¹⁵ approximately 10% of vaccinated individuals experienced a clinically notable change in cycle length of 8 days or more. However, 34.42% reported longer cycle lengths in the USA web-based survey.¹⁶ In a Norwegian young adult cohort, almost four out of ten reported one or more of seven predefined menstrual disturbances both before and after vaccination.¹⁸

In the subset of women who experienced changes in menstrual cycles in the present sample, in 61.9%, cycles were normalized within the first three cycles post-vaccination. Changes to their menstrual cycles were noticed up to 4 months after receiving their first injection in the UK-based sample,¹⁷ and cycle lengths returned to normal in the USA cohort,¹⁵ two cycles after vaccination.

In contrast to 14.9% in the current study who reported increased bleeding, 42.11% of the individuals experienced heavier flow in the USA survey¹⁶ as endometriosis (52.4%), menorrhagia (44.6%), and fibroids (46.3%) were the most commonly associated reproductive conditions. However, 11.2% of our sample respondents reported PCOD to be the widely associated reproductive condition as the study includes young adults predominantly. A total of 15.7% reported midcycle bleeding/spotting in the current sample however, 25.8% reported spotting in the US web-based survey.

In a retrospective cross-sectional study conducted in Wuhan, China,¹⁹ 28% of confirmed COVID-19 patients presented with menstrual changes, similar to 22.8% ($N = 171$; 39) of those infected by COVID-19 in the current study. A total of 41 ($N = 171$; 23.9%) women experienced increased flow post-infection and 16 ($N = 171$; 9.3%)

women had decreased flow in contrast to a decreased volume of 20% in the Wuhan study.¹⁹ A prolonged cycle length was observed in 33 ($N = 171$; 19.2%) respondents in the current survey similar to the Wuhan study (19%). However, Garg et al. from Agra, Uttar Pradesh, India did not find significant change postvaccination.²⁰

CONCLUSION

This research addresses many concerns among young women regarding menstruation post-vaccination, majorly self-reported online. The present study may not apply to the general population of India, as well-educated women who report minor menstrual changes generally comprise a minority. This study aids in assessing the prevalence of cycle changes in a country like India, where menstrual health is often neglected. All the menstrual changes were more apparent post-infection compared to post-vaccination. Only 17% experienced irregularities post-vaccination compared to 23.2% of the participants infected with COVID-19, the former disappeared within 3 months post-vaccination whereas it took 3–6 months for the latter to normalize. A total of 18.4% observed clots and mid-cycle bleeding was reported in 15.7% with a significant ($p < 0.05$) increase in dysmenorrhea. Since the majority of the population has no significant menstrual irregularities post-vaccination ($p > 0.05$), vaccines can be safely administered without any hesitancy. Previous cohort studies have mostly been vaccinated using mRNA vaccines, so this study adds to our knowledge of the effects of adenovirus-vectored (Covishield) and whole inactivated virus-based (Covaxin) COVID-19 vaccines. This is also the first study that uses the same data collection methods to interrogate menstrual changes following SARS-CoV2 infection and COVID-19 vaccination, allowing for a valid comparison of the two. The study also shines a light on the urge to include menstrual health in vaccine trials and disease progression studies. However, larger prospective cohorts with hormone analysis studies are required to prove the association between menstruation and COVID-19 further.

ORCID

Sreeja Moolamalla  <https://orcid.org/0000-0001-5302-5816>

REFERENCES

1. Worldometer. COVID live: Coronavirus statistics. 2022. <https://www.worldometers.info/coronavirus/>. Accessed on: 14 February 2022.
2. Chen T, Wu D, Chen H, et al. Clinical characteristics of 113 deceased patients with coronavirus disease 2019: Retrospective study. *BMJ* 2020;368:m1019. DOI: 10.1136/BMJ.M1019.
3. Hoffmann M, Weber K, Schroeder, et al. SARS-CoV-2 cell entry depends on ACE2 and TMPRSS2 and is blocked by a clinically proven protease inhibitor. *Cell* 2020;181:271–280.e8. DOI: 10.1016/J.CELL.2020.02.052.
4. Honorato SK, Pereira VM, Santos RAS, et al. Evidence that angiotensin-(1-7) is an intermediate of gonadotrophin-induced oocyte maturation in the rat preovulatory follicle. *Exp Physiol* 2012;97(5):642–650. DOI: 10.1113/EXPPHYSIOL.2011.061960.
5. Beery AK and Zucker I. Sex bias in neuroscience and biomedical research. *Neurosci Biobehav Rev* 2011;35(3):565–572. DOI: 10.1016/J.NEUBIOREV.2010.07.002.
6. Turnbull AV and Rivier CL. Regulation of the hypothalamic–pituitary–adrenal axis by cytokines: Actions and mechanisms of action. *Physiol Rev* 1999;79(1):1–71. DOI: 10.1152/PHYSREV.1999.79.1.1.
7. Girardi G and Bremer AA. Scientific evidence supporting coronavirus disease 2019 (COVID-19) vaccine efficacy and safety in people

- planning to conceive or who are pregnant or lactating. *Obstet Gynecol* 2022;139:3–8. DOI: 10.1097/AOG.0000000000004636.
8. Skelly DT, Harding A, Gilbert JJ, et al. Two doses of SARS-CoV-2 vaccination induce robust immune responses to emerging SARS-CoV-2 variants of concern. *Nat Commun* 2021;12(1):1–12. DOI: 10.1038/s41467-021-25167-5.
9. Lamb AR. Experiences with prophylactic typhoid vaccination: Its effect on menstruation. *Arch Intern Med* 1913;12:565–577. DOI: 10.1001/ARCHINTE.1913.00070050082008.
10. NPR. Can COVID vaccines cause temporary menstrual changes? 2022. <https://www.npr.org/sections/health-shots/2021/08/09/1024190379/covid-vaccine-period-menstrual-cycle-research>. Accessed on: 16 February 2022.
11. Baden LR, Sahly HE, Essink B, et al. Efficacy and safety of the mRNA-1273 SARS-CoV-2 vaccine. *N Engl J Med* 2021;384(5):403–416. DOI: 10.1056/NEJMOA2035389.
12. Sadoff J, Gray G, Vandebosch A, et al. Safety and efficacy of single-dose Ad26.COV2.S vaccine against Covid-19. *N Engl J Med* 2021;384(23):2187–2201. DOI: 10.1056/NEJMOA2101544.
13. Polack FP, Thomas S, Kitchin N, et al. Safety and efficacy of the BNT162b2 mRNA covid-19 vaccine. *N Engl J Med* 2020;383(27):2603–2615. DOI: 10.1056/NEJMOA2034577.
14. Oliver SE, Gargano J, Marin M, et al. The advisory committee on immunization practices' interim recommendation for use of Moderna COVID-19 vaccine. *Morb Mortal Wkly Rep* 2021;69(5152):1653–1656. DOI: 10.15585/MMWR.MM695152E1.
15. Edelman A, Boniface E, Benhar E, et al. Association between menstrual cycle length and coronavirus disease 2019 (COVID-19) vaccination. *Obstet Gynecol* 2022;139(4):1–9. DOI: 10.1097/AOG.0000000000004695.
16. Lee KM, Junkins EJ, Fatima UA, et al. Characterizing menstrual bleeding changes occurring after SARS-CoV-2 vaccination. *medRxiv* 2021;1–33. DOI: 10.1101/2021.10.11.21264863. In preprint.
17. Alvergne A, Kountourides G, Argentieri M, et al. COVID-19 vaccination and menstrual cycle changes: A United Kingdom (UK) retrospective case-control study. *medRxiv* 2021;1–31. DOI: 10.1101/2021.11.23.21266709. In preprint.
18. Trostad L. Increased occurrence of menstrual disturbances in 18- to 30-year-old women after COVID-19 vaccination. *SSRN Electron J* 2022;1–11. DOI: 10.2139/SSRN.3998180. In preprint.
19. Li K, Chen G, Hou H, et al. Analysis of sex hormones and menstruation in COVID-19 women of child-bearing age. *Reprod Biomed Online* 2021;42(1):260–267. DOI: 10.1016/j.rbmo.2020.09.020. DOI: 10.1016/j.rbmo.2020.09.020.
20. Garg R, Lal P, Agrawal P, et al. Menstrual cycle changes after COVID-19 infection: Does coronavirus-induced stress lead to hormonal change? *J South Asian Feder Obst Gynae* 2022;14(3):248–252. DOI: 10.5005/jp-journals-10006-2027.