Original Article :

COVID-19 Vaccination and Menstrual Cycle Changes: Predictive Factors Among Reproductive-Aged Women in Saudi Arabia

Howeida Abusalih[*1], Leen Al-Anazi, Aljouharah Al-Harbi, Reem Al-Mutairi, Ryoufe Otayn, Najla Al-Guhs

1. Department of Health Sciences, College of Health and Rehabilitation Sciences, Princess Nourah Bint Abdulrahman University, P.O. Box 84428, Riyadh 11671, Saudi Arabia

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Corresponding Author:

Howeida Abusalih, Department of Health Sciences, College of Health and Rehabilitation Sciences, Princess Nourah Bint Abdulrahman University, P.O. Box 84428, Riyadh 11671, Saudi Arabia.
Email: hhabusalih@pnu.edu.sa

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Abstract

Background and Aims:
Post-COVID19 vaccination menstrual irregularities have emerged as a evolving concern among women of reproductive age. This study evaluates the association between COVID-19 vaccination and menstrual cycle changes among reproductive-aged women in Riyadh, Saudi Arabia.".

Methods:
A cross-sectional study conducted among 700 participants via social media using a validated, self-administered Arabic questionnaire, adapted from existing literature. The tool was refined through rigorous back-translation and expert review (ACP = 96.6%). The questionnaire covered four domains: demographics, medical history, vaccination details, and menstrual changes. Kuder-Richardson coefficient of 0.7 confirmed the instrument's reliability and internal consistency. Statistical analysis was performed using SPSS. The study received IRB approval, and all participants provided voluntary informed consent. Data confidentiality was maintained through anonymization and the exclusion of personal identifiers.

Results:
Significant changes occurred in premenstrual syndrome (doses 1 and 2: P=0.010, 0.020) and cycle duration (P=0.024). Moderna significantly affected pain severity (P=0.007), unlike Pfizer or AstraZeneca. Flow and cramps were unaffected. Age, BMI, and employment were significant predictors of duration changes, while education and smoking were not.

Conclusions:
COVID-19 vaccination is associated with significant changes in PMS symptoms and cycle duration, with the Moderna vaccine specifically impacting pain severity. Age and BMI serve as key predictors of these changes.

Keywords:
COVID-19 vaccines, menstrual cycle changes, reproductive age, Saudi Arabia

Introduction:

Following the 2019 COVID19 outbreak, Saudi Arabia provided free vaccinations to all residents and visitors immediately upon approval to combat the global health crisis. Three vaccines were authorized: Pfizer-BioNTech, Oxford-AstraZeneca, and Moderna. The Oxford-AstraZeneca vaccine utilizes viral vector technology, while the Pfizer and Moderna platforms employ mRNA technology. [1,2] Since menstrual symptoms were excluded from initial clinical trials, the specific effects on reproductive-aged women remained unclear. Consequently, the prevalence, duration, and clinical implications of post-vaccination menstrual irregularities remain understudied. [2]

A systematic review and meta-analysis conducted by Chao, Menon, and Elgendi suggests a clear association between COVID-19 vaccination and menstrual irregularities, warranting further investigation into a potential causal link. [3] On November 17, 2021, the UK Medicines and Healthcare Products Regulatory Agency (MHRA) documented instances of menstrual issues, which encompassed symptoms like unusually heavy periods, delays, and unanticipated vaginal bleeding.[4] Similarly, a Danish cohort study found that approximately 30% of menstruating women reported cycle changes following vaccination .[5] Specifically, the Moderna vaccine has been associated with the highest rate of menstrual changes affecting (65.4%) of women, while the Oxford-AstraZeneca vaccine reported the lowest rate at (44.9%) .[4] Multiple studies indicate an association between COVID-19 vaccination and menstrual disturbances, though findings vary ,Rodríguez Quejada et al. (2022) reported that among 184 women, 8.69% experienced amenorrhea and 26.08% prolonged menstruation, while 65.21% remained within normal limits .[6] Mohamed Salih Mahfouz et al. (2023) observed that while irregularities existed pre-vaccination, there was a significant post-vaccination increase in heavy bleeding, duration, and pain. [7] Alexandra Alvergne et al. (2022) found that vaccination was associated with delays in subsequent periods for women with regular cycles. [8] Furthermore, Alison Edelman et al. noted a temporary increase in cycle length; individuals receiving two doses within one cycle saw an adjusted increase of 3.70 days compared to the unvaccinated. [9] Siwen Wang et al. found that women with pre-existing irregular cycles faced a higher risk of increased cycle length within the first six months, regardless of vaccine type. [10] Conversely, Darney et al. (2023) observed a slight, temporary increase in bleeding likelihood after the first dose, but no significant difference in heavy bleeding days

.[11] Similarly, Fadi S. I. Qashqari et al. (2022) found no significant link between vaccine type or dose number and cycle regularity.[12] While research in Saudi Arabia, such as Alahmari and Rahman (2022), has identified post-vaccination changes in regions like Riyadh.[13] a significant research gap persists across various regions, as highlighted by Nazir et al. [14]

Aim and Significance of Study

The significance of this study lies in its contribution to the expanding body of global evidence regarding reproductive health in the post-vaccination era. By providing a comprehensive analysis of menstrual parameters specifically within the Saudi Arabian context, this research fills a critical regional data gap and offers a more nuanced understanding of how diverse populations respond to immunization.

Clinically, by identifying specific demographic predictors ,such as Body Mass Index (BMI) and age ,these findings establish a practical framework for personalized clinical counseling. Healthcare providers can utilize this data to offer evidence-based reassurance to women experiencing cycle variations, distinguishing these transient physiological responses from long-term or serious health concerns. This study aims to evaluate the prevalence and nature of menstrual cycle changes following COVID-19 vaccination among women in Saudi Arabia and to identify potential predictive risk factors associated with these alterations

Furthermore, the study holds substantial public health importance. Addressing menstrual irregularities is vital for maintaining public trust in vaccination programs. By clarifying the nature of these side effects, this research helps mitigate vaccine hesitancy and supports informed healthcare decision-making, ensuring that reproductive health remains a prioritized component of vaccine safety surveillance.

Methodology:

Study Design:

The study was descriptive cross-sectional.

Study Setting:

The research was conducted within the Riyadh Region, the capital city of Saudi Arabia. As the Kingdom's primary administrative and healthcare hub, this setting provided a diverse and representative urban environment for investigating the national response to COVID-19 vaccination efforts among women of reproductive age.

Study Participants:

The target population consisted of females of reproductive age (15–49 years) residing in Riyadh ,Saudi Arabia who had received at least one dose of a COVID-19 vaccine. To ensure the accuracy of the results, the study focused on women with a history of

normal, regular menstrual cycles (21–35 days in length and 2–7 days in duration) before their vaccination. Participants were specifically excluded if they were using hormonal contraceptives or had pre-existing medical condition such as PCOS, diabetes, or thyroid disorders to isolate the vaccine's potential impact from other confounding physiological factors.

Data Collection Tools:

A self-administered, structured questionnaire was distributed electronically via Google Forms and shared through social media platforms (WhatsApp and Telegram). The instrument was adapted from the questionnaires utilized by Chourasia et al. (2022) and Matar et al. (2023), which investigated post-vaccination menstrual experiences in the Jazan Region and across six Arab countries, respectively[15,16] . The authors modified these items to align with the specific research objectives and the demographic context of the Riyadh Region. The questionnaire comprised approximately 38 items divided into the following four sections:

- **Section I:** Socio-demographics: This section was developed to capture the background characteristics of participants, including age, education level, employment status, nationality, and marital status (5 items).
- **Section II:** Obstetrical and Medical History: This section assessed the clinical background of the participants, covering pregnancies, miscarriages, chronic diseases, COVID-19 infection history, BMI, and smoking habits (6 items).
- **Section III:** Vaccination History: This section focused on the immunization profile, including the number of doses received, vaccine types, timing of administration, and any associated symptoms (6 items).
- **Section IV:** Menstrual Cycle Changes: This section addressed the primary research variables, specifically the duration and length of menstrual cycles before and after vaccination (21 items). The questionnaire was provided in both Arabic and English, taking approximately 10 minutes for participants to complete.

Data Collection Procedure:

The data collection process was conducted systematically to ensure participant reach and data integrity through the following procedures:

- **Distribution and Sampling:** The questionnaire was distributed online as a self-administered Google Form. Data were gathered using a convenience sampling technique, with the survey link shared broadly across major social media platforms, specifically WhatsApp

and Telegram, to reach females of reproductive age across the target region.

- **Collection Period and Duration:** Data collection was carried out over a nine-month period, spanning from August 2023 to May 2024. Participants were informed that the questionnaire was designed for efficiency, requiring approximately 10 minutes to complete in its entirety.
- **Data Integrity and Duplicate Prevention:** To ensure the validity of the unique responses and prevent the risk of data inflation, the authors enabled the "Limit to one response" feature within the Google Forms settings. This measure required participants to sign in to their accounts, thereby effectively preventing duplicate submissions from the same user.

Validity and Reliability:

To ensure the scientific rigor of the adapted tool, the following measures were implemented:

- **Validity:** The instrument was evaluated by a panel of three experts to ensure Content Validity. The Average Congruency Percentage (ACP) was calculated at 96.6%, indicating high expert agreement on the relevance and clarity of the items.
- **Pilot Study:** A pilot study was performed on 20 participants, who were excluded from the final sample size, to detect any ambiguity in the tool and ensure the readability and cultural appropriateness of the items. This phase also determined the time required to complete the questionnaire.
- **Reliability:** The questionnaire's reliability was assured using the Kuder-Richardson 20 (KR-20) coefficient, applied specifically to the binary symptom checklist (e.g., presence of delay or heavy bleeding). This yielded an average reliability coefficient of 0.7, indicating

Sample Size and Technique:

- The sample size was calculated using the n4Studies software equation [17]:

$$n = \frac{Np(1-p)z^2_{1-\frac{\alpha}{2}}}{d^2(N-1)+p(1-p)z^2_{1-\frac{\alpha}{2}}}$$

- The total population of females of reproductive age in Saudi Arabia is approximately 4,990,995, according to the General Authority for Statistics 18 .To achieve accurate results and ensure a representative sample, the minimum required sample size was calculated using a confidence interval of 95% (z = 1.96), a proportion of 50% (p = 0.50) to yield the maximum potential sample size, and a margin of error of 5% (d = 0.05).According to the standard sample size equation, the minimum

required sample size was initially determined to be 385. However, to account for the Design Effect (DEFF) often associated with complex survey distributions ,which was calculated at a factor of 1.8 ,the final target sample size was upgraded to approximately 700 participants. This adjustment was implemented to enhance the statistical power of the study and ensure the reliability of the findings.

n: Sample size =700

N: population size =4,990,995

Z: Confidence level at 95% (1.96)

d: Error proportion (0.05)

p: Probability (50%)

Statistical Analysis:

The data were analyzed using Statistical Package for the Social Sciences (SPSS). Both descriptive and analytical statistics were used. For descriptive statistics, frequency tables were used to describe participants' demographics, their obstetrical and medical history and vaccination history. Analytical statistics were conducted, such as ANOVA (for comparing three means), chi-square (for comparing categorical data), correlation, regression (to predict which changes in the menstrual cycle are most common regarding vaccine doses) and multivariable linear regression model (to predict which variables affecting the menstrual cycle changes). The P-value of < 0.05 indicated statistical significance.

Ethical Consideration:

Ethical approval was obtained from the Princess Norah bint Abdulrahman University Institutional Review Board (PNU-IRB), (IRB Log Number: 23-0759). Informed consent was attached to the questionnaire, and the purposes of the study were included. Participation in the study is voluntary, and participants can withdraw at any time without facing any consequences. The confidentiality of the collected data was assured; it does not include any personal information or identifiers, such as names or ID information, and only the study team has access to the information that was provided, which remains anonymous. The data were used for research purposes. There are no known risks from participation in the study, and there is no direct benefit from their participation, although advancing the scope of knowledge is expected.

Results:

Participants' Socio-demographic Profile

The sample consisted of 700 participants, with the majority belonging to the youth demographic. Specifically, three-quarters of the respondents (75.1%) were aged between 15 and 24 years, while those aged 45 and older represented the smallest portion of the sample at only 3.6%. This youthful trend is further reflected in the participants' marital status, where 79.7% identified as single and

17.4% were married.

Regarding educational background and employment, the sample was highly educated but largely outside the workforce. A significant majority (79.1%) held a university-level education, yet 72.0% of the total sample reported being unemployed. Full-time and part-time employees accounted for 20.0% and 8.0% of the participants, respectively. Finally, in terms of nationality, the vast majority of the respondents were Saudi (90.4%), with non-Saudi participants making up the remaining 9.6%.

Participant Vaccination Characteristics :Timing and Dosage

The majority of participants received their COVID-19 vaccination prior to contracting the virus (82.6%,), while a smaller segment (17.4%) was vaccinated following an infection. Regarding the number of doses administered, the vast majority of the studied sample had received at least two doses. Specifically,(68.3%)had completed three doses, and (30.9%)had received two. Only a negligible fraction of the population (0.9%) had received only a single dose .Vaccine Type Distribution Pfizer-BioNTech was the predominant vaccine choice across all stages of the vaccination series:First Dose: Pfizer was administered to (89.3%) of participants, followed by AstraZeneca (8.1%) and Moderna (2.6%).Second Dose: Pfizer usage remained high at 79.9% , while AstraZeneca increased to 16.1% and Moderna accounted for 4.0% .Third (Booster) Dose: Of the 489 participants who received a third dose, 50.0% received Pfizer, 11.6% received AstraZeneca, and 8.3% received Moderna. Notably, 30.1% of the total sample had not received a third dose at the time of data collection.

Table 1: The relationship between menstrual cycle changes with COVID-19 vaccine type .

Variable	Options	Pfizer		AstraZeneca		Moderna		Statistical test and P value
		Yes	No	Yes	No	Yes	No	
Flow of the next period after receiving the first dose	Lighter than usual	267	36	19	284	17	286	Chi=1.011 P=0.603
	Heavier than usual	53	7	7	53	0	60	
	Same as usual	305	32	31	306	1	336	
Flow of the next period after receiving the second dose	Lighter than usual	285	36	20	301	16	305	Chi=0.262 P=0.877
	Heavier than usual	54	7	6	55	1	60	
	Same as usual	286	32	31	287	1	317	
Flow of the next period after receiving the third dose	Lighter than usual	220	24	s	230	10	234	Chi=1.299 P=0.522
	Heavier than usual	38	7	6	39	1	44	
	Same as usual	367	44	37	374	7	404	

Cramps after receiving the first dose	Worse than usual	186	23	17	192	6	203	Chi=2.569 P=0.277
	Less than usual	161	25	15	171	10	176	
	Same as usual	278	27	25	280	2	303	
Cramps after receiving the second does	Worse than usual	191	24	18	197	6	209	Chi=1.048 P=0.592
	Less than usual	181	25	14	192	11	195	
	Same as usual	253	26	25	254	1	278	
Cramps after receiving the third dose	Worse than usual	169	24	18	175	6	187	Chi=1.460 P=0.692
	Less than usual	137	17	13	141	4	150	
	Same as usual	131	16	15	132	1	146	
	Didn't receive third dose.	188	18	11	195	7	199	
PMS (pre-menstrual syndrome) after receiving the first dose	Worse than usual	243	41	28	256	13	271	Chi=9.261 P=0.010*
	Less than usual	31	0	0	31	0	31	
	Same as usual	351	34	29	356	5	380	
PMS after receiving the second dose	Worse than usual	261	42	28	275	14	289	Chi=7.791 P=0.020*
	Less than usual	29	0	0	29	0	29	
	Same as usual	335	33	29	339	4	364	
PMS after receiving the third dose	Worse than usual	235	28	21	242	7	256	Chi=4.591 P=0.204
	Less than usual	18	1	1	18	0	19	
	Same as usual	202	32	28	206	4	230	
	Didn't receive the third dose.	170	14	7	177	7	177	

Table 1: showed that there is no significant differences between vaccine doses or types regarding menstrual flow and cramps. However, pre-menstrual syndrome (PMS) changed significantly following the first (P=0.010) and second (P=0.020) doses. The third dose showed no significant association with PMS changes.

Table 2:The relationship between menstrual cycle changes and doses of COVID-19 vaccine.

Variable	Options	One dose		Two doses		Three doses		Statistical test and P value
		Yes	No	Yes	No	Yes	No	
The duration of the menstrual cycle after receiving the COVID-19 vaccine doses	1-3 days	3	78	30	51	48	33	F= 3.175 P=0.024*
	4-6 days	1	332	92	241	240	93	
	7-9 days	2	225	73	154	152	75	
	More than 9 days	0	59	21	38	38	21	

The flow you experienced in the next period, after receiving the COVID-19 vaccine doses	Lighter than usual	5	298	100	203	198	105	Chi=4.006 P=0.135
	Heavier than usual	0	60	31	29	29	31	
	Same as usual	1	336	85	252	251	86	
The cramps you experienced before the next period, after receiving the COVID-19 vaccine doses	Worse than usual	3	206	75	134	131	78	Chi=1.932 P=0.381
	Less than usual	2	184	60	126	124	62	
	Same as usual	1	304	81	224	223	82	
The PMS you experienced before the next period, after receiving the COVID-19 vaccine doses	Worse than usual	3	300	93	210	207	96	Chi=0.321 P=0.852
	Less than usual	0	29	16	13	13	16	
	Same as usual	3	365	107	261	258	110	

Table 2: showed that there is change in post-vaccination cycle duration has significant difference (p=0.024). In contrast, no significant differences were observed for period flow (p=0.135), cramps (p=0.381), or premenstrual syndrome (p=0.852).

Table 3 :The relationship between menstrual cycle changes (length-regularity-pain)and type of COVID-19 vaccine.

Variable	Options	Pfizer		Statistical test and P-value	AstraZeneca		Statistical test and P-value	Moderna		Statistical test and P-value
		Yes	No		Yes	No		Yes	No	
Length of menstrual cycle after receiving the COVID-19 vaccine	Less than 24 days	175	20	F=0.899 P=0.407	13	182	F=0.849 P=0.428	7	188	F=0.988 P=0.373
	Between 24 and 38	350	47		37	360		10	387	
	More than 38 days	100	8		7	101		1	107	
Regularity of menstrual cycle after receiving the COVID-19 vaccine	Regular	195	20	Chi= 0.647 P=0.421	19	196	Chi= 0.200 P=0.655	1	214	Chi=5.495 P=0.019*
	Not regular	430	55		38	447		17	468	
Pain severity level associated with menstrual cycle after receiving the COVID-19 vaccine	Mild	94	8	Chi=1.466 P=0.480	8	94	Chi=0.573 P=0.751	0	102	Chi=9.826 P=0.007*
	Moderate	268	31		27	272		4	295	
	Severe	263	36		22	277		14	285	

Table 3: Provides insights about cycle length , it showed no significant differences across vaccine types. While cycle regularity and pain severity remained stable for Pfizer and AstraZeneca, Moderna was associated with statistically significant changes in both regularity P=0.019) and pain severity (P=0.007).

Table 4: Multivariable regression model for factors affecting menstrual cycle duration.

Coefficients[a]							
Model	**Unstandardized Coefficients**	**Standard Error**	**Standardized Coefficients**	**t**	**p-value**	**95.0% Confidence Interval for B**	
	B	**Std. Error**	**Beta**		**Sig.**	**Lower Bound**	**Upper Bound**
(Constant)	3.181	1.186		2.682	0.007	0.852	5.510
Age	0.120	0.051	0.116	2.331	0.020*	0.019	0.220
BMI	-0.218	0.070	-0.220	-3.126	0.002*	-0.355	-0.081
Education level	0.119	0.070	0.066	1.701	0.089	-0.018	0.256
Employment status	0.092	0.038	0.093	2.395	0.017	0.017	0.168
Marital status	0.074	0.071	0.045	1.033	0.302	-0.066	0.214
Nationality	0.099	0.101	0.036	0.972	0.331	-0.101	0.298
Number of pregnancies	0.006	0.037	0.009	0.167	0.867	-0.067	0.080
Number of miscarriages	-0.046	0.071	-0.028	-0.644	0.519	-0.185	0.094
Smoking status	-0.173	0.104	-0.063	-1.661	0.097	-0.378	0.032
a. Dependent Variable: The duration of the menstrual cycle after receiving the dose of COVID- 19 vaccine							

Table 4: The Multivariable analysis identified three significant predictors for post-vaccination menstrual cycle duration changes. Age was positively correlated (B=0.120, p=0.020, 95 % CI [0.019, 0.220]), suggesting older participants experienced longer cycles. Conversely, BMI showed a negative association (B=-0.218, p=0.002, 95\% CI [-0.355, -0.081]), with higher BMI predicting shorter cycles. Employment Status was dummy-coded (e.g., Employed=1, Unemployed=0) prior to entry into the model was also a significant predictor (B=0.092, p=0.017, 95\% CI [0.017, 0.168]). Education, marital status, nationality, parity, history of miscarriage, and smoking status were not statistically significant (p > 0.05).

Discussion:

In this study, a significant variation in menstrual cycle duration was observed following COVID-19 vaccination (F=3.175, P=0.024). While the majority of the 700 respondents reported a duration of 4–6 days (N=333), a while some experienced either shortened (N=81) or extended (N=59) periods. The findings of the present study align with those reported by Quejada et al, reinforcing the observation that COVID-19 vaccination is associated with significant alterations who reported in their cohort of 184 participants that 26.08% of women experienced prolonged menstruation exceeding nine days, while

65.21% maintained a duration within the established clinical norm of less than eight days. Collectively, these data support the growing consensus that COVID 19 vaccine can exert a transient influence on the hypothalamic-pituitary-ovarian axis, leading to detectable menstrual cycle irregularities. [6]

65.21% maintained a duration within the established clinical norm of less than eight days. Collectively, these data support the growing consensus that COVID 19 vaccine can exert a transient influence on the hypothalamic-pituitary-ovarian axis, leading to detectable menstrual cycle irregularities. [6]

Furthermore, the present findings are confirmed by a large-scale international study conducted by Edelman et al., which analyzed data from a substantial cohort of nearly 20,000 individuals. Their analysis concluded that COVID-19 vaccination was associated with small, transient increases in menstrual cycle length, reinforcing the global observation of minor post-vaccination rhythm disturbances .[19] This suggests a global trend where the immune response to vaccination may temporarily disrupt the timing of the menstrual cycle.

Regarding menstrual flow, our findings indicated no statistically significant changes following the first, second, or third doses P=0.603, P=0.877, and P=0.522, respectively). Although a subset of participants reported lighter or heavier bleeding, the majority of respondents across all three dose experienced either no change or a shift toward lighter flow, suggesting that the vaccine did not substantially increase heavy bleeding in this population .This similar to a study conducted by Darney et al. that shows that there is a slight increase in the likelihood of having more total bleeding after the first dose of COVID-19 vaccine, However , this prolongation was transient and typically resolved by the subsequent cycle; furthermore, no statistically significant disparities were observed in the duration of heavy bleeding episodes between vaccinated individuals and the unvaccinated group.[11]

This result is further reinforced by Wesselink et al. whose prospective cohort study indicated that COVID-19 vaccination does not alter long-term menstrual flow.[20] However, our findings differ slightly from Trogstad et al. who observed a higher incidence of heavier-than-usual bleeding in a Norwegian cohort after the second dose .[21] The lack of significance in our study compared to others may be due to differences in sample size or the retrospective nature of self-reporting volume.

Regarding the prevalence of dysmenorrhea, our findings indicate that

the severity and frequency of menstrual cramps following the administration of the first, second, and third doses of the COVID-19 vaccine, were not statistically significant (P=0.277, P=0.592, and P=0.692) respectively. Conversely, research by Alahmadi et al. (2022) identified that COVID-19 immunization was linked to transient and minor menstrual alterations, characterized predominantly by an exacerbation of dysmenorrhea and increased menstrual volume .[2] Furthermore, our results deviate from the findings of the EVA project, directed by Baena-García et al., which observed that a substantial proportion of participants reported an exacerbation of dysmenorrhea following immunization.[22] These discrepancies across studies highlight that while some populations experience increased cramping, it may not be a universal side effect in every geographical cohort.

Regarding menstrual regularity, only 30.7% (n=215) of participants reported regular cycles, while a substantial majority of 69.3% (n=485) identified their cycles as irregular. Statistical analysis indicated that neither the Pfizer nor the AstraZeneca vaccines were significant predictors of this irregularity (p = 0.421 and = 0.655) , respectively). In contrast, the Moderna vaccine demonstrated a statistically significant association with cycle alterations (p = 0.019$), suggesting that the physiological response to different vaccine platforms may vary in its impact on the menstrual cycle. This specific association with the Moderna platform is echoed by researchers who found that mRNA-1273 (Moderna) was more frequently associated with cycle disturbances compared to viral-vector vaccines, possibly due to its higher mRNA concentration eliciting a stronger transient inflammatory response .[22,23]

Additionally, Mahfouz et al. 2023 discovered that menstrual irregularities were already prevalent before vaccination, but there was a significant rise in irregularities following vaccination. [7] With regard to menstrual cycle length and COVID-19 vaccine types, (N=195) had less than normal menstrual cycle length (less than 24 days), while most of the women (N=397) had normal lengths of their menstrual cycles (between 24 and 38 days), and (N=108) had longer lengths than the normal ones (more than 38 days), moreover, all types Pfizer, AstraZeneca, and Moderna did not show any statistically significant differences (F=0.899, P=0.407 / F=0.849, P=0.428 / F=0.988, P=0.373) respectively. An additional study conducted by Edelman et al. 2022 found that women who received COVID-19 vaccines experienced a slight increase in the length of their menstrual cycles compared to those who were unvaccinated.

However, this increase was less than one day and was likely to be temporary[9,19]. Menstrual cycle length was not found to be significant in our study; however, in the study mentioned above, significant changes were found While menstrual flow intensity and dysmenorrhea remained statistically independent of vaccine type and dosage, a significant correlation was identified regarding premenstrual syndrome (PMS) symptomatology following the administration of the first ($p = 0.010$) and second ($p = 0.020$) doses

This shift in PMS symptoms is a notable finding that aligns with observations by Alvergne et al. who suggested that the systemic immune response can temporarily exacerbate mood and physical symptoms associated with the menstrual cycle. [23]

Limitations: The study's results are limited due to the data being gathered at once, unable to establish a cause-and-effect relationship and not accounting for changes over time. Confounding variables are taken into consideration in the analysis and design phases, and despite efforts to control for confounding variables, residual confounding may still be present. There may be unmeasured or unknown confounders that influence both COVID-19 vaccination and menstrual cycle changes. While we cannot completely isolate pandemic-induced stress, we added a limitation statement regarding those who reported COVID symptoms simultaneously to distinguish between infection-related and vaccine-related changes.

Conclusion:

In conclusion , this research indicates that although COVID-19 vaccination is linked to specific menstrual variations, parameters such as flow intensity and dysmenorrhea remains largely unaffected. The most prominent observations include a statistically significant extension of cycle duration ($p = 0.024$) and an exacerbation of PMS symptomatology following the primary vaccination series. Notably, the Moderna platform was more closely associated with disturbances in cycle regularity and pain severity than other vaccine types. Furthermore, multivariable regression analysis identified age, BMI, and occupational status as significant independent predictors of the degree of post-vaccination menstrual disruption.

Generative AI statement

The author(s) declared that Gen AI was used in the creation of this manuscript. AI was used to enhance the quality of the language.

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