



American Journal of Multidisciplinary Research and Innovation (AJMRI)

ISSN: 2158-8155 (Online), 2832-4854 (Print)

VOLUME 3 ISSUE 6 (2024)



PUBLISHED BY: E-PALLI PUBLISHERS, DELAWARE, USA

Does the COVID-19 Vaccines Effect on the Menstrual Cycle, Cross-Sectional Study Among Adult Females at King Saud University

Taghread Saadi Alghamdi^{1*}, Eltigani O. M. Omer²

Article Information

Received: May 08, 2024

Accepted: June 12, 2024

Published: November 13, 2024

Keywords

*Contraceptive Pills, COVID-19
Vaccine, Menstrual Cycle,
Oligomenorrhea, Polycystic Ovaries*

ABSTRACT

COVID-19 vaccinations have been associated with irregularities in the menstrual cycle and symptoms occurring pre and post-menstruation, affecting women's reproductive health. This study aimed to demonstrate the impact of COVID-19 vaccines on women's reproductive health by examining the association between COVID-19 vaccines and disturbed menstrual cycles. This cross-sectional survey-based study was conducted among adult females at King Saud University, Saudi Arabia, from April 2022 to August 2022. A total of 380 participants were selected through a stratified random sampling technique. Ethical approval was obtained from the Deanship of Scientific Research at King Saud University. The data were analysed using descriptive statistics and appropriate statistical tests. The results revealed that 53.9% of the participants experienced disturbances in the menstrual cycle after receiving the COVID-19 vaccination. Adult females aged 18-25 showed the highest rate of disorders. Menstrual disruptions were substantially correlated with marital status ($p = 0.05$), with a significant association between the number of COVID-19 vaccine doses and the occurrence of menstrual disturbances ($p = 0.001$). The administration of the vaccination during menstruation was linked to a notable occurrence of menstrual disturbances, although the p-value showed no statistical significance. A significant correlation was examined ($p < 0.05$) between pre-existing menstrual problems and the occurrence of disorders after receiving the COVID-19 vaccine ($p < 0.05$). The study emphasised the importance of tailored healthcare treatments for women following COVID-19 vaccination and the need for regular evaluation of reproductive health outcomes post-COVID-19 vaccination.

INTRODUCTION

The menstrual cycle is a regular and natural process that occurs within the female reproductive system (Schmalenberger *et al.*, 2021). The reproductive cycle starts with menarche, the initial occurrence of menstruation in adolescence, and ends with menopause, a stage that facilitates fertilisation and potential pregnancy (Patricio & Sergio, 2019; Vogazianou, 2019). The duration of healthy menstrual cycles can range from 21 to 37 days, with cycles < 21 days being identified as polymenorrhea and cycles > 37 days as oligomenorrhea (De Sanctis *et al.*, 2014). Typically, a normal menstrual cycle lasts for 28 days, starting from the beginning of menstruation and ending the day before the next period onset (Thiyagarajan *et al.*, 2022). Estradiol or estrogen (E2) and progesterone (P4) exhibit regular variations in hormone levels that regulate this cyclic process (Schmalenberger *et al.*, 2021). The follicular phase, originating with menstruation and extending until ovulation, can be identified by the development of ovarian follicles containing oocytes. During this stage, the levels of P4 remain low, while the levels of E2 gradually increase as they achieve a pre-ovulatory surge (Murray & Orr, 2020). In the following luteal phase, which occurs after ovulation until the start of menstruation, the primary follicle transforms into the corpus luteum, which releases progesterone and estrogen (Barbieri, 2014; K. Schmalenberger *et al.*, 2021). During

the mid-luteal phase, there is a noticeable increase in P4 levels, reaching their highest point, as well as a subsequent spike in E2 levels. The corpus luteum is involved in the event that fertilisation is unsuccessful, which results in a perimenstrual decline in E2 and P4 and the start of menstruation (Reed & Carr, 2015). This cycle continues with the onset of the subsequent menstrual period (Schmalenberger *et al.*, 2021).

Numerous experimental and long-term studies validate the presence of a particular subset of females who exhibit an abnormal response to regular changes in ovarian hormone levels (Berga, 2020; Wei *et al.*, 2018). The condition manifests as behavioural, emotional, and cognitive symptoms that primarily occur during the usual hormonal changes observed in the premenstrual and mid-luteal phases of the menstrual cycle (Schmalenberger *et al.*, 2021). A woman's menstrual cycle may exhibit abnormal or unusual characteristics. Menstrual cycle disorders encompass dysmenorrhea, amenorrhea lasting at least three months in the absence of pregnancy, and menorrhagia, which refers to heavy bleeding. Approximately 14% to 25% of women experience menstrual irregularities during childbearing, and these irregularities may differ between women (Male, 2021). However, irregular menstruation can occur due to hormonal imbalances, pregnancy, trauma, inflammation, and infections (Critchley *et al.*, 2020).

¹ Public Health Department, College of Public Health, Imam Abdurrahman Bin Faisal University, Dammam, Saudi Arabia

² Community Health Department, College of Applied Medical Sciences, Northern Border University, Arar, Saudi Arabia

* Corresponding author's e-mail: taghread.sa@gmail.com

Additionally, physical factors like excessive exercise, unhealthy food, and stress can impact the menstrual cycle (Huhmann, 2020). Other health issues like thyroid disorders, liver and kidney diseases, and certain medications like anticoagulants can also cause menstrual changes (Gray, 2013). Therefore, understanding these factors is crucial for managing menstrual cycles (Vladimirovna *et al.*, 2023). A gynaecologist can address menstrual issues, but factors like medication use, cycle duration, and gynaecological surgery increase the risk. Symptoms can be alleviated with dietary adjustments, hormone supplementation, oral contraceptives, diuretics, tranquillisers, antidepressants, and regular physical activity (Roos *et al.*, 2022).

Vaccination has played a major role in keeping infectious diseases under control. The emergence of COVID-19 triggered a worldwide health crisis, prompting the development of numerous vaccines and the implementation of widespread immunisation programs across the world (Sualeh *et al.*, 2022). Several vaccines were developed to control the infection announced by the World Health Organisation (WHO), such as Sinopharm, Sinovac, Novavax, and Pfizer (BNT162b2) (Polack *et al.*, 2020). However, there was evidence of vaccine hesitation, particularly among women of reproductive age who were concerned that the vaccination may interfere with their menstrual cycle (Sualeh *et al.*, 2022). A study by Li *et al.* (2021) showed that about 20% of COVID-19 patients had shortened menstrual cycles, while 19% experienced prolonged cycles and 28% experienced changes in menstruation (Li *et al.*, 2021). In another study, Naina Kumar *et al.* 2023 demonstrated that COVISHIELD and COVAXIN vaccinations were linked to irregularities in the menstrual cycle and pre- and post-menstrual symptoms in a small subset of patients (Kumar *et al.*, 2023). The reluctance regarding vaccination could result from the association between the vaccine and menstruation complications (Sualeh *et al.*, 2022).

LITERATURE REVIEW

A regular menstrual cycle serves as a reliable indicator of a well-functioning Hypothalamic-Pituitary-Ovarian (HPO) system and a woman's state of health. The menstrual characteristics exhibit variability on a monthly basis throughout an individual's lifespan (Bull *et al.*, 2019). Changes in frequency, intensity, duration, or regularity can identify menstrual irregularities (Jung *et al.*, 2018). These variations arise due to several reasons, including coagulopathy, ovulatory dysfunction, medication usage, and modifiable elements such as abrupt weight loss, severe exercise, obesity, and psychological disorders (Polack *et al.*, 2020). However, mental stress is considered a significant factor; recent research has linked irregular menstrual cycles to increased levels of stress and anxiety during the COVID-19 pandemic (Demir *et al.*, 2021).

Recent studies suggest that COVID-19 infection and vaccination can impact menstrual cycles (Alvergne *et al.*, 2021; Male, 2021; Taşkalıdıran *et al.*, 2022). In a case-

control study conducted in the United Kingdom, 20% of the female participants reported experiencing irregular menstrual cycles post-vaccination (Alzahrani *et al.*, 2023).

COVID-19 Vaccination and its Side Effects

Vaccines are constantly monitored and managed for safety and efficacy, but they can still cause side effects. These symptoms often manifest as minor pain and redness at the injection site or a fever, and they usually disappear within a few days (Hatmal *et al.*, 2021). In 2022, approximately 1,871,932,835 people (23.61% of the global population) received two doses of a COVID-19 vaccine; meanwhile, in Saudi Arabia, 21,449,067 people (60.69% of the population) were fully vaccinated with two doses (Organization, 2022). A third dose of COVID-19 vaccine was given to low-immunity individuals after 10 months of the first dose (Moreira Jr *et al.*, 2022). Despite FDA approval and difficulty in predicting side effects, many have been reported through surveillance systems issued by the Centers for Disease Control & Prevention (CDC) for the Vaccine Adverse Events Reporting System (VAERS) and After Vaccination Health Checker (V-Safe) (Organization, 2022). Side effects range from mild to severe and include redness, chest pain, swelling, fatigue, headache, muscle ache, nausea, fever, chills, difficulty in breathing, and menstrual irregularities in women (Beatty *et al.*, 2021).

A report by CDC 2023 showed 2,403,628 cases of side effects due to COVID-19 vaccines, including 98,163 cases of blood and lymphatic disorders, 124,613 cases of heart disorders, and 103,310 cases of reproductive system and breast disorders (Centers for Disease Control and Prevention., 2023). A study conducted in Saudi Arabia by Alghamdi *et al.* (2021) reported that adverse side effects were observed by the Pfizer vaccine after the second dose (13.22%) compared to the first dose (4.17%). Breathlessness and chest pain were recorded following the administration of the Oxford-AstraZeneca (ChAdOx1) vaccine and less frequently through the Pfizer vaccine (Alghamdi *et al.*, 2021). Another study by Alhazmi *et al.* (2021) found that 60% of participants experienced adverse effects from COVID-19 vaccines, with fatigue (90%) and soreness at the injection site (85%) being common (Alhazmi *et al.*, 2021).

COVID-19 Vaccination and Menstrual Cycle Disturbances

According to a CDC report, 26,450 (19.19%) cases among adult females experienced heavy menstrual bleeding, 14,835 (10.76%) cases suffered from delayed menstruation, and 14,560 cases had menstrual disorders and several other side effects related to breast injuries (Centers for Disease Control and Prevention, 2023). A study conducted by Al-Mousa *et al.* (2022) in Saudi Arabia found that the COVID-19 vaccine caused changes in the menstrual cycle, including increased duration, abundance, and pain. Around 60% of cases experienced these disorders after the vaccine. Females aged 15-24

years were two times more likely to experience these changes, indicating a significant impact of the vaccine on the menstrual cycle (Almoussa, 2022). Moreover, a study by Gibson *et al.* (2022) found that 55% of participants received the Pfizer vaccination, 37% received Moderna's vaccine, and 8% received the Johnson and Janssen vaccine (Gibson *et al.*, 2022). This study found a slight increase in menstrual cycle duration following COVID-19 vaccination, with a significant increase in the likelihood of a cycle lasting over 38 days (Gibson *et al.*, 2022). However, this effect was not persistent. The duration of menstrual cycles increased for 1-2 cycles after vaccination but then recovered to their original length. The increase was associated with dosages administered during the early and mid-follicular phase (Gibson *et al.*, 2022). A second dosage within the final 14 days of the cycle, typically aligning with the luteal phase, shortened the average cycle length. The study suggests that the association between vaccination and menstrual cycle length depends on the timing of the dosage and may align with specific phases of the menstrual cycle (Gibson *et al.*, 2022).

Previous studies demonstrated a correlation between the administration of the COVID-19 vaccine and elongation of the menstrual cycle, as well as irregularities in its pattern (Alghamdi *et al.*, 2021; Muhaidat *et al.*, 2022). Studies conducted by Alvergne *et al.* (2022) and Edelman *et al.* (2022) reported a certain degree of correlation between vaccination doses and menstrual disturbances (Alvergne *et al.*, 2022). Consequently, the study by Farland *et al.* (2023) found that 25% of the participants who received vaccine experienced menstrual cycle disruptions, with the majority occurring after the second dose (56%) (Farland *et al.*, 2023). Common issues included irregular menstruation (43%), heavy bleeding (31%), increased period discomfort (30%), and intensified premenstrual symptoms (34%). The study results revealed that individuals with higher BMI and higher self-reported perceived stress levels were more likely to experience these changes after vaccination (Farland *et al.*, 2023). Similarly, H. M. Al Kadri *et al.* (2023) found menorrhagia, oligomenorrhea, and polymenorrhea as the most common menstrual irregularities post-vaccination, highlighting the significant number of women experiencing irregular menstruation (Al Kadri *et al.*, 2023). However, a study by Isılay Taşkaldıran *et al.* (2022) & Tayyab *et al.* (2022) revealed that 35.7% of 241 COVID-19-infected women experienced menstrual changes within the first three cycles. Among 537 individuals who received various COVID-19 vaccinations, 15.1% reported changes (Taşkaldıran *et al.*, 2022). Women who received the Sinovac and Pfizer vaccines had a higher incidence of menstrual irregularities post-vaccination (Tayyaba Rehan *et al.*, 2022).

A study by Chavin D. Gopaul *et al.* (2023) revealed that menstrual cycle issues were common among those who received the COVID-19 vaccine, including delayed menstruation and excessive bleeding (Gopaul *et al.*, 2023). The results were consistent with a previous study

by Woon & Male *et al.* (2022), who observed a 2.3-day delay in menstrual cycles after the first and second doses. The Norwegian Institute of Public Health also found increased menstrual flow in young women aged 18-30 after receiving the first and second doses, with 13.6% and 15.3%, respectively (Von Woon & Male, 2022). However, no conclusive evidence was found between the COVID-19 vaccination and other menstrual irregularities, such as missed periods (Gopaul *et al.*, 2023). Therefore, this study aimed to demonstrate the impact of COVID-19 vaccines on women's reproductive health by examining the association between COVID-19 vaccines and disturbed menstrual cycles.

MATERIALS AND METHODS

Study Design and Population

This cross-sectional study was conducted among adult females at King Saud University, Riyadh, from April 2022 to August 2022. The study population consists of 380 participants who experienced menstrual cycle disturbances after receiving COVID-19 vaccine.

Ethical Approval

Ethical approval was obtained from the Deanship of Scientific Research at King Saud University (Ref No: KSU-HE-22-156). Written informed consent was also obtained from the participants, and the study was carried out in conformity with the 1964 Declaration of Helsinki. The STROBE guidelines were followed, and any subsequent revisions or with comparable ethical standards.

Inclusion and Exclusion Criteria

The study included a clinically suitable participant cohort: adult females aged 18 to 50 years. Participants who received the COVID-19 vaccine and menstruating were selected for the study. Conversely, the exclusion criteria included participants aged below 18, lactating and pregnant, who had previously experienced ovarian dysfunction, who used intrauterine or oral contraceptives, and who did not receive the COVID-19 vaccine.

Data Collection and Sampling Technique

The data was collected through a structured questionnaire consisting of different components such as demographics, physical exercise behaviour, menstrual disorders, the impact of the COVID-19 vaccine on the menstrual cycle, and side effects associated with the COVID-19 vaccine. The questionnaire was designed using Google Forms and distributed through online social media platforms. Furthermore, a stratified random sampling technique was employed to collect the data.

Data Analysis

The data was analysed using Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, USA) version 20.0. Frequencies and percentages were calculated using descriptive statistics, and association analysis was done to

evaluate the correlation between variables. The p-value of < 0.05 was considered statistically significant.

RESULTS AND DISCUSSION

The results section presents a comprehensive analysis and statistical interpretations based on data collection. A total of 380 participants were included in the study. Table 1 presents the association between menstrual disorders and the COVID-19 vaccine among adult females at King Saud University. Notably, 59.5% of females aged 18-25 experienced menstrual disorders, with a decreasing percentage for older age groups. While single women exhibited a higher percentage (71.8%) compared to married and divorced. Females with normal weight showed a higher percentage (54.5%) compared to obese females. Tables 2(a), 2(b), and 2(c) present characteristics of female participants, COVID-19 vaccination, infection history, and impact of vaccination on menstrual cycle, respectively. Table 3 shows an association between diet, physical exercise and menstrual disorders after obtaining the COVID-19 vaccine. The highest number of females with unhealthy diets (54.5%) and moderate-intensity exercise (92.6%) had menstrual disorders. Among participants, (39.2%) of females had troubled

psychological health post-COVID-19 vaccination. Table 4 reveals an association between menstrual disorders post-COVID-19 vaccination and chronic diseases. The highest number of menstrual disturbances was observed in females with chronic disease (14.6%) compared to hormone imbalance (12.9%). However, the association analysis was not significant. The correlation between menstrual disorders post-COVID-19 vaccination and the health behaviours and practices, medical treatments and reproductive health of the participants is presented in Table 5. There was no significant link between infection and vaccination, but higher rates of infection were observed after vaccination. The analysis revealed that (76.8%) females did not use any therapeutic drugs; reproductive health was better, but breastfeeding was less common among women with children. Further, there was no significant association between vaccination stages and menstruation issues, but higher rates were observed for those receiving two or three doses. Figure 1 displays the use of therapeutic drugs among participants, whereas Figures 2 and 3 illustrate common types of disturbances during the menstrual cycle post-COVID-19 vaccination and the duration of side effects among adult females at King Saud University.

Table 1: Demographic characteristics and impact of COVID-19 vaccine on menstrual cycle

	Frequency (n = 380)	Percentage (n %)
Participant Consent		
No	4	1.1
Yes	376	98.9
Age		
18–25	226	59.5
26–35	87	22.9
36–49	67	17.6
Nationality		
Non-Saudi	15	3.9
Saudi	365	96.1
Marital Status		
Single	273	71.8
Married	92	24.2
Divorced	15	3.9
Profession		
Bachelors Student	207	54.5
Post-Graduate Student	70	18.4
Employee	71	18.7
Faculty Member	32	8.4
Body Mass Index		
Underweight	40	10.5
Normal weight	207	54.5
Overweight	80	21.1
Obese class 1	30	7.9
Obese class 2	16	4.2
Obese class 3	7	1.8

Table 1 shows that menstrual problems following the COVID-19 vaccination reduced with increasing age, with the association not being statistically significant. Adult females aged 18 to 25 had the highest rate of disorders following COVID-19 vaccination. Menstrual disruptions were substantially correlated with marital status with

single women reporting the highest occurrence. The comparison was significant, with $p = 0.05$. There was no significant correlation observed between BMI levels and disruptions in the menstrual cycle. However, obese females reported fewer disorders than normal-weight females, who reported the most disorders.

Table 2(a): Characteristics of female participants

Characteristics	Frequency (n = 380)	Percentage (n %)
Are you pregnant?		
No	377	99.2
Yes	3	0.8
Are you breastfeeding?		
No	374	98.4
Yes	6	1.6
Do you have menstrual disorders?		
No	181	47.6
Yes	199	52.4
Do you have a thyroid disorder?		
No	358	94.2
Yes	22	5.8
Do you have a hormone imbalance?		
No	331	87.1
Yes	49	12.9
Do you have children?		
No	297	78.2
Yes	83	21.8
Do you use any of these contraceptives?		
Nothing	354	93.2
The oral contraceptive pill	21	5.5
Intrauterine device	5	1.3

Table 2(b): COVID-19 vaccination and infection history

Characteristics	Frequency (n = 380)	Percentage (n %)
Have you been infected with Acute Respiratory Syndrome Coronavirus 2 before getting COVID-19 vaccination?		
No	334	87.9
Yes	46	12.1
Have you been infected with Acute Respiratory Syndrome Coronavirus 2 after getting COVID-19 vaccination?		
No	286	75.3
Yes	94	24.7
How many doses of COVID-19 vaccine did you receive?		
One dose	3	8
Two doses	129	33.9
Three doses	248	65.3
What kind of vaccine did you receive?		
Pfizer Biontec	316	83.2
Oxford AstraZeneca	64	16.8
What kind of vaccine did you receive for the second time?		

Did not receive the second dose	1	0.3
Pfizer Biontec	334	87.9
Oxford AstraZeneca	40	10.5
Moderna	5	1.3
What kind of vaccine did you receive for the third time?		
Did not receive third dose	111	29.2
Pfizer Biontec	214	56.3
Oxford AstraZeneca	9	2.4
Moderna	46	12.1

Table 2(c): Impact of COVID-19 vaccine on menstrual cycle

Characteristics	Frequency (n =380)	Percentage (n %)
Have you experienced any side effects after the vaccine?		
No	111	29.2
Yes	269	70.8
When did the side effects appear?		
Immediately after the vaccine	49	12.9
Within 24 hours after the vaccine	277	72.9
During the first week	17	4.5
After more than a week	37	9.7
How long did the side effects last?		
After few hours of vaccination	57	15
Two days or less	142	37.4
One week	50	13.2
A month or less	16	4.2
More than a week	115	30.3
Did you receive the COVID-19 vaccine during the menstrual cycle?		
No	272	71.6
Yes	108	28.4
Have you experienced one of these symptoms related to the menstrual cycle after the vaccine?		
Not applicable	181	47.6
Amenorrhoea	28	7.4
Oligomenorrhoea	56	14.7
Menorrhagia	32	8.4
Length of menstruation more than 8 days	5	1.3
Dysmenorrhoea	25	6.6
Polymenorrhoea	30	7.9
Short period (< 2 days)	17	4.5
Bleeding between menstruation cycles	6	1.6
How long have you had symptoms of menstrual disorder after the vaccine?		
Not applicable	159	41.8
One month	38	10.0
Two months	43	11.3
Three months and more	140	36.8
Do you think these symptoms of the menstrual cycle that you experienced are related to the COVID-19 vaccines?		
No	175	46.1

Yes	205	53.9
In which dose did you get the side effects related to the menstrual cycle?		
I do not know	216	56.8
First dose	64	16.8
Second dose	58	15.3
Third dose	42	11.1

Tables 2(a, b, and c) show female participant’s medical history, COVID-19 vaccination status, and the impact of the vaccine on their menstrual cycle. Most participants did not exhibit hormonal abnormalities, were not breastfeeding, and were pregnant. The majority of the participants received three doses of the vaccination, with Pfizer being the largest. The majority reported

negative effects on their menstrual cycle, with 72.9% occurring within 24 hours and 30.3% lasting over a week (CI: 95%). However, 269 participants (70.8%) responded that they experienced side effects after vaccine. Side effects like fever, fatigue, headaches, muscle discomfort, and injection site pain typically were the most common among participants.

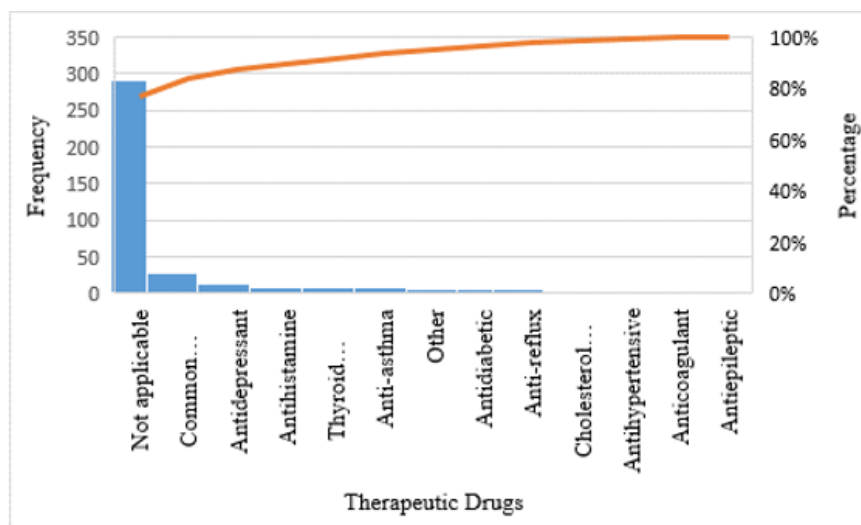


Figure 1: Use of Therapeutic Drugs in between COVID-19 vaccination or menstrual cycle period

Table 3: Associations of Diet and Physical Exercise Behavior with Menstrual Disorders after Obtaining a COVID-19 Vaccine

Variables	Frequency (n =380)	Percentage of females who had menstrual disorders after vaccination (n %)	Association analysis	
			Value	Sig.
Diet				
Unhealthy and unbalanced diet	207	54.5	10.229	.332
Healthy and balanced diet	173	45.5		
Exercise				
Practising daily exercise				
No	255	67.1	6.075	.732
Yes	125	32.9		
Moderate-intensity exercise	352	92.6	17.634	.04
Vigorous-intensity exercise	28	7.4		
Spent 75 min or less per week	277	72		
Spent 76–150 min per week	84	22.1	15.212	.647
Spent 151–300 min per week	19	5.0		
Psychological Health				
Troubled psychological health	149	39.2	20.345	.016
Balanced psychological health	231	60.8		

Table 3 shows that adult females with an unhealthy and unbalanced diet reported the highest rate of disorders (54.5%), and the P-value was not statistically significant ($p = 0.332$). Menstrual disorders were reported by approximately (32.9%) of females who exercised daily. Meanwhile, (92.6%) of adult females who engaged in moderate exercise and received the COVID-19 vaccine

reported suffering from a disorder with a P-value < 0.05 ($P = 0.04$), considered statistically significant. The exercise duration, 75 minutes or less per week, was associated with the menstrual cycle (72%) compared to 150-300 mins per week. However, the p-value ($p = 0.647$) was not statistically significant at (CI; 95%).

Table 4: Associations between Menstrual Disorders after Obtaining a COVID-19 Vaccine and Adult Females Suffering from Chronic Diseases

Variables	Association analysis	
	Value	Sig.
Disorders		
Chronic disease	106.356	.115
Thyroid disorder	4.212	.897
Hormone imbalance	8.734	.462
Menstrual disorders before the COVID-19 vaccine	77.210	.001
No reproductive disease	61.179	.234
Polycystic ovaries		
Uterine fibrosis		
Uterine tumours		
Migratory endometrium		
Pelvic inflammation		
Any other inflammation		
COVID-19 Infection		
Infected with SARS-CoV-2 before vaccination	5.589	.78
Infected with SARS-CoV-2 after vaccination	10.234	.332

Table 4 indicated a significant correlation ($p = < 0.05$) between pre-existing menstrual problems and the occurrence of disorders after receiving the COVID-19 vaccine ($p < 0.05$). While certain chronic diseases and other health-related factors were linked to menstrual irregularities, the p-value showed no statistical significance ($p = 0.115$). Polycystic ovaries had a higher percentage (14.16%) compared to those without

reproductive diseases (80.53%), but the association analysis lacks statistical significance. Other reproductive issues showed negligible associations. The occurrence of menstrual disturbances was associated with SARS-CoV-2 infection both before and after vaccination, with respective percentages of (12.1%) and (24.7%). However, the p-value showed no significant correlation between the variables.

Table 5: Associations between Menstrual Disorders after Obtaining a COVID-19 Vaccine and Health Related Behaviours and Practices

Variables	Association analysis	
	Value	Sig.
Infected with SARS-CoV-2 before vaccination	5.589	.78
Infected with SARS-CoV-2 after vaccination	10.234	.332
Therapeutic drug consumption	84.485	.954
Have children	14.539	.104
Breastfeeding	19.599	.021
No contraceptive use	21.084	.275
Oral contraceptive pill use		
Intrauterine device use		
Received one dose	66.620	$< .001$
Received two doses		
Received three doses		
Obtained a COVID-19 vaccine dose during the menstrual cycle	11.787	.226

Table 5 demonstrates a significant correlation between breastfeeding and menstrual disturbances ($p = 0.021$), as well as a significant association between the number of COVID-19 vaccine doses and the occurrence of menstrual disturbances ($p = 0.001$). The administration of the vaccination during menstruation was linked

to a notable occurrence of menstrual disturbances, although the p-value showed no statistical significance. Moreover, the prevalence of menstrual disturbances was remarkably high (93.2%) in females who did not take contraceptive pills. However, the correlation was not statistically significant.

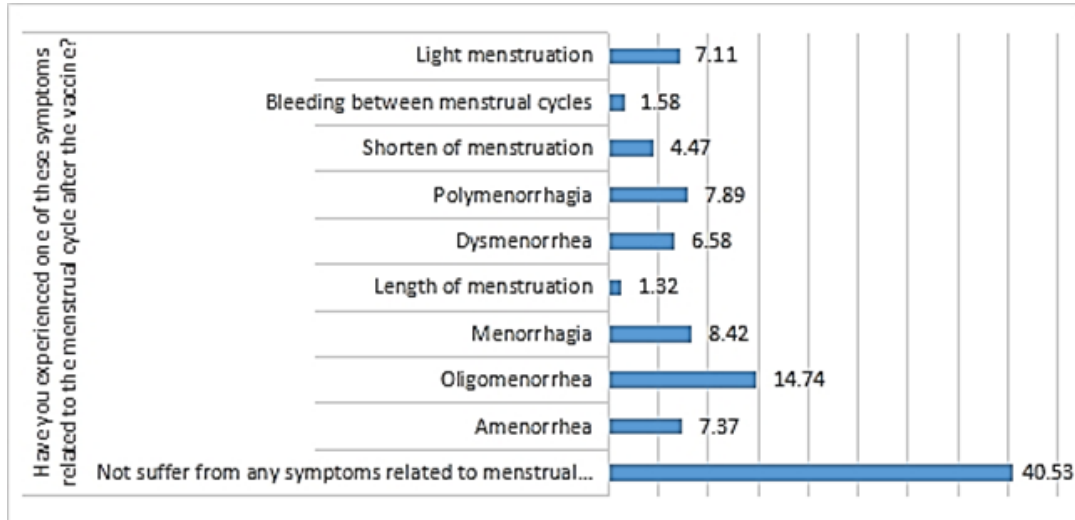


Figure 2: The Most Common Types of Disturbances Related to Menstrual Cycle Disturbances among Adult Females at King Saudi University after COVID-19 Vaccination

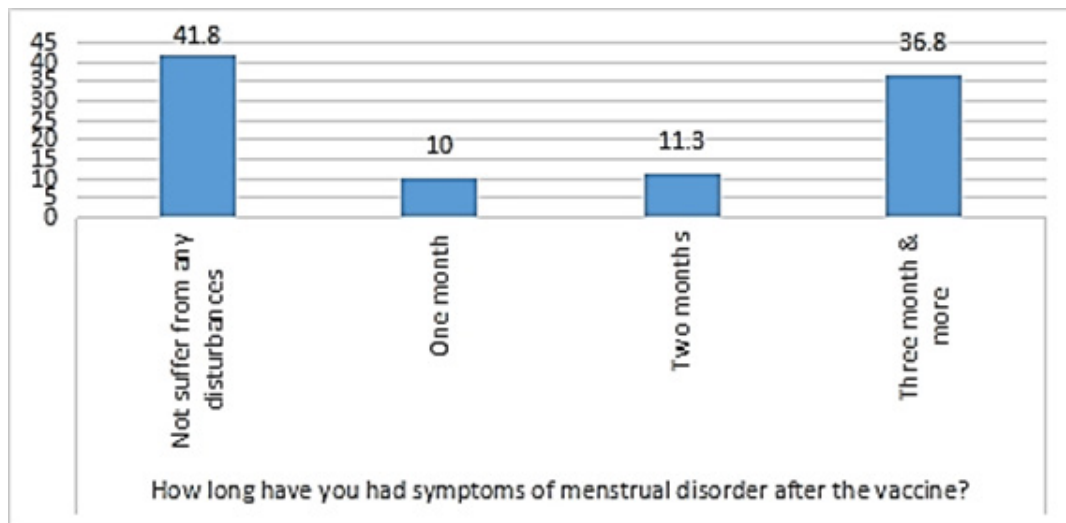


Figure 3: Duration of Side Effects Associated with the Menstrual Cycle after Receiving a COVID-19 Vaccine

Discussion

During the COVID-19 pandemic, various vaccines were introduced worldwide to overcome the symptoms of infection. Saudi Arabia has approved the use of three SARS-CoV-2 vaccines: Pfizer-BioNTech, Oxford-AstraZeneca ChAdOx1 chimpanzee adenovirus vector, and Moderna. The vaccines were approved in December 2020, February 2021, and July 2021 (ALHUR, 2023). As of November 2022, Saudi Arabia had administered around 67 million vaccine doses, with 15 million individuals receiving booster doses. The vaccines have been validated through clinical trials, and common side

effects like fever, fatigue, headaches, muscle discomfort, and injection site pain typically resolve within a few days (Alahmadi *et al.*, 2022). Menstrual irregularities, often unnoticed symptoms, have become more prevalent after the COVID-19 vaccination (Alahmadi *et al.*, 2022). These irregularities significantly impact women's quality of life and have sparked concerns about a potential link between the vaccine and menstruation patterns. Furthermore, the hesitation of young women to receive the COVID-19 vaccination has been intensified by unfounded claims suggesting that the vaccine could have adverse effects on their future fertility (Male, 2021). There was a global

apprehension about the potential correlation between menstrual irregularities and the COVID-19 vaccine, with women concerned about the duration of these negative effects and hesitant to receive more doses (Alaamri *et al.*, 2022). A study by Fadi *et al.* (2022) identified a potential correlation between irregular menstrual cycles and the COVID-19 vaccine, which may affect the overall well-being of women (Qashqari *et al.*, 2022).

The present study results revealed that 71.8% of adult females with menstrual disturbances were single, 54.5% had an average weight, and were between the ages of 18 and 25. Additionally, 67.1% of the participants did not exercise regularly, 54.5% had unhealthy diet patterns, and 60.8% reported good psychological health. Further, only 12.9% of participants had an imbalance in hormones, 5.8% had a thyroid gland problem, and 13.72% had a chronic condition. Among participants, 3.1% had uterine fibrosis, 14.16% had polycystic ovaries, 3.2% took antidepressants, and 7.4% used conventional analgesics. In addition, 93.2% of participants did not use contraceptive pills, and 1.6% of participants breastfed their children. These risk factors intensify the effects of COVID-19 vaccinations on menstrual cycles, as the majority did not indicate any irregularities in menstruation. However, the study found minor impacts in relation to diet quality, increased physical activity, thyroid issues, and venereal illnesses during the menstrual cycle. A total of 33.9% of participants received two doses of COVID-19 vaccination, while 65.3% received three doses. Pfizer was the most commonly administered vaccine, with 83.2% receiving the first dose, 87.9% receiving the second, and 56.3% receiving the third dose. These results are consistent with Isilay Tas kaldiran *et al.* (2022), who reported that women who received Pfizer and Sinovac vaccinations had a higher incidence of menstruation changes post-vaccination (Taşkaldıran *et al.*, 2022). Gibson *et al.* (2022) similarly documented a consistent outcome, revealing that 58% of participants who received Pfizer vaccination experienced this consequence (Gibson *et al.*, 2022).

Moreover, 28.4% of participants had the vaccination while they were menstruating. The findings of the chi-square test indicated that there was a highly significant association ($p = 0.001$) between the number of vaccine doses and the effects of the vaccines on menstrual disruptions. The incidence of menstrual cycle disturbances increased with the number of received vaccine doses, with the Pfizer and AstraZeneca vaccination participants experiencing the highest incidence of disturbances. These findings are in line with Farland *et al.* (2023), who demonstrated that a slight increase in menstrual cycle length was correlated with the number of COVID-19 vaccination doses (Farland *et al.*, 2023). Trogstad *et al.* (2022) reported that the most common disturbances related to various menstrual cycle changes following COVID-19 vaccination were heavier than usual periods, delayed periods, and unexpected vaginal bleeding (Trogstad *et al.*, 2022). However, the present study results showed that menorrhagia (8.4%),

polymenorrhagia (7.9%), and amenorrhoea (7.4%) were the most common disturbances following oligomenorrhoea (14.7%). Conversely, 47.6% of participants reported no menstrual cycle-related negative effects post-vaccination. According to Almousa *et al.* (2022), women who previously experienced irregular menstruation were less likely than those who previously experienced normal menstruation to experience menstrual disturbances post-vaccination. However, this difference was not statistically significant (Almousa, 2022). In contrast, a study by Chao *et al.* (2022) demonstrated a statistically significant ($P < 0.0001$) correlation between COVID-19 vaccination and menstrual disturbances (Chao *et al.*, 2022). In comparison, Alahmari *et al.* (2022) evaluated that there was no significant correlation between COVID-19 vaccination and menstruation problems. The side effects can be the result of an immunological response rather than the vaccine or any of its elements (Alahmari & El, 2022).

This study's findings suggest that COVID-19 vaccination impacted women's menstrual cycles and reproductive health. The interaction between the immune system and endocrine system was likely responsible for the negative effects of these vaccinations. However, the findings by Chavin *et al.* (2023) partially supported previous studies indicating an association between COVID-19 vaccination and subsequent irregular menstrual periods (Gopaul *et al.*, 2023). With the exception of delayed periods and other menstrual issues like abnormal bleeding, severe symptoms, and miscellaneous symptoms, this study found that self-reported menstrual cycle disturbances such as missed periods, spotting, irregular cycles, and flow fluctuations did not show significant differences after the first and second dose of vaccination (Gopaul *et al.*, 2023). Consequently, the study indicated that the irregularities in the menstrual cycle post-COVID-19 vaccination were temporary and returned to normal after a short period (Gopaul *et al.*, 2023). This information is crucial for reducing young women's vaccine reluctance and improving the effectiveness of the vaccination campaign. Understanding the link between vaccination and post-vaccination changes can help young women prepare for potential changes in their menstrual cycles.

CONCLUSION

In conclusion, the study showed the impact of COVID-19 vaccination on menstrual disturbances in adult females in KSU. Over half of the females experienced at least one issue related to the menstrual cycle after receiving the vaccine. The study suggests that people receiving COVID-19 vaccines engage in more beneficial interventions, but the precipitating factors should be considered when administering the vaccine to mitigate disruption. The Pfizer-BioNTech vaccine was among the most widely used and induced changes in menstrual disturbances after vaccination. Further research is needed on the long-term safety of COVID-19 vaccines on females and the overall population's health.

Limitation and Strengths

- The study's limitations may include a small sample size and cross-sectional design, which can hinder the ability to establish causality and generalizability. Selection bias may be introduced due to the online distribution of the questionnaire.
- However, the study provided valuable insights into the association between menstrual cycle disturbances and COVID-19 vaccination, highlighting areas for further research and emphasising public health concerns.

Recommendations

- Future studies and clinical trials should investigate the menstrual-related adverse effects to develop vaccines.
- Education programs should be developed to enhance understanding of the impact of COVID-19 vaccination on menstrual cycles.
- Establishing a systematic health monitoring system is necessary in order to monitor and report adverse events.
- Future research should include a comprehensive assessment of mental health status in order to understand the association between menstrual health and psychological well-being.
- It is essential to improve public health communication strategies and update guidelines for healthcare professionals managing menstruation disorders.
- Policymakers should include menstrual health when implementing vaccination safety monitoring activities.

Acknowledgement

The authors are thankful to King Saud University for their continuous support throughout the study. The authors also appreciate the Public Health Department at Imam Abdurrahman Bin Faisal University for supervising this study.

REFERENCES

- Al Kadri, H. M., Al Sudairy, A. A., Alangari, A. S., Al Khateeb, B. F., & El-Metwally, A. A. (2023). COVID-19 vaccination and menstrual disorders among women: Findings from a meta-analysis study. *Journal of Infection and Public Health*.
- Alaamri, O., Okmi, E. A., & Suliman, Y. (2022). Vaccine hesitancy in Saudi Arabia: A cross-sectional study. *Tropical Medicine and Infectious Disease*, 7(4), 60.
- Alahmadi, A. M., Aljohani, A. H., Fadhloun, R. A., Almohammadi, A. S., Alharbi, D. F., Alrefai, L. S., Fadhloun, R., Almohammadi, A., & Alharbi, D. (2022). The effect of the COVID-19 vaccine on the menstrual cycle among reproductive-aged females in Saudi Arabia. *Cureus*, 14(12).
- Alahmari, A. M., & Rahman, S. K. a. E. (2022). Relationship between menstrual cycle changes and types of covid-19 vaccines among women living in Riyadh, Saudi Arabia 2022. *Medical Science*, 26(126), 1–9. <https://doi.org/10.54905/disssi/v26i126/ms340e2306>
- Alghamdi, A. N., Alotaibi, M. I., Alqahtani, A. S., Al
- About, D., & Abdel-Moneim, A. S. (2021). BNT162b2 and ChAdOx1 SARS-CoV-2 post-vaccination side-effects among Saudi vaccinees. *Frontiers in Medicine*, 8, 760047.
- Alhazmi, A., Alamer, E., Daws, D., Hakami, M., Darraj, M., Abdelwahab, S., Maghfuri, A., & Algaissi, A. (2021). Evaluation of side effects associated with COVID-19 vaccines in Saudi Arabia. *Vaccines*, 9(6), 674.
- ALHUR, A. A. (2023). Public Health Informatics: The Importance of Covid-19 Dashboard in KSA for Sharing and Visualizing Health Information. *Journal of Information Systems and Digital Technologies*, 5(1), 43–59.
- Almousa, I. A. (2022). Changes In the Menstrual Cycle Among the Covid-19 Vaccinated Women in The Eastern Province of Saudi Arabia: A Cross-Sectional Survey, 2022. *The Egyptian Journal of Hospital Medicine*, 89(1), 4260-4264.
- Alvergne, A., Kountourides, G., Argentieri, M. A., Agyen, L., Rogers, N., Knight, D., Sharp, G. C., Maybin, J. A., & Olszewska, Z. (2021). COVID-19 vaccination and menstrual cycle changes: A United Kingdom (UK) retrospective case-control study. *medRxiv (Cold Spring Harbor Laboratory)*. <https://doi.org/10.1101/2021.11.23.21266709>
- Alvergne, A., Woon, E. V., & Male, V. (2022). Effect of COVID-19 vaccination on the timing and flow of menstrual periods in two cohorts. *Frontiers in reproductive health*, 4.
- Barbieri, R. L. (2014). The endocrinology of the menstrual cycle. *Human fertility: methods and protocols*, 145-169.
- Beatty, A. L., Peyser, N. D., Butcher, X. E., Cocohoba, J. M., Lin, F., Olgin, J. E., Pletcher, M. J., & Marcus, G. M. (2021). Analysis of COVID-19 vaccine type and adverse effects following vaccination. *JAMA network open*, 4(12), e2140364-e2140364.
- Berga, S. L. (2020). The Menstrual Cycle and Related Disorders. *Female Reproductive Dysfunction*, 23-37.
- Bull, J. R., Rowland, S. P., Scherwitzl, E. B., Scherwitzl, R., Danielsson, K. G., & Harper, J. (2019). Real-world menstrual cycle characteristics of more than 600,000 menstrual cycles. *NPJ digital medicine*, 2(1), 83.
- About V-Safe. (2024, August 8). *Vaccine Safety Systems*. <https://www.cdc.gov/vaccine-safety-systems/v-safe/index.html>
- Chao, M. J., Menon, C., & Elgendi, M. (2022). Effect of COVID-19 vaccination on the menstrual cycle. *Frontiers in Medicine*, 9, 1065421.
- Critchley, H. O., Babayev, E., Bulun, S. E., Clark, S., Garcia-Grau, I., Gregersen, P. K., Kilcoyne, A., Kim, J. Y. J., Lavender, M., & Marsh, E. E. (2020). Menstruation: science and society. *American journal of obstetrics and gynecology*, 223(5), 624-664.
- De Sanctis, V., Bernasconi, S., Bianchin, L., Bona, G., Bozzola, M., Buzi, F., De Sanctis, C., Rigon, F., Tatò, L., & Tonini, G. (2014). Onset of menstrual cycle and menses features among secondary school girls in Italy:

- A questionnaire study on 3,783 students. *Indian journal of endocrinology and metabolism*, 18(Suppl 1), S84.
- Demir, O., Sal, H., & Comba, C. (2021). Triangle of COVID, anxiety and menstrual cycle. *Journal of Obstetrics and Gynaecology*, 41(8), 1257-1261.
- Farland, L. V., Khan, S. M., Shilen, A., Heslin, K. M., Ishimwe, P., Allen, A. M., Herbst-Kralovetz, M. M., Mahnert, N. D., Pogreba-Brown, K., & Ernst, K. C. (2023). COVID-19 vaccination and changes in the menstrual cycle among vaccinated persons. *Fertility and sterility*, 119(3), 392-400.
- Gibson, E. A., Li, H., Fruh, V., Gabra, M., Asokan, G., Jukic, A. M. Z., Baird, D. D., Curry, C. L., Fischer-Colbrie, T., & Onnela, J. P. (2022). Covid-19 vaccination and menstrual cycle length in the Apple Women's Health Study. *NPJ digital medicine*, 5(1), 165.
- Gopaul, C. D., Bassaw, B., Ventour, D., & Thomas, D. (2023). Effects of Covid-19 vaccines on the menstrual cycle: A cross-sectional study. *The Open Public Health Journal*, 16(1).
- Gray, S. H. (2013). Menstrual disorders. *Pediatrics in review*, 34(1), 6-18.
- Hatmal, M. M., Al-Hatamleh, M. a. I., Olaimat, A. N., Hatmal, M., Alhaj-Qasem, D. M., Olaimat, T. M., & Mohamud, R. (2021). Side effects and perceptions following COVID-19 vaccination in Jordan: A randomized, Cross-Sectional study implementing machine learning for predicting severity of side effects. *Vaccines*, 9(6), 556. <https://doi.org/10.3390/vaccines9060556>
- Huhmann, K. (2020). Menses requires energy: A review of how disordered eating, excessive exercise, and high stress lead to menstrual irregularities. *Clinical Therapeutics*, 42(3), 401-407.
- Jung, E. K., Kim, S. W., Ock, S. M., Jung, K. I., & Song, C. H. (2018). Prevalence and related factors of irregular menstrual cycles in Korean women: The 5th Korean National Health and Nutrition Examination Survey (KNHANES-V, 2010–2012). *Journal of Psychosomatic Obstetrics & Gynecology*, 39(3), 196-202.
- Kumar, N., Gangane, N., Mohapatra, I., Rukadikar, C., Sharmila, V., Pushpalatha, K., Eerike, M., Santhoshi, G., Samantaray, S. R., Seth, S., Trigunait, P., Reddy, N. J., Patel, S., Rani, S., Mishra, R., & Negi, K. (2023). Effect of COVID-19 vaccination on menstrual cycle patterns of reproductive age women: a multi-centric observational study. *Current Drug Research Reviews*, 16(2), 237–248. <https://doi.org/10.2174/2589977515666230608140606>
- Li, K., Chen, G., Hou, H., Liao, Q., Chen, J., Bai, H., Lee, S., Wang, C., Li, H., & Cheng, L. (2021). Analysis of sex hormones and menstruation in COVID-19 women of child-bearing age. *Reproductive biomedicine online*, 42(1), 260-267.
- Male, V. (2021). Menstrual changes after covid-19 vaccination. *BMJ*, n2211. <https://doi.org/10.1136/bmj.n2211>
- Moreira Jr, E. D., Kitchin, N., Xu, X., Dychter, S. S., Lockhart, S., Gurtman, A., Perez, J. L., Zerbini, C., Dever, M. E., & Jennings, T. W. (2022). Safety and efficacy of a third dose of BNT162b2 Covid-19 vaccine. *New England journal of medicine*, 386(20), 1910-1921.
- Muhaidat, N., Alshrouf, M. A., Azzam, M. I., Karam, A. M., Al-Nazer, M. W., & Al-Ani, A. (2022). Menstrual symptoms after COVID-19 vaccine: a cross-sectional investigation in the MENA region. *International journal of women's health*, 395-404.
- Murray, C. M., & Orr, C. J. (2019). Hormonal regulation of the menstrual cycle and ovulation. In *Elsevier eBooks* (pp. 159–167). <https://doi.org/10.1016/b978-0-12-814823-5.00012-x>
- World Health Organization: WHO. (2021, July 9). COVID-19 subcommittee of the WHO Global Advisory Committee on Vaccine Safety (GACVS): updated guidance regarding myocarditis and pericarditis reported with COVID-19 mRNA vaccines. In. <https://www.who.int/news/item/09-07-2021-gacvs-guidance-myocarditis-pericarditis-covid-19-mrna-vaccines>
- Patricio, B.-P., & Sergio, B.-G. (2019). Normal menstrual cycle. *Menstrual Cycle*, 15.
- Polack, F. P., Thomas, S. J., Kitchin, N., Absalon, J., Gurtman, A., Lockhart, S., Perez, J. L., Pérez Marc, G., Moreira, E. D., & Zerbini, C. (2020). Safety and efficacy of the BNT162b2 mRNA Covid-19 vaccine. *New England journal of medicine*, 383(27), 2603-2615.
- Qashqari, F. S., Dahlawi, M., Assaggaf, H. M., Alsafi, R., Gari, A., Abudawood, A., Al-Dobokey, A., Alsulami, S., Bukhari, R., & Majeed, S. A. (2022). Effect of the COVID-19 vaccine on the menstrual cycle among females in Saudi Arabia. *Ethiopian journal of health sciences*, 32(6).
- Reed, B. G., & Carr, B. R. (2018, August 5). *The normal menstrual cycle and the control of ovulation*. Endotext - NCBI Bookshelf. <https://www.ncbi.nlm.nih.gov/books/NBK279054/>
- Roos, E. J., Simms-Cendan, J., Cheung, C., Laufer, D., & Grover, S. R. (2021). Pediatric and adolescent gynecology through a global lens. *International Journal of Gynecology & Obstetrics*, 156(2), 189–196. <https://doi.org/10.1002/ijgo.13723>
- Saleh Alzahrani, H., Ali Algashami, S., Abdulaziz Alharkan, A., Sultan Alotaibi, N., & Waseem Algahs, N. (2023). The effect of COVID-19 vaccination on the menstrual cycle in female in Riyadh, Saudi Arabia. *Saudi Pharmaceutical Journal*, 31(5), 746-751. <https://doi.org/https://doi.org/10.1016/j.jsps.2023.03.015>
- Schmalenberger, K. M., Tauseef, H. A., Barone, J. C., Owens, S. A., Lieberman, L., Jarczok, M. N., Girdler, S. S., Kiesner, J., Ditzen, B., & Eisenlohr-Moul, T. A. (2020). How to study the menstrual cycle: Practical tools and recommendations. *Psychoneuroendocrinology*, 123, 104895. <https://doi.org/10.1016/j.psyneuen.2020.104895>

- Schmalenberger, K. M., Tauseef, H. A., Barone, J. C., Owens, S. A., Lieberman, L., Jarczok, M. N., Girdler, S. S., Kiesner, J., Ditzen, B., & Eisenlohr-Moul, T. A. (2021). How to study the menstrual cycle: Practical tools and recommendations. *Psychoneuroendocrinology*, *123*, 104895. <https://doi.org/https://doi.org/10.1016/j.psyneuen.2020.104895>
- Sualeh, M., Uddin, M. R., Junaid, N., Khan, M., Pario, A., & Ain, Q. (2022). *Impact of COVID-19 Vaccination on Menstrual Cycle: A Cross-Sectional Study From Karachi, Pakistan*. *Cureus*, *14*(8).
- Taşkaldıran, I., Vuraloğlu, E., Bozkuş, Y., İyidir, Ö. T., Nar, A., & Tütüncü, N. B. (2022). Menstrual Changes after COVID-19 Infection and COVID-19 Vaccination. *International Journal of Clinical Practice*, *2022*, 1–5. <https://doi.org/10.1155/2022/3199758>
- Tayyaba Rehan, S., Imran, L., Mansoor, H., Sayyeda, Q., Hussain, H. u., Cheema, M. S., Tahir, M. J., Asghar, M. S., Mahmood Fadelallah Eljack, M., & Islam, M. S. (2022). Effects of SARS-CoV-2 infection and COVID-19 pandemic on menstrual health of women: A systematic review. *Health Science Reports*, *5*(6), e881.
- Thiyagarajan, D. K., Basit, H., & Jeanmonod, R. (2024, September 27). Physiology, menstrual cycle. *StatPearls-NCBI Bookshelf*. <https://www.ncbi.nlm.nih.gov/books/NBK500020/>
- Trogstad, L., Juvet, L., Feiring, B., & Blix, K. (2022). Covid-19 vaccines and menstrual changes. *BMJ medicine*, *1*(1).
- Vladimirovna, S. V., Anvarovna, S. L., Vladimirovna, M. E., & Khidirovna, L. Z. (2023). Menstrual Cycle Disturbances in the Reproductive Period. *Central Asian Journal of Medical and Natural Science*, *4*(2), 389-397.
- Vogazianou, A. (2019). Anatomy and physiology of the female reproductive system. *Advanced Practice in Endocrinology Nursing*, 739-752.
- Von Woon, E., & Male, V. (2022). Effect of COVID-19 vaccination on menstrual periods in a prospectively recruited cohort. *medRxiv (ColdSpringHarborLaboratory)*. <https://doi.org/10.1101/2022.03.30.22273165>
- Wei, S.-M., Schiller, C. E., Schmidt, P. J., & Rubinow, D. R. (2018). The role of ovarian steroids in affective disorders. *Current opinion in behavioral sciences*, *23*, 103-112.