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## Navigating the Uncharted Waters: Comprehending the Effects of COVID-19 on the Reproductive Health of Women

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### Abstract:

The COVID-19 epidemic has brought attention to the effects on the reproductive health of women. This extensive paper explores several aspects of this link, including the impact of extended COVID-19, menstruation irregularities, pregnancy outcomes, and immunization effects. It also looks at how COVID-19 interacts with hormones, ovarian health, and reproductive organs.

More research is necessary because COVID-19 has been shown to interfere with the menstrual cycle, which may have an impact on ovarian and endometrial function. Vigilant care is crucial since pregnant women, particularly those with comorbidities, are more likely to experience severe sickness and complications. Despite being generally safe, COVID-19 immunization has been linked to transient menstrual abnormalities, which calls for more research. These menstrual abnormalities can be prolonged by long COVID, which calls for more research.

There is still much to learn about the topic, even though the essay offers insightful information. It is critical that we fully understand COVID-19's effects on female reproductive health as we continue to navigate its difficult terrain. For women to receive appropriate treatment and support both during and after the pandemic, this awareness is essential. To address these complex concerns and protect women's reproductive health in the face of current and future health challenges, a multidisciplinary strategy combined with ongoing research initiatives is essential.

**Keywords:** COVID-19, reproductive health, ovarian reserve, SARS-CoV-2, Assisted Reproductive Technologies.

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# Navigating the Uncharted Waters: Comprehending the Effects of COVID-19 on the Reproductive Health of Women

## Introduction

The advent of the coronavirus in 2019 (COVID-19) in December 2019 caused a worldwide health emergency resulting in millions of illnesses and deaths (1-5). Current information suggests that the virus, immunizations, and Long COVID-19 may have an impact on reproductive health (6). When a woman contracts acute SARS-CoV-2 infection, her immune system tends to react more quickly and with less inflammation (7).

Infertility is a global concern (8-10), and according to WHO recent reports, around 17.5% of the adult population – roughly 1 in 6 worldwide – experience infertility, showing the urgent need to increase access to affordable, high-quality fertility care for those in need (11), in particular during COVID-19 era. However, menstrual irregularities have been associated in observational studies with SARS-CoV-2 infection and immunization (12). Nonetheless, it is still unclear how often these menstrual alterations occur and what causes them, which is why they should receive more study during the COVID-19 pandemic (13).

The implications of vaccination, Long COVID-19, SARS-CoV-2 infection, and the pandemic on female reproductive health—including the consequences of infection during pregnancy, sexual health, and assisted reproductive technology—are included in this overview. More research is required in these areas due to the paucity of available data. Furthermore, a clinical management strategy for the menstrual cycle and reproductive health disorders is put out.

## Influence of SARS-CoV-2 on women's Reproductive biology

COVID-19 infection may disturb the menstrual cycle, primarily producing irregular menstruation, decreased menstrual volume, and prolonged cycles. The virus may enter cells in the ovaries and endometrium, potentially impacting hormone production and endometrial responses (6, 14). The virus's presence in the reproductive tract may disrupt immune function, leading to alterations in vaginal blood loss (15). SARS-CoV-2 could interfere with vascular endothelial function and systemic hemostasis, affecting menstrual blood loss. Stress during medical treatment can also affect the menstrual cycle (16). Severe COVID-19

may induce hypothalamic amenorrhea due to factors like ACE2 down-regulation, aberrant hormone levels, medications, and stress (17).

## Assisted Reproductive Technologies and COVID-19

Limited clinical data is available on the influence of SARS-CoV-2 infection on Assisted Technology of Reproduction (ART) procedures (6). The virus may disturb ovarian and/or endometrial function and sperm parameters (6). While there is some evidence of reduced embryo quality, overall, ART outcomes during the pandemic do not significantly differ from the pre-pandemic period. Psychological impacts on ART during the pandemic include stress, anxiety, and depression among women undergoing infertility treatments (18).

## COVID-19 Infection Throughout Pregnancy

Pregnant females have a similar rate of COVID-19 infection as the general population. However, they are more likely to experience serious obstetric complications, particularly in the third trimester (19). Risk factors for severe infection include obesity, diabetes, and gestational diabetes with insulin dependence. Certain comorbidities increase the risk of infection (20). Pregnant females are at a higher risk of severe illness, often requiring intensive care. SARS-CoV-2-related thrombotic or respiratory complications are the leading causes of death among pregnant women (6).

## Effects of COVID-19 Vaccination on Reproductive Health

COVID-19 vaccination has been associated with minor and temporary menstrual changes, including longer cycles and heavier bleeding (13). Data suggests that these changes are less risky than SARS-CoV-2 infection (13). The exact cause of these menstrual changes is unclear and requires further research (14).

Research suggests that COVID-19 vaccines do not impact women's ovarian reserves or fertility (21). However, inadequate data is available on the impacts of vaccines on pregnancy or their fetuses (13).

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### **Impact of Long SARS-CoV-2 on Female Reproductive Health**

Long COVID-19 can lead to menstrual disturbances, such as irregular cycles and heavy bleeding (6). It's essential to distinguish these from temporary disruptions due to stress. There's a need for further research to understand the connections between long COVID-19 and female reproductive hormones. Some symptoms of long COVID-19 overlap with menopause, and women may misattribute their prolonged COVID-19 symptoms to menopause. Further research is needed to explore these relationships (22).

Women experiencing persistent menstrual disturbances after COVID-19 infection or vaccination should seek medical evaluation to identify any underlying reproductive health issues. Management strategies are available for heavy menstrual bleeding, depending on individual circumstances (6, 23).

### **Effects of COVID-19 on Hormones**

Research suggests that COVID-19 has only a minor impact on the female ovarian endocrine system. Studies have not found significant differences in sex hormone concentrations between COVID-19 patients and controls, and monthly variations do not appear to affect sex hormone levels (16). Some studies indicate that low serum levels of testosterone/luteinizing hormone (T/LH), sex hormone-binding globulin (SHBG), and follicle-stimulating hormone/luteinizing hormone (FSH/LH), along with high levels of LH and estrogen/testosterone (E2/T), may increase the risk of COVID-19. The likelihood of elevated LH and E2/T serum levels and decreased T/LH, FSH/LH, and SHBG levels increases with the clinical severity of COVID-19. Clinicians need to be aware that COVID-19 may negatively affect gonadal function (24).

However, other studies suggest that COVID-19 patients may have elevated levels of hormones like FSH, LH, and PRL, indicating that their ovarian function may be suppressed in response to inflammation. LH and PRL levels may increase due to the nervous system-related effects of SARS-CoV-2. Mental health issues during the pandemic may also impact hormonal levels. It appears that AMH, a measure of ovarian reserve,

is not affected by COVID-19 (25). Further research is needed to better understand the hormonal impact of SARS-CoV-2 (16).

### **Influence of SARS-CoV-2 on Ovarian Reserve**

The potential impacts of SARS-CoV-2 on female reproductive structures, specifically the ovaries, have not been extensively studied. One study found that SARS-CoV-2 infection did not seem to alter gonadotropins and ovarian endocrine secretions in infertile females, based on blood LH, FSH, E2, and AMH measurements taken from menstrual cycle days 2 to 5. Nonetheless, additional studies with a greater number of patients are required to completely comprehend the effects of COVID-19 infection on female ovarian function (21).

According to some researchers, COVID-19 may cause ovarian harm, such as decreased ovarian reserve and problems with reproductive endocrine function. This suggests that direct viral infection, an uncontrollably high inflammatory or immunological response, or malfunctioning of the hypothalamic-pituitary-ovarian (HPO) axis (26), leading to ovarian injury, could cause a transient reduction in ovarian reserve and reproductive potential (27). Others, however, have determined that possessing COVID-19 has no appreciable effect on ovarian reserve and that differences in anti-Mullerian hormone (AMH) levels may be related to an individual's response level (high versus low) (28).

### **Effects of SARS-CoV-2 on Reproductive Organs and Gametes**

The existence of SARS-CoV-2 in the female reproductive system and its possible interaction with gametes remain uncertain based on the evidence currently available. Infertile individuals having fertility preservation operations are encouraged to undertake testing to ensure that their gametes remain free of SARS-CoV-2, even if there is no indication of the virus in female gametes or reproductive organs (29). There is disagreement about whether SARS-CoV-2 is present in semen; some research suggests that the virus may shed into seminal plasma (30).

Men should wait to do reproductive treatments and keep an eye on their sperm parameters if they have a fever caused by COVID-19. Complete

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cleaning of gametes and embryos before storage, hygienic cryostorage practices, and screening of both spouses for SARS-CoV-2 are among the special measures required to minimize potential viral contamination during the cryopreservation of gametes and embryos (31). Since no virus has been found in female gametes or reproductive tissues, the female reproductive system appears to be less damaged (32). This is probably because the zona pellucida serves as a protective barrier.

The SARS-CoV-2 pandemic has led to a reevaluation of the necessity of reproductive treatments, resulting in complex recommendations based on evolving research. Initially, organizations like the American Society for Reproductive Medicine (ASRM) recommended that only infertile patients already undergoing emergency fertility preservation should proceed with their therapies, with an emphasis on embryo cryopreservation (33). In a similar vein, the "European Society of Human Reproduction and Embryology (ESHRE)" advised infertile patients to consider postponing pregnancy through oocyte or embryo cryopreservation due to the lack of data on COVID-19-related pregnancies (34).

### **Influence of COVID-19 on Pregnancy Outcomes and Neonatal Status**

The expression of TMPRSS2 and ACE2, crucial receptors for COVID-19 infection, can vary in embryos. Strong ACE2/TMPRSS2 co-expression in peri-implantation embryos indicates susceptibility to the virus. Infection appears more likely in fully hatched blastocysts and can be prevented with neutralizing antibodies. Live SARS-CoV-2 has been found to infect blastocysts but is less common in those with intact zona pellucida. This infection has cytopathic effects (35).

The relationship between COVID-19 and pregnancy outcomes remains an area of active research, and findings may vary. Some studies suggest that pregnant women with COVID-19 do not have significantly higher rates of gestational diabetes, hypertensive disorders, or pre-eclampsia compared to pregnant women without the virus. These studies reported few cases of spontaneous miscarriage or termination among pregnant females with COVID-19 (36).

However, other meta-analyses and systematic reviews have indicated that pregnant females may be at an increased risk of severe SARS-CoV-2 infection in comparison to non-pregnant women. Symptomatic COVID-19 has been linked with a higher risk of preterm birth and a higher likelihood of cesarean delivery compared to asymptomatic COVID-19. Severe SARS-CoV-2 is significantly linked with pre-eclampsia, preterm birth, gestational diabetes, and low birth weight (37). Pregnant women with SARS-CoV-2 are more likely to deliver their neonates prematurely and face a higher risk of maternal death and ICU admission, with their infants also more likely to be admitted to the neonatal unit (37).

### **Mechanism of SARS-CoV-2 Infection in the Female Reproductive organs**

The balance between angiotensin-(1-7) and angiotensin II (Ang II) in the renin-angiotensin system (RAS) is crucially regulated via angiotensin-converting enzyme 2 (ACE2). While Ang II promotes inflammation, tissue remodeling, and vasoconstriction, Ang-(1-7) has vasodilatory and anti-inflammatory properties. ACE2 catalyzes Ang I and II to synthesize Ang-(1-9) and Ang-(1-7), respectively. The virus enters host cells through ACE2 receptors, primarily through the spike (S) protein's interaction with ACE2. This viral entry is facilitated by the proteolytic cleavage catalyzed by transmembrane protease serine 2 (TMPRSS2) in the cell's cytoplasm (38).

The infection of SARS-CoV-2 leads to a reduction in ACE2 expression, contributing to decreased Ang-(1-7) and increased Ang II levels. This imbalance results in the inflammatory responses observed in COVID-19 patients (38, 39).

Ovarian cells express high levels of ACE2, suggesting their potential vulnerability to SARS-CoV-2 infection, particularly during the initial weeks of embryo development. ACE2 has a critical role in regulating the balance between Ang II and Ang-(1-7) and influences steroid secretion, follicle development, and ovulation. Downregulation of ACE2 caused by COVID-19 infection may impair ovarian function. Age-related changes in ACE2 expression and variations in ACE2 expression across menstrual

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phases in the endometrium may contribute to susceptibility to viral damage (14, 40).

Imbalances in the Ang II/Ang-(1-7) ratio within ovarian cells may lead to endometrial diseases. ACE2's role has been highlighted in the prognosis of endometrial cancer (38). During pregnancy, the placenta expresses all components of the RAS, and ACE2 abnormalities may lead to conditions such as preeclampsia and fetal growth restriction (28). These findings underscore the significance of ACE2 in female reproductive health.

### Factors Affecting Infectivity of COVID-19 through Sexual Contact

Age and gender do not significantly affect the chances of COVID-19 infection, but they can impact the severity of the illness. Co-morbid health disorders, particularly those disturbing the renin-angiotensin mechanism, are crucial factors influencing the risk of severe SARS-CoV-2. Significant risk factors for serious illness include male sex and older age (41).

The SARS-CoV-2 epidemic has had a notable effect on people's capacity to obtain medical care, especially STI testing. Due to reduced opportunities for data collection and STI diagnosis brought on by this service reduction, the true burden of STIs during the epidemic may have been underestimated (42).

### Conclusion

Significant concerns over the COVID-19 pandemic's effects on women's reproductive health have been brought up. This article has examined several topics, such as the impact of extended COVID-19, menstrual irregularities, pregnancy outcomes, and immunization impacts. The intricate connections between COVID-19 and hormones, ovarian health, and reproductive organs have also been covered.

The results imply that COVID-19 may impact ovarian function, endometrial responses, and the menstrual cycle. Pregnant women are more susceptible to serious illness and problems, especially if they have underlying medical disorders. The investigation is necessary since COVID-19 immunization has caused transient changes in menstruation. chronic menstrual irregularities can be caused by chronic COVID.

Despite these findings, there are still a lot of unanswered concerns, thus more research is needed. To effectively care for and assist women both during and after the pandemic, it is imperative to comprehend the interactions between COVID-19 and female reproductive health. To tackle these intricate problems and guarantee women's reproductive health in the face of present and future health obstacles, a multidisciplinary strategy and ongoing research are required.

### References

1. Amal Talib Al Sa'ady ZAA, Ali Fadhil Obaid, Hayder Abdul-Amir Makki Alhindy, Amir S. Al-Mumin Prevalence of adverse effects from COVID-19 vaccine among Iraqi adults: A retrospective cross-sectional study. *Journal of Emergency Medicine, Trauma Acute Care.* 2022;3(6):1-9.
2. Al-Hindy Hayder AM A-MA, Mousa MJ. Association of dental caries in the era of COVID-19 with the number of occluded coronary vessels: A non-traditional risk factor in patients with acute coronary syndrome. *Journal of Emergency Medicine, Trauma & Acute Care.* 2023;3(8):1-7.
3. Hajir Karim Abdul-Hussein KAA-A, Mustafa Karim Abdul-Hussein, Hayder Abdul-Amir Makki Al-Hindy. The Liver Function Abnormalities in COVID-19 Patients and Their Association with Age and Sex: A Cross-Sectional Study. *Archives of Razi Institute.* 2023;77(5):453-8.
4. Hayder Abdul-Amir Maki Al-Hindy JM, HO Hashim. BCG Vaccine in preventing COVID-19 epidemic had to be reviewed: correlation does not imply causation. *Australian Journal of Basic and Applied Sciences.* 2021;14 (11): 58-63.
5. Sameer Mohialdeen NAHF, Abbas Jaafar Khaleel Al-Anbari, Bassam Maddah H. Al-Alosi. Acute arterial thrombosis in patients admitted with COVID-19 infection: Clinical experience. *Journal of Emergency Medicine, Trauma and Acute Care.* 2022;2022(3):1-7.
6. Maher M, Owens L. SARS-CoV-2 infection and female reproductive health: A narrative review. *Best Pract Res Clin Endocrinol Metab.* 2023;37(4):101760.

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- Harding AT, Heaton, Nicholas S. The Impact of Estrogens and Their Receptors on Immunity and Inflammation during Infection. *Cancers* (Basel). 2022;14(4):909.
- Adnan A. H. Al-Bdairi HA-AMA-H, Mohend A.N. Al-Shalah Preoperative measures of serum Inhibin B, and FSH levels predict sperms retrieval outcome in non-obstructive azoospermic males. *Clinical Schizophrenia Related Psychoses*. 2021;15(S8):1-5.
- Adnan A. H. Al-Bdairi HA-AMA-H, Sallama Hamid Alkhudair, Khudhair Hussein Alkadhim. Serum and Seminal Plasma Concentrations of Inhibin B and FSH: A Case-Control Comparison Study between Fertile and Infertile Males *History of Medicine*. 2023;8(2):22-8.
- Adnan A. H. Al-Bdairi HKHA-k, Suhaila F. Al-Shaikh, Hayder Abdul-Amir Makki Al-Hindy. ABO Blood grouping and Rhesus factor: Association with ovarian reserve and the outcomes after in-vitro fertilization. *History of Medicine*. 2022;8(1):18-28.
- Organization WH. 1 in 6 people globally affected by infertility, Fact sheets. <https://www.who.int/news/item/04-04-2023-1-in-6-people-globally-affected-by-infertility>. 2023.
- Farland LV, Khan SM, Shilen A, Heslin KM, Ishimwe P, Allen AM, et al. COVID-19 vaccination and changes in the menstrual cycle among vaccinated persons. *Fertil Steril*. 2023; 119(3):392-400.
- Zaçe D, La Gatta E, Petrella L, Di Pietro ML. The impact of COVID-19 vaccines on fertility systematic review and meta-analysis. *Vaccine*. 2022;40(42):6023-34.
- Lebar V, Laganà AS, Chiantera V, Kunič T, Lukanović D. The Effect of COVID-19 on the Menstrual Cycle: A Systematic Review. *J Clin Med*. 2022;11(13):3800.
- Fernando SR, Chen X, Cheng K-W, Wong BPC, Qi S, Jiang L, et al. ACE inhibitors on ACE1, ACE2, and TMPRSS2 expression and spheroid attachment on human endometrial Ishikawa cells. *Reproductive Biology*. 2022; 22(3):100666.
- Li S, Liu H, Li D, Chen F. Female reproductive health during the COVID-19 pandemic: latest evidence and understanding. *Arch Gynecol Obstet*. 2023:1-6.
- Bechmann N, Maccio U, Kotb R, Dweik RA, Cherfane M, Moch H, et al. COVID-19 Infections in Gonads: Consequences on Fertility? *Horm Metab Res*. 2022;54(8):549-55.
- Shi W, Wang M, Xue X, Li N, Chen L, Shi J. Association Between Time Interval from COVID-19 Vaccination to In Vitro Fertilization and Pregnancy Rate After Fresh Embryo Transfer. *JAMA Network Open*. 2022 ;5(10):e2236609-e.
- Yeğin GF, Desdicioğlu R, Seçen E, Aydın S, Bal C, Göka E, et al. Low Anti-Mullerian Hormone Levels Are Associated with the Severity of Anxiety Experienced by Healthcare Professionals During the COVID-19 Pandemic. *Reprod Sci*. 2022;29(2):627-32.
- Sessa R, Filardo S, Masciullo L, Di Pietro M, Angeloni A, Brandolino G, et al. SARS-CoV-2 Infection in Pregnancy: Clues and Proof of Adverse Outcomes. *International journal of environmental research and public health*. 20 23;20(3).
- Male V. COVID-19 vaccination and menstruation. *Science*. 2022;378 (6621):704-6
- Maertens K, Orije MRP, Van Damme P, Leuridan E. Vaccination during pregnancy: current and possible future recommendations. *European Journal of Pediatrics*. 2020;179(2): 235-42.
- Davis HE, Assaf GS, McCorkell L, Wei H, Low RJ, Re'em Y, et al. Characterizing long COVID in an international cohort: 7 months of symptoms and their impact. *EClinical Medicine*. 2021;38:101019.
- Lott N, Gebhard CE, Bengs S, Haider A, Kuster GM, Regitz-Zagrosek V, et al. Sex hormones in SARS-CoV-2 susceptibility: key players or confounders? *Nat Rev Endocrinol*. 2023;19(4):217-31.
- Alzvain F, Bashatwa M, Hamadneh B. Psychological stress and its relation to social distancing among a sample of Saudi during COVID-19 pandemic. *J Educ Health Promot*. 2021;10:281.
- Ali Hilal Jubair BMSA-J, Hayder Abdul-Amir Makki Al-Hindy. Evaluating the Role of Thyroid Stimulating Hormone and Ferritin Levels with Hair Loss among Patients with COVID-19: Case-Control Study. *Journal of*

## Navigating the Uncharted Waters: Comprehending the Effects of COVID-19 on the Reproductive Health of Women

- Medical Research and Health Sciences. 2023; 9(6):27020–2731.
27. Madaan S, Talwar D, Jaiswal A, Kumar S, Acharya N, Acharya S, et al. Post-COVID-19 menstrual abnormalities and infertility: Repercussions of the pandemic. *J Educ Health Promot.* 2022;11:170.
  28. NICE. Heavy menstrual bleeding: assessment and management. NICE Guideline 88. NICE uAawnoun. Available at: [www.nice.org.uk/ng88](http://www.nice.org.uk/ng88). 2018.
  29. Anifandis G, Messini CI, Simopoulou M, Sveronis G, Garas A, Daponte A, et al. SARS-CoV-2 vs. human gametes, embryos, and cryopreservation. *Syst Biol Reprod Med.* 2021;67(4):260-9.
  30. Delaroché L, Bertine M, Oger P, Descamps D, Damond F, Genauzeau E, et al. Evaluation of SARS-CoV-2 in semen, seminal plasma, and spermatozoa pellet of COVID-19 patients in the acute stage of infection. *PLoS One.* 2021; 16(12):e0260187.
  31. Baghchechi M, Dunn J, Jaipaul N, Jacob SE. Art of prevention: Life in the time of coronavirus. *International Journal of Women's Dermatology.* 2020;6(3):137-41.
  32. Segars J, Katler Q, McQueen DB, Kotlyar A, Glenn T, Knight Z, et al. Prior and novel coronaviruses, Coronavirus Disease 2019 (COVID-19), and human reproduction: what is known? *Fertility and Sterility.* 2020;113 (6): 1140-9.
  33. Campitiello M CM, González-Ravina C, Vergara V, Pacheco A, et al. . SARS-CoV-2 infection does not affect ovarian reserve in women undergoing assisted reproduction. *Clin J Obstet Gynecol.* 2023;6:021-5.
  34. Pomeroy KO, Schiwe MC. Cryopreservation and IVF in the time of COVID-19: what is the best good tissue practice (GTP)? *J Assist Reprod Genet.* 2020;37(10):2393-8.
  35. Zhou J, Choi S, Liu H, Zhang J, Tian Y, Edlow AG, et al. Is SARS-CoV-2 Infection a Risk Factor for Early Pregnancy Loss? ACE2 and TMPRSS2 Coexpression and Persistent Replicative Infection in Primitive Trophoblast. *J Infect Dis.* 2021;224(Suppl 6):S660-s9.
  36. Ata B, Vermeulen N, Mocanu E, Gianaroli L, Lundin K, Rautakallio-Hokkanen S, et al. SARS-CoV-2, fertility, and assisted reproduction. *Human Reproduction Update.* 2022;29(2):177-96.
  37. Juan J, Gil MM, Rong Z, Zhang Y, Yang H, Poon LC. Effect of coronavirus disease 2019 (COVID-19) on maternal, perinatal and neonatal outcome: systematic review. *Ultrasound Obstet Gynecol.* 2020;56(1):15-27.
  38. Suhad Hafidh HA-AMA-H, Abbas Jaafar Al-Anbari, Hussein Ali Abdulabbas, Auday Majeed. Advances in Angiotensin Converting Enzyme-2 and Renin-Angiotensin System Against COVID-19: A Pharmacotherapy and Physicochemical Review Authors. *Journal of Medical Research and Health Science.* 2023; 9(6):2742–53.
  39. Wei SQ, Bilodeau-Bertrand M, Liu S, Auger N. The impact of COVID-19 on pregnancy outcomes: a systematic review and meta-analysis. *CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne.* 2021;193(16):E540-e8.
  40. Chi J, Gong W, Gao Q. Clinical characteristics and outcomes of pregnant women with COVID-19 and the risk of vertical transmission: a systematic review. *Arch Gynecol Obstet.* 2021;303(2):337-45.
  41. Madjunkov M, Dviri M, Librach C. A comprehensive review of the impact of COVID-19 on human reproductive biology assisted reproduction care and pregnancy: a Canadian perspective. *J Ovarian Res.* 2020; 13 (1):140.
  42. Meister T, Pisarev H, Kolde R, Kalda R, Suija K, Milani L, et al. Clinical characteristics and risk factors for COVID-19 infection and disease severity: A nationwide observational study in Estonia. *PLoS One.* 2022;17(6): e027 0192.

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