



Pregnant Women and Infants Infected with SARS-COV-2: A Brief Overview

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Abstract

Coronavirus disease 2019 (COVID-19) is now a global health concern and a wide range of people are at risk. Pregnant women are considered high-risk groups due to hormonal changes and weakness in the immune system. In the present study, the transmission of COVID-19 from mother to fetus and infection of children under the age of 10 with this virus were discussed. This study tries to investigate whether the coronavirus can be transmitted from a pregnant mother to her fetus and whether the virus can be transmitted to the baby through breast milk. According to researchers, children under the age of 10 do not get the disease; however, the first case of a baby with coronavirus was reported in Mashhad, Iran, based on the world's up-to-date studies and the perceptions of medical experts.

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Coronaviruses are a large family of viruses that can infect both humans and animals, some of which cause respiratory infections. Human respiratory infections range from a mild disease like the common cold to severe illnesses such as Middle East respiratory syndrome (MERS) and severe acute respiratory syndrome (SARS) (1). A novel coronavirus has been identified as the cause of an outbreak of respiratory illness that began in December 2019 in Wuhan, China, and then spread throughout the world. The most common and initial symptoms of COVID-19 include fever (83%-98%), cough (56%-85%), myalgia or fatigue (44%-51%), and dyspnea (31%). Special groups of people are more prone to the disease such as the elderly, people with lung disease, cancer, heart failure, brain disease, kidney disease, liver disease, and also pregnant women. The morbidity and mortality rates were higher in these group than in healthy controls (2).

To date, no credible scientific evidence on the susceptibility of pregnant women to COVID-19 has been published. However, because of the immune system and physiological changes in pregnant women, they might be more susceptible to viral respiratory infections, such as COVID-19. Earlier studies showed that the immune system is weakened by pregnancy, which makes mothers more susceptible to various infections and diseases. About 90% of pregnant women have a weak immune system during the 9 months of pregnancy, the main reason for which is a hormonal imbalance in the body. For this reason, pregnant women may be at higher risk for acute illnesses (such as severe acute respiratory coronavirus syndrome (SARS-CoV) and Middle East coronavirus respiratory syndrome (MERS-CoV) and other viral respiratory infections, such as influenza) than other people (3). No complications have been reported in pregnant women infected with COVID-19 during

pregnancy. In other infections with coronavirus like SARS-CoV and MERS-CoV during pregnancy, many complications were reported such as miscarriage and preterm labor (4). However, it should be noted that high fever in the first trimester of pregnancy could increase the risk of certain complications such as heart defects and congenital malformations in the fetus (2).

Computed tomography (CT) scans play an important role in the diagnosis and treatment follow-up of patients who are suspected to have COVID-19 (5). According to recently published articles, CT scans have much higher sensitivity in diagnosing COVID-19 than the polymerase chain reaction test (6). However, pregnant women are always considered high-risk patients, and ionizing radiation limits are available for pregnant patients, especially in the first trimester. In general, the principle is that imaging methods based on ionizing radiation (radiology and CT scan) should not be used in pregnant women. In cases of necessity, based on the request of the doctor and the impossibility of using other methods, it can be used with maximum protection (7). A polymerase chain reaction (PCR) test should be used to detect coronavirus in pregnant women. If necessary, radiographic imaging and non-contrast chest CT scans can be used in pregnant women who are suspected of COVID-19. Because of the higher accuracy and diagnostic value of CT scans, it is often preferred to chest radiography (7). In some cases, despite the fact that the clinical signs show the presence of the disease, nothing may be seen on chest radiography. Initially, the physician should inform the patient about the necessity of imaging methods and their advantages and disadvantages and make his/her maximum effort to reduce the absorbed dose in patients.

Here are some suggestions on how to reduce absorbed dose in patients:

1. To reduce the absorbed dose, the lowest possible dose in radiology and CT scan should be used in patients who are suspected to have COVID-19 based on a protocol prepared by the Iranian Society of Radiology.
2. In CT scan and chest radiography, local protection of the fetus (lead cover on the patient's abdomen) should be used.
3. In the first trimester, because of radiation damage to the fetus, more caution should be exercised in requesting radiography or CT scan of the lung. Therefore, at first, chest radiography with an abdominal shield should be requested and if it is undiagnosed, chest CT scans should be requested, and in the second and third trimesters, low-dose CT scans can be requested from the beginning.
4. Abdominal lead shields should be used, especially in the first trimester. However, it should be noted that the allowable absorbed dose of radiation in pregnant women is less than 50 mGy and the fetal absorbed dose of radiation is 0.002 mGy in

lung radiography of mother and 0.2 mGy in lung CT scan. According to the published articles and guidelines, these amounts of radiation do not have any proven negative effect on fetal health (7).

The virus that causes COVID-19 is thought to be transmitted mainly through close contact with an infected person and respiratory droplets. However, it is unknown whether a pregnant woman who is infected with COVID-19 can transmit this virus to her fetus (during the pregnancy) or infant (during the labor). However, an investigation on a limited number of babies born from mothers infected with this virus showed that embryonic or neonatal involvement by this virus is possible (2). For pregnant women, amniotic fluid assessment, PCR of SARS-CoV-2, and cord blood testing were used.

1. Amniotic Fluid Assessment

It is a method in which the amniotic fluid is taken from the uterus for testing or treatment. During pregnancy, this fluid surrounds and protects the fetus, and by taking it, we can use it for diagnosing infectious diseases or for testing fetal lung.

2. SARS-COV-2 PCR

It is a common laboratory method which is used to diagnose viruses such as HIV or SARS. The name of this test is SARS-CoV-2 because the virus that causes the disease is now called SARS-CoV-2, and 82% of the SARS virus is genetically similar to this novel coronavirus. There are three stages of testing for novel coronavirus. This is the final test and it takes 24-72 hours to get the results.

3. Cord Blood Testing

Umbilical cord blood, also known as placental blood, is the blood that flows in the circulation of a developing fetus in the uterus. According to the manager of Royan Stem Cell Technology Company, investigations are being conducted to find out whether stem cells can help treat COVID-19. In China, as the first country that reported an outbreak of the novel coronavirus, studies reported that umbilical cord stem cells can be used to prevent or treat this disease. However, more studies are needed to verify this claim.

4. Swab Samples

A good sample for detection of coronavirus should contain a significant amount of epithelial cells of the respiratory tract, which can be taken by swab from the nose and throat.

5. Breast Milk Samples

The Centers for Disease Control and Prevention (CDC) has provided temporary guidelines for breastfeeding mothers with COVID-19. In a limited number of cases reported so far, there is not any evidence that viruses can be transmitted by mothers infected with COVID-19.

However, it is not yet clear whether the virus can be transmitted through breast milk (i.e., the presence of an infectious virus in breast milk) or not. In any case, breastfeeding by an infected mother should be done in coordination with the health care physicians.

At the moment, the main concern is not whether the virus can be transmitted through breast milk; the problem is that an infected mother can transmit the virus through respiratory droplets during the lactation period.

An infected mother should take precautions to prevent the virus from transmitting to her baby (including washing her hands before touching her baby and wearing a mask, especially during breastfeeding). If breastfeeding is done by a manual or electric pump, mothers should wash their hands before touching any part of the pump or bottle and follow the recommendations for proper cleaning of the pump after each use (2).

In a study published in *the Lancet* journal by Huang and et al on 9 pregnant women, all women were in the 26-40 age range and were in the third trimester of pregnancy (weeks 36 to 39). RT-PCR was performed on respiratory samples to detect SARS-CoV-2. They also underwent CT scans. In CT scans of pregnant women, as in other non-pregnant women, multiple patchy ground-glass shadows were regarded as typical findings. All nine pregnant women gave birth by cesarean section. None of them had a history of underlying conditions such as diabetes, high blood pressure, or heart disease. Seven people had a fever below 39°C without chills. The body temperature was reported to be between 36.6 and 38.8 on different days. Additionally, other symptoms, such as cough and myalgia were seen in patients.

Samples of amniotic fluid from pregnant women with COVID-19 pneumonia were obtained by direct aspiration during delivery. Blood samples from the umbilical cord and throat swabs of infants born from infected pregnant women were quickly transferred from the operating room to the laboratory after delivery. The results of SARS-CoV-2 tests were negative in six patients based on amniotic fluid, umbilical cord blood, infant throat swab, and breast milk samples. Moreover, the samples of milk were also collected from mothers with COVID-19 after the first lactation. The possibility of direct transmission of the coronavirus from mother to infant was assessed by evaluating these samples. Studies have shown that in all cases, healthy babies are born without COVID-19 and any signs of respiratory illness (4, 8, 9).

However, on March 27, 2020, the first baby with COVID-19 was born with a birth weight of 900 g in Imam Reza hospital in Mashhad, Iran. Dr. Farhat, a faculty member of the Department of Neonatal Medicine at Mashhad University of Medical Sciences, reported the details of this operation. He stated that doctors in the delivery room resuscitated the baby immediately, but since the baby's mother was suspected to have COVID-19, the baby was admitted to the neonatal intensive care unit.

Moreover, the tests showed that the baby's platelet count was 35 000 and the baby's PCR test was positive. He stated that because the mother was suspected to have COVID-19, the baby was examined and tested after birth, and the test results were positive for coronavirus. He stated that this case was the first baby infected with COVID-19 in Iran and the world. After the baby was born, the hypothesis that children under the age of 10 are unlikely to get infected with coronavirus was violated. Afterwards, a few more cases in other countries, especially in the United States were reported, and the first infant death (a 6-week-old baby) from COVID-19 was announced by J. Pritzker. Dr. Isaac, director of the Illinois Department of Public Health, confirmed that the baby died from this disease, indicating that no case of infant death from COVID-19 was reported before.

In a recent study, Chinese researchers reported cases of children and infants infected with the virus, however, they had milder symptoms than adults. It was reported that only 6% of children had severe symptoms and critical condition, while the prevalence of severe cases in adults was 18.5% on average.

Researchers have not yet determined why children with COVID-19 are less likely to get sick than adults. One researcher explains that the specific shape and condition of the coronavirus receptor in children may differ from those in adults. However, studies on children and pregnant women showed that no severe diseases have been observed in this group of people. The reason may be that children's immune response differs from that of adults (10).

Natalie McDermott, a professor at London College, agrees that the immune system of older children and adolescents is fully prepared to fight viral infections. They may be infected with the virus but have a milder form of the illness with no signs of infection. This is similar to SARS in which the children get less infected. The cause of SARS, which spread in 2002-2003, was another type of coronavirus, in which a small number of children became infected. The CDC has reported 135 cases of SARS in children, but no deaths have been reported in children or adolescents. However, COVID-19 can cause death in children and babies (8). In this study, the hypothesis that children are likely to be infected or died from COVID-19 is violated. However, no convincing reason for this has been found.

A team of the students of Mazandaran University of Medical Sciences tried to investigate the probability of incidence, severity, and prognosis of this disease in children in comparison with adults in their study. They examined 9 patients with COVID-19 infection who were hospitalized in different hospitals in Iran. There were six boys. The youngest was two years old and the oldest was ten years old. All children had at least a family member infected with COVID-19. Fever, chills, myalgia, coughs, tachypnea (abnormal breathing sounds) were similar in

all samples. None of the patients had diarrhea, vomiting, or a runny nose. Three of them had leukocytes and lymphopenia. RNA of the novel coronavirus was found in three cases. In all cases, they received supportive care and were discharged within 6 days with a good general condition. As a result, the prognosis for COVID-19 pneumonia is good in children with no underlying disease, and patients recover without the need for a nurse to adopt practical interventions (LPN/r), administer Ribavirin, or use mechanical ventilation. This study constitutes a strong violation of the hypothesis that children do not get infected with COVID-19 and also confirmed that the disease can be treated sooner in children and they would have milder symptoms (11).

In this article, diagnostic methods of novel coronavirus for the mother, fetus, and infant are explained, however, the study did not find a comprehensive answer to the question whether novel coronavirus can be transmitted from a pregnant mother to the fetus or not. This question can be answered completely by further investigations and researches. However, in general, by studying the transmission methods of previous cases, we found that the virus cannot be transmitted from mother to fetus through breast milk, umbilical cord blood or amniotic fluid unless further studies by scientists find cases of violations. In addition, the basic question "Why do we see this disease in children under the age of ten?" was explained. At the beginning of the disease, there were speculations that children and infants are not likely to get the disease, however, we observed the violation of this principle. The cause is likely to be a different behavior of the virus towards their immune system in comparison with adults, and the disease is milder in children because of their body's readiness to fight infectious and pathogenic agents.

Conflict of Interests Disclosure

The authors declare no conflict of interests.

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Ethical Statement

Not applicable.

Authors' Contribution

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References

- World Health Organization (WHO). Multi-centre Collaborative Network: Laboratories testing for SARS. Geneva: WHO; 2013.
- Liu D, Li L, Wu X, et al. Pregnancy and Perinatal Outcomes of Women With Coronavirus Disease (COVID-19) Pneumonia: A Preliminary Analysis. *AJR Am J Roentgenol.* 2020;215(1):127-132. doi:10.2214/AJR.20.23072.
- Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet.* 2020;395(10223):497-506. doi: 10.1016/s0140-6736(20)30183-5.
- Wang S, Guo L, Chen L, et al. A case report of neonatal COVID-19 infection in China [published online ahead of print, 2020 Mar 12]. *Clin Infect Dis.* 2020;ciaa225. doi:10.1093/cid/ciaa225.
- Abdollahi H. Less is more: intelligent intensive care for SARS-CoV-2 based on the imaging data. *J Med Imaging Radiat Sci.* 2020;51(2):198-9. doi: 10.1016/j.jmir.2020.04.002.
- Ai T, Yang Z, Hou H, Zhan C, Chen C, Lv W, et al. Correlation of Chest CT and RT-PCR testing in coronavirus disease 2019 (COVID-19) in China: a report of 1014 cases. *Radiology.* 2020;200642. doi: 10.1148/radiol.20200642.
- Little MP, Charles MW, Wakeford R. A review of the risks of leukemia in relation to parental pre-conception exposure to radiation. *Health Phys.* 1995;68(3):299-310. doi:10.1097/00004032-199503000-00001.
- Shi H, Han X, Jiang N, Cao Y, Alwalid O, Gu J, et al. Radiological findings from 81 patients with COVID-19 pneumonia in Wuhan, China: a descriptive study. *Lancet Infect Dis.* 2020;20(4):425-34. doi: 10.1016/s1473-3099(20)30086-4.
- WHO. Novel Coronavirus – China Available from: <https://www.who.int/csr/don/12-january-2020-novel-coronavirus-china/en/>. [Updated January 12, 2020. Accessed February 12, 2020.
- Nikpour M, Behmanesh F, Darzipoor M, Zavareh MS. Pregnancy Outcomes and Clinical Manifestations of Covid-19 in Pregnant Women: A Narrative Review. *J Mil Med.* 2020;22(2):177-83. doi:10.30491/JMM.22.2.177.[Persian].
- Rahimzadeh G, Ekrami Noghabi M, Kadkhodaei Elyaderani F, Navaeifar MR, Enayati AA, Manafi Anari A, et al. COVID-19 infection in Iranian children: a case series of 9 patients. *J Pediatr Rev.* 2020;8(2):139-44. doi: 10.32598/jpr.8.2.139.