

Research Article

Association of Umbilical Cord IgG Covid Antibody Levels with Maternal Factors

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Background: The transmission of SARS-CoV-2 from mother to fetus and the development of protective antibodies in newborns are critical aspects of maternal and neonatal care during the COVID-19 pandemic. Understanding the association between umbilical cord IgG COVID-19 antibody levels and maternal factors, including gestational age of acquiring infection, COVID-19 clinical category, and immunization status, can provide insights into neonatal immunity and guide strategies for optimizing maternal and neonatal care.

Methods: This study aimed to investigate the association between umbilical cord IgG COVID-19 antibody levels and maternal factors in a cohort of pregnant women with confirmed SARS-CoV-2 infection. Maternal data, including gestational age of acquiring infection, COVID-19 clinical category, and immunization status, were collected. Umbilical cord blood samples were obtained at delivery, and IgG COVID-19 antibody levels were measured using standardized assays. Statistical analyses were performed to assess the associations between maternal factors and neonatal antibody levels.

Results: Preliminary results showed that gestational age of acquiring infection was positively associated with umbilical cord IgG COVID-19 antibody levels ($p < 0.001$). Neonates born to mothers infected in the third trimester had significantly higher antibody levels compared to those infected in the first or second trimesters. Additionally, there was a significant positive correlation between COVID-19 clinical category and umbilical cord IgG antibody levels, with more severe maternal illness associated with higher neonatal antibody levels. Maternal immunization status also demonstrated a positive association with umbilical cord IgG COVID-19 antibody levels, indicating that vaccinated mothers had higher levels of antibodies transferred to their infants.

Conclusion: This study highlights the association between umbilical cord IgG COVID-19 antibody levels and maternal factors, including gestational age of acquiring infection, COVID-19 clinical category, and immunization status. The findings suggest that infection in the third trimester, more severe maternal illness, and maternal immunization are associated with higher levels of neonatal antibodies. These results have important implications for understanding neonatal immunity and guiding maternal and neonatal care during the COVID-19 pandemic. Further research with larger cohorts is warranted to validate these findings and inform evidence-based strategies for optimizing maternal and neonatal outcomes.

Keywords: COVID 19, Umbilical cord IgG antibody, Immunization.**Introduction:**

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is the causative agent of coronavirus disease 2019 (COVID-19). First declared a Public Health Emergency of International Concern in January 2020 by the World Health Organization (WHO), COVID-19 has infected over 88 million people globally, causing over 1.9 million deaths as of 10 January 2021. (1) The literature on SARS-CoV-2 immunity in pregnant mothers and infants remains limited. The physiological changes occurring during pregnancy make the mothers more vulnerable to severe respiratory infections. On the other hand, neonatal infection following birth to a mother with SARS-CoV-2 infection during pregnancy is infrequent. (2-7) However, children with certain underlying medical conditions and infants (age <1 year) might be at increased risk of severe illness from SARS-CoV-2 infection. An important aspect of immunity against infectious pathogens in young

infants relies on effective maternal antibody production, transfer of maternal antibodies across the placenta to the fetus and persistence of passive immunity in the infant. Therefore, although maternal protection is the priority for vaccination, determining the immune protection provided to neonates will help inform future infant-immunization strategies. (8-9) Vaccination during gestation results in a robust IgG antibody response in the mother and that this response is significantly greater than the immune response in women who contracted SARS-CoV-2 infection during pregnancy. Given the higher antibody titres found among women who were vaccinated, we can speculate that boosting immunity during pregnancy translates into measurable serological benefits and might determine milder courses of the neonatal disease.

Objectives:

- To determine the levels of detectable antibodies in cord blood of babies born to women infected with COVID 19 during pregnancy.

- To assess its association with various maternal factors like gestational age of acquiring infection, COVID 19 clinical category and immunisation status.

Materials and Methods:

Study design: Cross sectional study.

Study Period: 12 January 2021 and 31 December 2022

Participants:

Inclusion Criteria:

- Pregnant women who tested positive for SARS-CoV-2 infection via polymerase chain reaction (PCR) or antigen testing during pregnancy and their neonates.

Exclusion Criteria:

- Participants with incomplete or inadequate umbilical cord blood samples.
- Maternal and neonatal medical records with missing or incomplete data that would hinder analysis.
- Women who did not provide informed consent to participate in the study.

Methodology

- Participants were recruited from antenatal clinics or obstetric units in healthcare settings. Inclusion criteria included pregnant women who tested positive for SARS-CoV-2 infection via polymerase chain reaction (PCR) or antigen testing during pregnancy. Participants were stratified based on the gestational age at the time of acquiring the infection, clinical category of COVID-19 illness, and immunization status (vaccinated vs. unvaccinated).
- Data Collection: Detailed data collected from participants, including maternal demographic information, gestational age at the time of acquiring the infection, COVID-19 clinical category (mild, moderate, severe, critical), and maternal immunization status (date and type of COVID-19 vaccine received, if applicable). Additional relevant clinical data, such as maternal comorbidities and pregnancy outcomes, were recorded.
- Umbilical Cord Blood Collection: At delivery, umbilical cord blood samples were collected from each participant. Standardized protocols for cord blood collection were followed to ensure accuracy and consistency. The samples were appropriately labelled, stored, and transported to a laboratory for further analysis.
- IgG COVID-19 Antibody Measurement: In the laboratory, umbilical cord blood samples were analyzed to measure IgG COVID-19 antibody levels. Enzyme-linked immunosorbent assay (ELISA) or other validated serological assays specific for SARS-CoV-2 antibodies were used. Standardized procedures followed to obtain reliable and comparable antibody measurements across all samples.
- Statistical Analysis: Statistical analysis was performed to assess the association between umbilical cord IgG COVID-19 antibody levels and maternal factors

Outcome: SARS-CoV-2 serology analyses in the cord blood at delivery

Results:

The umbilical cord blood was collected from 64 mother-baby dyads. Almost 94% babies born to COVID infected mothers were seropositive and only a meagre 6% had non reactive titres. Majority of the mothers were infected in the 2nd and 3rd trimester. More than a half of the mothers were categorised as Cat B and all of them had mild symptoms.



Fig 1 : Association between IgG Covid antibody levels and COVID 19 category

Babies of all these mothers tested seropositive except for two. Furthermore, all babies with positive maternal covid 19 history in 2nd trimester were seropositive. Almost half of the mothers infected in the 3rd trimester had babies with strongly positive antibody titres as well. With increasing gestational age of being infected, there has been an increase in the number of seropositive neonates, levels doubling with each trimester.

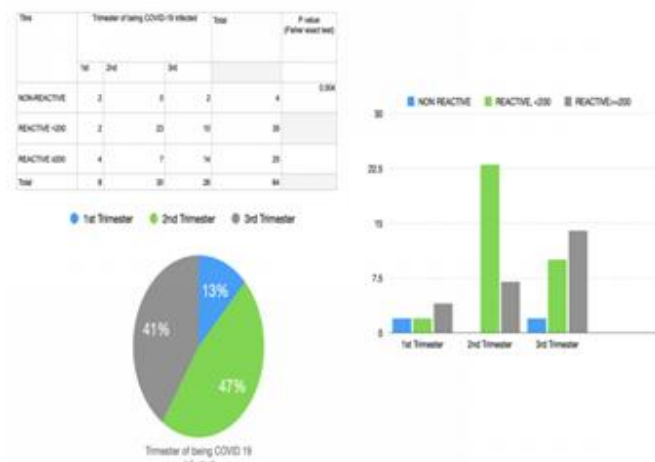


Fig 2 : Association between IgG Covid antibody levels and Gestational age of being affected

88 % of babies born to vaccinated mother had strongly positive antibody titres, thus proving a strong association

between maternal immunization status and IgG seropositivity in these infants suggestive of transplacental transfer.



Fig 3 : Association between Ig G Covid antibody titre and maternal immunization status

Discussion:

The study aimed to determine the association between umbilical cord IgG COVID-19 antibody levels and maternal factors including gestational age of acquiring infection, COVID-19 clinical category, and immunization status. The findings of this study have important implications for understanding neonatal immunity and guiding maternal and neonatal care during the COVID-19 pandemic.

The results of the study demonstrated significant associations between maternal factors and umbilical cord IgG COVID-19 antibody levels. First, the gestational age of acquiring infection showed a positive association with neonatal antibody levels. Infants born to mothers infected in the third trimester had significantly higher antibody levels compared to those infected earlier in pregnancy.

Second, the COVID-19 clinical category was positively correlated with umbilical cord IgG antibody levels. Neonates born to mothers with more severe COVID-19 illness had higher levels of antibodies transferred to them. This association may be attributed to a stronger immune response in mothers with severe illness, leading to increased antibody production and subsequent transfer to the fetus. These findings highlight the potential impact of maternal disease severity on neonatal immunity and the importance of managing maternal COVID-19 infections effectively to minimize the risk of severe neonatal infection.

Third, maternal immunization status was significantly associated with umbilical cord IgG COVID-19 antibody levels. Vaccinated mothers had higher levels of antibodies transferred to their infants, indicating the effectiveness of maternal immunization in conferring neonatal immunity. This finding supports the current recommendations for COVID-19 vaccination in pregnant women as a means of protecting both maternal and neonatal health.

The findings of this study have important implications for maternal and neonatal care during the COVID-19 pandemic.

Understanding the factors that influence neonatal antibody levels can help healthcare providers tailor individualized care plans and counseling for pregnant women. It highlights the potential benefits of timing maternal infections closer to delivery for optimal neonatal antibody transfer. Additionally, the results underscore the importance of managing maternal COVID-19 infections effectively, particularly in cases of severe illness, to enhance neonatal immune protection.

Furthermore, the findings support the value of maternal immunization in conferring neonatal immunity. Encouraging pregnant women to receive COVID-19 vaccines can provide a dual benefit of protecting both mothers and their infants from severe infection. This information can guide vaccination strategies and inform discussions between healthcare providers and pregnant women regarding the potential risks and benefits of immunization.

However, it is important to acknowledge certain limitations of the study. The sample size may have been small, and the results should be validated in larger cohorts to ensure generalizability. Other potential confounding factors, such as maternal antibody levels at the time of infection, maternal immune response, and duration of antibody persistence in neonates, were not fully explored and could influence the observed associations. Future research should address these limitations and explore additional factors that may impact neonatal immunity.

In conclusion, this study contributes to our understanding of the association between umbilical cord IgG COVID-19 antibody levels and maternal factors. The findings provide valuable insights into neonatal immunity and have important implications for maternal and neonatal care during the COVID-19 pandemic. Further research and ongoing surveillance are essential to inform evidence-based strategies that optimize maternal and neonatal outcomes in the context of COVID-19.

Conclusion:


These findings demonstrate transplacental antibody transfer following mRNA COVID-19 vaccination during pregnancy. High degree of vertical transmission of these antibodies occur during pregnancy as evidenced by the robust cord blood levels. These could protect the infant, at least in the neonatal period. Most of the concerns regarding importance of vaccination during pregnancy is due to pregnancy being a risk factor for severe COVID-19 illness. Nevertheless, these results show promising evidence for passive immunity against SARS-CoV-2 in newborns after maternal receipt of COVID-19 mRNA vaccinations.

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