Maternal-Neonatal Transfer of SARS CoV-2 IgG Antibodies among Parturient Women Treated with BNT162b2 mRNA Vaccine during Pregnancy

Omer NIR MD, Anat SCHWARTZ MD, Shlomi TOUSSIA-COHEN MD, Leah LEIBOVITCH MD, Tzipi STRAUSS MD, Keren ASRAF PhD, Ram DOOLMAN PhD, Ms. Sivan SHARABI M.Sc, Carmit COHEN DVM, PhD, Yaniv LUSTIG PhD, Gili REGEV-YOCHAY MD, MPH, Yoav YINON MD

PII: S2589-9333(21)00187-7
DOI: https://doi.org/10.1016/j.ajogmf.2021.100492
Reference: AJOGMF 100492


Received date: 17 July 2021
Revised date: 11 September 2021
Accepted date: 14 September 2021

Please cite this article as: Omer NIR MD, Anat SCHWARTZ MD, Shlomi TOUSSIA-COHEN MD, Leah LEIBOVITCH MD, Tzipi STRAUSS MD, Keren ASRAF PhD, Ram DOOLMAN PhD, Ms. Sivan SHARABI M.Sc, Carmit COHEN DVM, PhD, Yaniv LUSTIG PhD, Gili REGEV-YOCHAY MD, MPH, Yoav YINON MD, Maternal-Neonatal Transfer of SARS CoV-2 IgG Antibodies among Parturient Women Treated with BNT162b2 mRNA Vaccine during Pregnancy, American Journal of Obstetrics & Gynecology MFM (2021), doi: https://doi.org/10.1016/j.ajogmf.2021.100492

This is a PDF file of an article that has undergone enhancements after acceptance, such as the addition of a cover page and metadata, and formatting for readability, but it is not yet the definitive version of record. This version will undergo additional copyediting, typesetting and review before it is published in its final form, but we are providing this version to give early visibility of the article. Please note that, during the production process, errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

© 2021 Elsevier Inc. All rights reserved.
Title: Maternal-Neonatal Transfer of SARS CoV-2 IgG Antibodies among Parturient Women Treated with BNT162b2 mRNA Vaccine during Pregnancy

Authors: Omer NIR, MD\textsuperscript{1,2}; Anat SCHWARTZ, MD\textsuperscript{1,2}, Shlomi TOUSSIA-COHEN, MD\textsuperscript{1,2}, Leah LEIBOVITCH, MD\textsuperscript{2,3}, Tzipi STRAUSS, MD\textsuperscript{2,3}, Keren ASRAF, PhD\textsuperscript{4}, Ram DOOLMAN PhD\textsuperscript{4}, Ms. Sivan SHARABI, M.Sc\textsuperscript{4}. Carmit COHEN, DVM, PhD\textsuperscript{2,5}, Yaniv LUSTIG, PhD\textsuperscript{2,6}, Gili REGEV-YOCHAY, MD, MPH\textsuperscript{2,5}, Yoav YINON, MD\textsuperscript{1,2}

Affiliations:

\begin{itemize}
\item \textsuperscript{1}Department of Obstetrics and Gynecology, Sheba Medical Center, Tel-Hashomer, Israel
\item \textsuperscript{2}Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel
\item \textsuperscript{3}Neonatology, Edmond and Lily Safra Children Hospital, Sheba Medical Center, Tel-Hashomer, Israel
\item \textsuperscript{4}The Dworman Automated Mega Laboratory, Sheba Medical Center, Tel-Hashomer, Israel
\item \textsuperscript{5}Infection prevention & Control Unit, Sheba Medical Center, Tel-Hashomer, Israel
\item \textsuperscript{6}Central Virology Laboratory, Ministry of Health and Sheba Medical Center, Tel-Hashomer, Israel
\end{itemize}

Conflict of interest: The authors report no conflict of interest.

Funding: Ferring COVID-19 Investigational Grant

Corresponding author:
Yoav Yinon, MD
Department of Obstetrics and Gynecology
Sheba Medical Center, Tel-Hashomer 52621, Israel
Phone: +972-546744141
Email: yoav.yinon27@gmail.com
Condensation: Pregnant women vaccinated against SARS CoV-2 during pregnancy transfer IgG antibodies to their neonates.

Short title: Maternal-neonatal SARS CoV-2 IgG antibodies transfer following vaccination of pregnant women.

AJOG at a glance

A. Why was this study conducted?

- Pregnant women were excluded from initial trials of SARS CoV-2 vaccine, hence little is known about its efficacy in this population.
- It is known that maternal-neonatal transfer of antibodies exists both transplacentally and via lactation.
- We sought to determine the maternal-neonatal transfer of SARS CoV-2 IgG antibodies among vaccinated parturient women.

B. What are the key findings?

- SARS-CoV-2 IgG antibodies were detected in samples of cord blood, newborn dried blood spot and breast milk.
- Neonatal and breast milk antibody levels were positively correlated with maternal serum antibody levels.
- Higher levels of cord blood antibodies were detected among vaccinated women compared to COVID-19 recovered women.

C. What does this study add to what is already known?

- High rates of maternal-neonatal SARS CoV-2 antibodies transfer exist among vaccinated pregnant women.
In addition to maternal protection against COVID-19, the SARS CoV-2 vaccine may also provide neonatal humoral immunity.

Abstract

Background: The exclusion of pregnant women from COVID-19 mRNA vaccine trials raised hesitancy regarding the benefit of vaccination of pregnant women, hence little is known about the vaccine’s efficacy in this population.

Objective: To determine the maternal-neonatal transplacental transfer of SARS CoV-2 antibodies among vaccinated parturient women. A control group of COVID-19 recovered patients was included in order to compare IgG levels between vaccinated and recovered patients.

Study Design: A prospective cohort study in a single tertiary medical center in Israel between February and March 2021; parturient women who had been vaccinated with BNT162B2 mRNA vaccine during pregnancy were included and compared to COVID-19 recovered parturient women. SARS CoV-2 IgG antibodies were measured in maternal and cord sera, dried blood spot samples taken from newborns, and breast-milk samples. The primary outcome was to determine whether neonatal cord and dried blood spot samples were positive for SARS CoV-2 antibodies and to evaluate transfer ratio defined as cord blood IgG divided by maternal IgG levels.

Results: The study included 64 vaccinated parturient women and 11 parturient women who had COVID-19 disease during pregnancy. All maternal blood sera samples and 98.3% of cord blood
sera samples were positive for SARS Cov-2 IgG with median concentrations of 26.1 (IQR 22.0;39.7) and 20.2 (IQR 12.7;29.0) respectively. Similarly, 96.4% of neonatal blood spot samples and all breast milk samples were positive for SARS CoV-2 IgG with median concentrations of 11.0 (IQR 7.2;12.8) and 4.9 (IQR 3.8;6.0), respectively. There was a significant positive correlation between maternal serum levels of SARS Cov-2 IgG and cord blood (R=0.483, p=0.0001), neonatal blood spot (R=0.515, p=0.004), and breast milk levels (R=0.396, p=0.005) of SARS CoV-2 IgG. The median placental transfer ratio of SARS-COV-2 IgG was 0.77. Comparison of vaccinated with recovered COVID-19 patients revealed significantly higher SARS CoV-2 IgG levels in maternal serum and cord blood among vaccinated women (p<0.0001).

**Conclusion(s):** Our study demonstrated efficient transfer of SARS CoV-2 IgG across the placenta from women vaccinated with BNT162b2 mRNA vaccine during pregnancy to their neonates with positive correlation between maternal serum and cord blood antibody concentrations. In addition to maternal protection against COVID-19, the vaccine may also provide neonatal humoral immunity.

**Key Words:** Pregnancy, COVID-19 vaccine, SARS CoV-2 antibodies, neonatal immunity, antibodies transfer
INTRODUCTION

Accumulating evidence indicates that pregnant women are more likely to experience COVID-19 complications compared with non-pregnant women\textsuperscript{1}. The novel BNT162b2 mRNA vaccine against SARS CoV-2 was shown to be effective both in a randomized trial and in a nationwide mass vaccination setting, yet pregnant and lactating women were excluded from all clinical trials\textsuperscript{2,3}. Vaccination recommendations during pregnancy differ greatly around the globe. In view of the risk associated with COVID-19 disease in pregnancy which seems to outweigh the potential unwanted effects of the BNT6b2 mRNA vaccine, the Israeli Ministry of Health has issued an official recommendation for vaccinating pregnant women\textsuperscript{4-8}.

Transplacental passage of maternal derived SARS CoV-2 antibodies among seropositive women who were infected with COVID-19 has been described, showing that cord blood IgG antibody concentrations were directly associated with maternal antibody concentrations and with time elapsed from maternal infection to delivery\textsuperscript{9-12}. In addition to maternal protection against COVID-19 following vaccination, the potential benefit of transplacental and lactation passage of antibodies is of immense importance, as it may provide infants with protection against COVID-19 at a phase in which their humoral response is still inefficient\textsuperscript{13-19}. Such findings may play an additional key consideration in deciding whether to vaccinate pregnant women.

Our aim was to assess the transfer of maternal antibodies among infants born to women vaccinated with BNT6b2 mRNA vaccine during pregnancy by measuring SARS CoV-2 antibodies in maternal and cord sera, infant blood spot sample, and breast-milk during post-partum hospitalization.
MATERIALS AND METHODS

A prospective cohort study of parturient women who had been vaccinated with BNT162b2 mRNA vaccine during pregnancy and COVID-19 recovered parturient women who were admitted for delivery at a single tertiary medical center between February and March 2021. Inclusion criteria included pregnant women aged 18 years or older who had received two doses of BNT162b2 mRNA covid-19 vaccine at least 14 days prior to delivery. COVID-19 recovered women with previous documented positive polymerase-chain-reaction (PCR) test for SARS CoV-2 served as a control group; patients were defined as recovered if they were asymptomatic for 3 days or more after 10 days had elapsed from the initial positive PCR test for SARS CoV-2. Documentation of a positive PCR test during the acute phase of infection was required, as well as a signed form by the Ministry of Health stating that the patients were defined as recovered. Eligible women were offered to participate upon admittance to the delivery room or operating room in cases of elective Cesarean delivery. Data regarding general medical history and pregnancy outcomes were collected.

Maternal blood samples were obtained upon admittance, and cord blood samples were taken immediately post-partum. Serum samples were centrifuged at 4000 G for 4 min in room temperature. The samples were tested for SARS-COV-2 RBD IgG using the commercial automatic immunoassay access SARS-COV-2 IgG (Beckman Coulter, CA, USA) according to manufacturer’s instructions, and samples cutoff (S/Co) equal or above 1.1 were considered positive. Dried blood
spots (DBS) samples were obtained from the infants on Guthrie cards at day one post-partum. Breast milk samples were collected during post-partum hospitalization. DBS and milk samples were tested for SARS CoV-2 IgG by a Receptor-Binding-Domain (RBD) ELISA as previously demonstrated\textsuperscript{20,21} with the following modifications: milk samples were diluted 1:2 for IgG. For DBS, 4-mm punches were taken from a single Guthrie card and antibodies were extracted by incubation with 250\(\mu\)l of 1% skim milk in PBS with 0.05% TWEEN for 90 min. One hundred microliters of extracted material were taken for IgG testing transfer ratio was calculated as cord blood SARS-COV-2 IgG divided by maternal IgG concentration. Transfer ratio, defined as median maternal serum IgG levels divided by cord blood median IgG levels, was calculated.

The study was approved by the Sheba Medical Center Institutional Review Board (8142-21).

Descriptive statistics were used to assess the demographic and clinical characteristics of the participants and are presented as mean±standard deviation (SD) or median and interquartile ranges (IQR) as appropriate. SARS CoV-2 antibody levels were analyzed and correlation between maternal concentrations and cord, neonatal, and breast milk concentrations was assessed.

RESULTS

The study included 64 parturient women who had been vaccinated with two doses of BNT162b2 mRNA vaccine and 11 parturient women who had COVID-19 disease during pregnancy. The
demographic and clinical characteristics are presented in Table 1. The mean time interval between the 2nd vaccination and delivery was 21.7(±11.0) days for vaccinated women, and 92.5(±75.8) days between positive PCR test for SARS CoV-2 infection and delivery in recovered COVID-19 patients (p<0.0001). All maternal blood sera samples and 98.3% of cord blood sera samples were positive for SARS Cov-2 IgG with median concentrations of 26.1 (IQR 22.0;39.7) and 20.2 (IQR 12.7;29.0) respectively. Similarly, 96.4% of neonatal blood spot samples (n=55) and all breast milk samples (n=30) were positive for SARS CoV-2 IgG with median concentrations of 11.0 (IQR 7.2;12.8) and 4.9 (IQR 3.8;6.0) respectively (Table 2).

There was a significant positive correlation between maternal serum levels of SARS Cov-2 IgG and cord blood (R=0.483, p=0.0001), neonatal blood spot (R=0.515, p=0.004), and breast milk levels (R=0.396, p=0.005) of SARS CoV-2 IgG (Figure 1 A-C). The median placental transfer ratio of SARS-COV-2 IgG was 0.77. We observed a negative significant correlation between time elapsed since the second dose of the vaccine and maternal serum IgG levels (r=-0.386, p=0.003), but correlation with cord blood IgG levels was not as clear (r=0.159, p=0.14) (Figure 2). Comparison of vaccinated to recovered COVID-19 patients revealed significantly higher SARS CoV-2 IgG levels in maternal and cord blood samples among vaccinated women (p<0.0001) (Table 2).
COMMENT

Principal Findings: Our study demonstrated efficient transfer of SARS CoV-2 IgG across the placenta from women who were vaccinated with BNT162b2 mRNA vaccine during pregnancy to their neonates with positive correlation between maternal serum and cord blood antibody concentrations. Neonatal blood spot as well as breast milk samples of vaccinated parturient were also positive for SARS CoV-2 IgG. Vaccine induced maternal serum and cord blood antibody titers were higher than those found in recovered COVID-19 patients.

The presence of neonatal SARS CoV-2 antibodies after maternal vaccination indicates that in addition to maternal protection against COVID-19, the BNT162b2 mRNA vaccine may also provide neonatal immunity while humoral response is still inefficient. Such findings may play an additional key consideration in deciding whether to vaccinate pregnant women, especially with the increased maternal morbidity and mortality associated with COVID-19 disease in pregnancy.

Results in the Context of What is Known: In a previous study on parturient women who had COVID-19 disease during pregnancy, maternal SARS-CoV-2 IgG antibodies IgG were transferred across the placenta in 87% of patients. In addition, cord blood antibody levels were correlated with maternal antibody concentrations as well as with duration between onset of infection and delivery\(^9\). In our study, cord and neonatal blood spot levels of antibodies were significantly higher among infants of vaccinated parturient women compared to recovered COVID-19 disease. In line with our results, a recent study by Gray et al. has also shown greater response among vaccinated women compared to recovered patients\(^{22}\). Yet, it is unclear whether
vaccination confers better neonatal immunity compared to maternal infection with SARS CoV-2 during pregnancy. Of note, the time elapsed between disease or vaccination and delivery was significantly longer among the COVID-19 recovered patients, which could also explain the difference we found in cord and neonatal blood antibody levels between the two groups.

The optimal timing of maternal vaccination to achieve maximal protection of the newborn is still unknown. Mithal et al. have recently shown that the antibody transfer ratio seems to increase with latency from vaccination, suggesting that earlier vaccination may produce a greater infant immunity\(^2^3\). Studies on other vaccinations found that placental transfer ratios increased when the time between maternal infection and delivery was longer\(^2^4\). Other vaccinations in pregnancy such as Tdap immunization are given between 27 and 36 weeks of gestation according to the ACOG and CDC recommendations\(^2^5\). However, some studies have indicated that Tdap vaccine might be more effective when administered during the second trimester of pregnancy\(^2^6\). In the current study, all participants were vaccinated in the third trimester at a mean gestational age of 33.5, but no correlation between time from vaccination and cord blood antibody levels was demonstrated. However, a recent study including 20 parturient women who received mRNA COVID-19 vaccine found cord blood antibody concentrations to be correlated with time since vaccination\(^2^7\). The placental transfer ratio reported in the aforementioned study was 0.34, which is lower compared to a ratio of 0.77 found in our study. This difference may be attributed to the longer interval of vaccination to delivery in our cohort (21.7 vs 11 days). Since transplacental transfer begins at around 17 weeks of gestation increasing exponentially as gestation advances, maternal vaccination in the early
second trimester might be optimal for newborn protection. Data derived from other vaccines indicate that transplacentally acquired antibodies usually decline by the second month of life, and the protective efficacy is expected to be reduced at the age of 6 to 12 months.

Based on our study, we cannot estimate the period of time during which potential protection against COVID-19 lasts among the infants. However, we demonstrated SARS CoV-2 IgG in breast-milk samples of lactating women after delivery, which may further enhance neonatal immunity. Similarly, Gray et al. have shown the presence of vaccine-generated antibodies in breast-milk samples of 31 lactating women, who received the COVID-19 mRNA vaccine. The role and extent to which antibodies transferred through breast milk can protect breast fed infants is still unresolved.

Clinical and Research Implications: The results of this study show that in addition to maternal protection against COVID-19 during pregnancy, the novel BNT6b2 mRNA vaccine may also potentially provide protection to newborns in a sensitive period during which their humoral protection is ineffective. Further research is needed in order to reinforce public health policy regarding vaccination during pregnancy. Despite the reassuring findings of the current study, further research is needed to determine several unanswered question; first, for how long does the potential humoral protections lasts, and how clinically effective is this protection from acquiring COVID-19 during infancy. Second, the optimal timing of vaccination during pregnancy with respect to neonatal protection remains unresolved, and additional large-scale research is required.
Strengths and Limitations: This is the one of the largest study to date assessing maternal-neonatal transfer of antibodies following COVID-19 vaccination of pregnant women. The strengths of our study include prospective assessment of several different markers of maternal-neonatal transfer of antibodies in a short time period; samples collection in close temporal proximity to the date of vaccination; and the inclusion of a relatively large cohort of vaccinated parturient women, an important group which was not included in clinical trials evaluating the effectiveness of BNT6b2 mRNA vaccine. Moreover, a comparison group of COVID-19 recovered parturient women was also included using the same methods. This study has several limitations: first, lack of long-term follow up and serial sample collection. Second, since all women were vaccinated during a short window of the third trimester (33.5±3 weeks) we cannot determine the most beneficial time to vaccinate. As the vaccine was a new treatment at the time this study was conducted, women vaccinated during first or second trimester were not included since they haven’t delivered by the time the study was completed. Furthermore, this study did not prove clinical efficacy in protecting infants from COVID-19. Neither the degree of neonatal protection against SARS CoV-2 nor the length of time that such potential protection lasts from delivery can be assessed from this study alone, and further large-scale, long-term research is required to elucidate this issue.

Conclusions: We have demonstrated that parturient women who had been vaccinated with a full 2-dose BNT6b2 mRNA vaccine prior to delivery transfer SARS CoV-2 IgG antibodies to their infants with evidence of antibodies in cord blood, neonatal blood spot samples and breast milk samples. These data show an additional benefit of the novel BNT6b2 mRNA vaccine in
potentially providing protection to newborns in a sensitive period during which their humoral protection is ineffective. Further research is needed to determine the optimal time for vaccination during pregnancy with respect to newborn immunity, and whether transplacentally transferred SARS CoV-2 antibodies provide clinically and long lasting infant protection.

References:

TABLE 1 – Cohort demographic characteristics of parturient following BNT162b2 mRNA vaccine versus COVID-19 recovered women

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>BNT162b2 mRNA vaccinated women (n=64)</th>
<th>COVID-19 recovered women (n=11)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal age (years)</td>
<td>33.8(±5.8)</td>
<td>32.7(±5.7)</td>
<td>0.56</td>
</tr>
<tr>
<td>BMI</td>
<td>28.2(±4.9)</td>
<td>31.6(±4.6)</td>
<td>0.06</td>
</tr>
<tr>
<td>Type I Diabetes Mellitus</td>
<td>1(1.6)</td>
<td>1(9.1)</td>
<td>0.27</td>
</tr>
<tr>
<td>Pregestational hypertension</td>
<td>1(1.6)</td>
<td>0</td>
<td>0.99</td>
</tr>
<tr>
<td>Other medical conditions</td>
<td>Hypercoagulability</td>
<td>3(4.7)</td>
<td>0(0)</td>
</tr>
<tr>
<td></td>
<td>Autoimmune disease</td>
<td>5(7.8)</td>
<td>2(18.2)</td>
</tr>
<tr>
<td>Smoking</td>
<td>4 (6.3)</td>
<td>1 (9.1)</td>
<td>0.99</td>
</tr>
<tr>
<td>Medications</td>
<td>Levothyroxine/PTU</td>
<td>3(4.7)</td>
<td>1(9.1)</td>
</tr>
<tr>
<td></td>
<td>Aspirin and/or LMWH</td>
<td>5(7.8)</td>
<td>0(0)</td>
</tr>
<tr>
<td></td>
<td>Prednisone</td>
<td>3(4.7)</td>
<td>0(0)</td>
</tr>
<tr>
<td></td>
<td>Insulin</td>
<td>1(1.6)</td>
<td>2(18.2)</td>
</tr>
<tr>
<td>Gestational Diabetes Mellitus</td>
<td>4(6.3)</td>
<td>2(18.2)</td>
<td>0.21</td>
</tr>
<tr>
<td>Gestational hypertensive disease</td>
<td>2(3.1)</td>
<td>0(0)</td>
<td>0.72</td>
</tr>
<tr>
<td>Gestational age at vaccination – 2nd dose or positive SARS CoV-2 PCR (weeks)</td>
<td>33.5(±3.2)</td>
<td>27.2(±11)</td>
<td>0.07</td>
</tr>
<tr>
<td>Parameter</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>p-value</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>-----------------</td>
<td>-----------------</td>
<td>---------</td>
</tr>
<tr>
<td>Gestational age at delivery (weeks)</td>
<td>38.7 ± 1.3</td>
<td>39.0 ± 1.2</td>
<td>0.46</td>
</tr>
<tr>
<td>Vaginal delivery</td>
<td>43 (64)</td>
<td>8 (72.7)</td>
<td>0.99</td>
</tr>
<tr>
<td>Newborn gender - Male</td>
<td>28 (43.9)</td>
<td>6 (54.5)</td>
<td>0.53</td>
</tr>
<tr>
<td>Neonatal birthweight (grams)</td>
<td>3187.2 ± 484.3</td>
<td>3470.0 ± 427.9</td>
<td>0.06</td>
</tr>
<tr>
<td>2nd vaccine or positive SARS CoV-2 PCR to sampling interval (days)</td>
<td>21.7 ± 11.0</td>
<td>92.5 ± 75.8</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Multiple gestation</td>
<td>2 (3.1)</td>
<td>0 (0)</td>
<td>0.72</td>
</tr>
</tbody>
</table>

BMI - body mass index

Gestational hypertensive disease comprised of pregnancy induced hypertension and preeclampsia toxemia

Autoimmune disease is comprised of Hypothyroidism and Ulcerative Colitis

Data are presented as n (%) or mean ±SD where appropriate
### TABLE 2 - Serology for COVID-19–specific Antibodies

<table>
<thead>
<tr>
<th></th>
<th>BNT162b2 mRNA vaccinated women (n=64)</th>
<th>COVID-19 recovered women (n=11)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal serum IgG</td>
<td>26.1 (22.0;39.7)</td>
<td>2.6 (0.9;3.5)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Neonatal cord blood</td>
<td>20.2 (12.7;29.0)</td>
<td>3.27 (0.5;4.6)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Dried blood spot*</td>
<td>11.0 (7.2;12.8)</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Breastmilk IgG **</td>
<td>4.9 (3.8;6.0)</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Data are presented as median (IQR)

* Dried blood spot samples (n=55)

** Breastmilk samples (n=30)

N/A – Not Available
Figure 1A Association between maternal serum and neonatal cord SARS-CoV-2 specific IgG. Figure 1B. Association between maternal serum and neonatal dried blood-spot specific SARS-CoV-2 IgG. Figure 1C. Association between maternal serum and breastmilk SARS-CoV-2 specific IgG.
Association between maternal serum and neonatal dried blood-spot specific SARS-CoV-2 IgG

- IgG positive above 1.1 S/Co
- IgG maternal serum to neonatal dried blood spot correlation (r=0.39, p=0.005)
Association between maternal serum and breastmilk SARS-CoV-2 specific IgG

- Breastmilk IgG positive above 1.1 S/Co
- IgG maternal breastmilk to serum correlation ($r=0.51$, $p=0.004$)
Figure 2 Association between time elapsed from vaccination and maternal and cord blood IgG levels