

Dear all

Here a list of initial literature search results we did over the weekend on breastmilk, breastfeeding and pregnancy-related to COVID-19. It was conducted with great support from one of our Master of Science in Public Health students at Johns Hopkins Ms. Xiaodi Xu who was also able to scan through literature exclusively available in Mandarin Chinese. Annex 1 shows the keywords we used to search through the various scientific databases. The last part (references 13-16) is just an overview of recommendations done by Chinese health officials concerning breastmilk, breastfeeding and COVID-19 and these documents did not contain any scientific materials. I hope this is helpful for your work. Regards, Mija Ververs

1. **Chen, H., Guo, J., Wang, C., Luo, F., Yu, X., Zhang, W., ... & Liao, J. (2020). Clinical characteristics and intrauterine vertical transmission potential of COVID-19 infection in nine pregnant women: a retrospective review of medical records. The Lancet 2020 Feb 12, 395(10226), 809-815. [e-pub]. [https://doi.org/10.1016/S0140-6736\(20\)30360-3](https://doi.org/10.1016/S0140-6736(20)30360-3)**

They did a retrospective review of medical records from nine pregnant women with COVID-19 pneumonia admitted to Zhongnan Hospital of Wuhan University from Jan 20 to Jan 31, 2020. All nine pregnant women with COVID-19 pneumonia tested positive for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) by use of quantitative RT-PCR (qRT-PCR) on samples from the respiratory tract. The nine pregnant women were all in their third trimester, and all underwent caesarean section. 6 breastmilk samples from patients were collected after their first lactation to test for the presence of SARS-CoV-2. Neither the test kit recommended by CDC nor their in-house nested RT-PCR assays detected SARS-CoV-2 in these samples.

2. **Zhang, Y. H., Lin, D. J., Xiao, M. F., Wang, J. C., Wei, Y., Lei, Z. X., ... & Xiang, W. (2020). 2019-novel coronavirus infection in a three-month-old baby. Chinese journal of pediatrics, 2020 Feb 11;58(0):E006. DOI: 10.3760/cma.j.issn.0578-1310.2020.0006. [Epub ahead of print] *In Mandarin Chinese only***

An infant was breastfed after birth, with normal growth and good health status. The infant was admitted to the hospital on January 26 and continued to be breastfed. She was detected positive on January 27 and confirmed infection. The nasopharyngeal swab specimens collected from the parents on January 26 were tested negative, but the parents were diagnosed positive one week later. They excluded the parent as the source of infection and it was speculated that the child may be the infection source of her parents. In this case, viral nucleic acid was detected in the stool of the mother, but no viral nucleic acid was detected in breastmilk or urine.

3. **Kai-qian Kam, Chee Fu Yung, Lin Cui, Raymond Lin Tzer Pin, Tze Minn Mak, Matthias Maiwald, Jiahui Li, Chia Yin Chong, Karen Nadua, Natalie Woon Hui Tan, Koh Cheng**

Thoon, A Well Infant with Coronavirus Disease 2019 (COVID-19) with High Viral Load, *Clinical Infectious Diseases*, 28 February 2020, ciaa201, <https://doi.org/10.1093/cid/ciaa201>

A well 6-month-old boy was referred to KK Women's and Children's Hospital (KKH) on 4 February 2020, and a nasopharyngeal specimen taken on admission and tested by rRT-PCR confirmed the diagnosis of COVID-19 infection. His mother's symptoms started on 29 January 2020 and the first nasopharyngeal swab on 3 February 2020 was positive for SARS-CoV-2. Breastmilk samples on 8 February were negative. The authors think that the infant likely acquired the virus from a household member, but it was difficult to ascertain the day of infection as there were no reported symptoms.

- 4. Cuifang Fan, Di Lei, Congcong Fang, Chunyan Li, Ming Wang, Yuling Liu, Yan Bao, Yanmei Sun, Jinfa Huang, Yuping Guo, Ying Yu, Suqing Wang, Perinatal Transmission of COVID-19 Associated SARS-CoV-2: Should We Worry?, *Clinical Infectious Diseases*, 17 March 2020, ciaa226, <https://doi.org/10.1093/cid/ciaa226>**

They described two physicians with COVID-19 during the third trimester of gestation but their newborns showed no abnormalities at birth, and specimens were collected at or after delivery. The *first* woman delivered a baby girl with C-section after a week of confirmation, and the baby was separated from her mother immediately after birth without skin-to-skin contact; SARS-CoV-2 was not detected in breast milk.

The *second* woman underwent a caesarean section 4 days after being confirmed; SARS-CoV-2 was not detected in breastmilk. The authors think that due to the immune response to the infection, it is possible that the mother produced sufficient neutralizing antibodies without developing serious conditions, and these passive antibodies may have a protective effect on the infant via breastfeeding.

However, considering person-to-person transmission and positive nasopharyngeal swab after two consecutive negative samples, breastfeeding was discouraged despite the fact they did not detect SARS-CoV-2 in consecutive breastmilk samples during follow-up in this case.

- 5. Yuxia Cui, MD, Maolu Tian, MM, Dong Huang, MD, Xike Wang, MD, Yuying Huang, BM, Li Fan, MM, Liang Wang, BM, Yun Chen, MM, Wenpu Liu, BM, Kai Zhang, BM, Yue Wu, BM, Zhenzhong Yang, BM, Jing Tao, BM, Jie Feng, BM, Kaiyu Liu, BM, Xianwei Ye, MD, Rongpin Wang, MD, Xiangyan Zhang, MM, Yan Zha, MD, A 55-Day-Old Female Infant infected with COVID 19: presenting with pneumonia, liver injury, and heart damage, *The Journal of Infectious Diseases*, 17 March 2020, jiaa113, <https://doi.org/10.1093/infdis/jiaa113>**

A 55-day-old otherwise healthy female infant that received mixed feeding became ill January 28, 2020, and the infant and her parents had contact with relatives who had symptoms like cough

and fever 10 days before. The child's parents were diagnosed with COVID-19 on January 31, and three consecutive tests of SARS-CoV-2 RNA in the breast milk of the mother were negative between February 2 to February 4. The authors think that it deserves further study to determine whether there is any barrier preventing the virus from entering the milk and whether a confirmed case could continue to provide her breastmilk for infants.

6. Wang^{1a}, X., Zhou^{2a}, Z., Zhang, J., Zhu, F., Tang, Y., Shen, X., & Shen, X. (2020). A case of 2019 Novel Coronavirus in a pregnant woman with preterm delivery. *Clinical Infectious Diseases*, 28 February 2020, ciaa200, <https://doi.org/10.1093/cid/ciaa200>

On February 2, 2020, a 28-year-old female, who was 30 weeks pregnant, presented to a fever clinic of Suzhou Municipal Hospital with intermittent fever for one week, and two throat swab samples were collected and tested negative. On February 6, the second SARS-CoV-2 RT-PCR results of her sputum came back positive. A preterm male infant was delivered at 30 weeks of pregnancy, with Apgar scores of 9 and 10 at 1 and 5 minutes, respectively. On day 3 after cesarean section, RT-PCR analyses of the neonatal throat swab and stool samples were COVID-19 negative. He was kept in the isolation ICU of the neonatal nursery for observation without any contact with his mother after birth. The newborn was given formula instead of breast milk ever since. They didn't take any sample of breastmilk for testing.

7. Wang, S., Guo, L., Chen, L., Liu, W., Cao, Y., Zhang, J., & Feng, L. (2020). A case report of neonatal COVID-19 infection in China. *Clinical Infectious Diseases*, 12 March 2020, ciaa225, <https://doi.org/10.1093/cid/ciaa225>

This a neonatal COVID-19 infection in China with pharyngeal swabs tested positive by rRT-PCR assay 36 hours after birth. However, whether the case was a vertical transmission from mother to child remains to be confirmed. On admission, the women's body temperature was 37.8 °C and she had no cough or sputum. Emergency Cesarean section was performed, and the mother had been wearing an N95 mask throughout the operation, and the infant had no contact with the mother after birth. They recommended the mother not to breastfeed and empty the breast milk to avoid mastitis. After finding evidence of neonatal infection, they performed nucleic acid tests for SARS-CoV-2 on the mother's breast milk sample which was collected 36 hours after birth and it was negative for the virus.

8. Li Y, Zhao R, Zheng S, Chen X, Wang J, Sheng X, et al. Lack of vertical transmission of severe acute respiratory syndrome coronavirus 2, China. *Emerging infectious diseases*, 26(6). 5 March 2020, <https://doi.org/10.3201/eid2606.200287>

A 30-year-old pregnant woman at 35 weeks' gestation confirmed positive for SARS-CoV-2 infection delivered an infant by cesarean section in a negative-pressure operating room. An Lit. Search COVID-19 and breastmilk, breastfeeding and pregnancy - Xi & Ververs-23 March 2020

oropharyngeal swab specimen, obtained immediately after the infant was taken from the uterus, indicated that the infant was negative for SARS-CoV-2, and was sent to the negative-pressure ward. On the delivery day, although the woman's sputum was positive, serum, urine, feces, amniotic fluid, umbilical cord blood and placenta, and breast milk samples were negative.

9. Yang, H., Wang, C., & Poon, L. C. (2020). **Novel coronavirus infection and pregnancy. Ultrasound in Obstetrics & Gynecology. 05 March 2020.**
<https://doi.org/10.1002/uog.22006>

This paper refers to the situation in China that all newborns are separated from their infected mothers for at least 14 days, which makes direct breastfeeding unfeasible; however, the mothers are advised to express their breastmilk in order to maintain milk production, once they test negative for COVID-19, they are then able to breastfeed their infant.

10. Favre, G., Pomar, L., Qi, X., Nielsen-Saines, K., Musso, D., & Baud, D. (2020). **Guidelines for pregnant women with suspected SARS-CoV-2 infection. The Lancet Infectious Diseases. 03 March 2020.** [https://doi.org/10.1016/S1473-3099\(20\)30157-2](https://doi.org/10.1016/S1473-3099(20)30157-2)

This guideline points out that newborns of mothers confirmed positive for SARS-CoV-2 should be isolated for at least 14 days or until viral shedding clears, during which time direct breastfeeding is not recommended.

11. Li F, Feng ZC, Shi Y. **Proposal for prevention and control of the 2019 novel coronavirus disease in newborn infants** *Archives of Disease in Childhood - Fetal and Neonatal Edition* Published Online First: 04 March 2020. doi: 10.1136/archdischild-2020-318996

This article concerns recommendations concerning newborns: Infants with highly suspected or confirmed COVID-19 should be referred to the designated neonatal ward. All medical staff involved should wear protective equipment. The neonatal department should be strictly stratified into transitional, quarantine, living and work areas. Infants with suspected infections should be isolated in a single room, while confirmed patients should be moved into separate rooms. After admission, avoiding breastfeeding from COVID-19 mother until recovery should be adequately performed. **NO SCIENTIFIC DATA PRESENTED IN THIS REFERENCE**

12. Wang L, Shi Y, Xiao T, Fu J, Feng X, Mu D, Feng Q, Hei M, Hu X, Li Z, Lu G, Tang Z, Wang Y, Wang C, Xia S, Xu J, Yang Y, Yang J, Zeng M, Zheng J, Zhou W, Zhou X, Zhou X, Du L, Lee SK, Zhou W; on behalf of the Working Committee on Perinatal and Neonatal Management for the Prevention and Control of the 2019 Novel Coronavirus Infection. **Chinese expert consensus on the perinatal and neonatal management for the prevention and control of the 2019 novel coronavirus infection (First edition).** *Ann Transl Med* 2020;8(3):47. doi: 10.21037/atm.2020.02.20

Perinatal and neonatal management: The possibility of the vertical transmission of 2019-nCoV cannot be ruled out. Infants should not be fed with breast milk from mothers with confirmed or suspected of 2019-nCoV. If the suspected or diagnosed mother and her breast milk test negative for 2019-nCoV, infants should be fed with breast milk. Donor milk can be considered for use after being screened for 2019-nCoV, because the virus may be excreted into the milk during the incubation period.

NO SCIENTIFIC DATA PRESENTED IN THIS REFERENCE

From:

CNKI (China National Knowledge Infrastructure) Database in China – this includes references on Medicine.

Search results

13. Peng, J., Wang, X., Yang, M. H., Wang, M. J., & Zheng, X. R. (2020). Management plan for prevention and control of novel coronavirus pneumonia among children in Xiangya Hospital of Central South University. *Zhongguo dang dai er ke za zhi= Chinese journal of contemporary pediatrics*, 22(2), 100-105. 2020 Feb. DOI: 10.7499/j.issn.1008-8830.2020.02.004 *Published in Mandarin Chinese with English abstract*

Under the organization of the Xiangya Hospital of Central South University, the Department of Pediatrics has formulated an action plan with Xiangya unique model to prevent and control novel coronavirus pneumonia (NCP) among children according to the current epidemic situation and diagnostic and therapeutic program in China. For perinatal newborns, breastfeeding is not recommended for infants born to women who are suspected or confirmed with NCP, but the women should express milk regularly to ensure lactation. Breastfeeding is not feasible until infected mothers are cured.

NO SCIENTIFIC DATA PRESENTED IN THIS REFERENCE

14. Pediatric Committee. (2020). Emergency response plan for the neonatal intensive care unit during epidemic of 2019 novel coronavirus. *Chinese journal of contemporary pediatrics*, 22(2), 91. 2020 Feb. DOI: 10.7499/j.issn.1008-8830.2020.02.002 *Published in Mandarin Chinese with English abstract*

For each infant admitted to the hospital, health workers ask his/her mother, family members, caregivers, and people who have been in contact: 1) whether they are 2019-nCoV confirmed or suspected cases; 2) whether they have a resident history in epidemic areas in the past 2 weeks, especially in Wuhan, Hubei Province; 3) whether they have been in close contact with patients with respiratory infections in the past 2 weeks; 4) whether they have been in close contact with wild animals in the past 2 weeks. If any of the above conditions are met, the infant will be placed in a single room and observed for 14 days. During the observation period, in order to reduce the

risk, avoiding being breastfed by mothers confirmed with COVID-19 is recommended. **NO SCIENTIFIC DATA PRESENTED IN THIS REFERENCE**

- 15. Working Group for the Prevention and Control of Neonatal 2019-nCoV Infection in the Perinatal Period of the Editorial. Perinatal and neonatal management plan for prevention and control of 2019 novel coronavirus infection (1st Edition). Chinese Journal of Contemporary Pediatrics, 2020, 22(2): 87-90. DOI: 10.7499/j.issn.1008-8830.2020.02.001 *Published in Mandarin Chinese with English abstract***

Women with critical conditions should be isolated from infants for 14 days after delivery. After the mother is cured, breastfeeding can be accepted.

High-risk infants, including who has been close contact with confirmed family members and caregivers, or have been exposed to sources of infection in public places, are recommended to avoid being breastfed by mothers who have been confirmed with COVID-19 to reduce risks. Besides, if they are fed by donated breast milk, the milk should be pasteurized. **NO SCIENTIFIC DATA PRESENTED IN THIS REFERENCE**

- 16. ZHANG D Y, YAO M, WANG J J, et al. Guidance on the Control and Prevention of SARS-CoV-2 Infection in Primary Healthcare Settings in Rural China (First Edition) . Chinese General Practice, 2020, 23(7): 763-769. DOI: 10.12114/j.issn.1007-9572.2020.00.246 *Published in Mandarin Chinese with English abstract***

Home isolation and medical observation means that after the evaluation of medical staff at the primary health institution, the person with a history of exposure to the epidemic source but without clinical symptoms will be isolated at home (single room), followed by a person to track their health status.

Mothers who are isolated at home can continue breastfeeding, but they must wear medical masks properly and keep their hands hygienic during breastfeeding, like washing hands with soap and running water or using hand disinfectants containing alcohol. **NO SCIENTIFIC DATA PRESENTED IN THIS REFERENCE**

Annex 1.

PubMed

search details: (((("Milk, Human"[Mesh] OR "Breast Milk Expression"[Mesh]) OR "Breast Feeding"[Mesh]) OR "Pregnancy"[Mesh]) OR "Pregnant Women"[Mesh]) OR ("Infant"[Mesh] OR "Infant, Newborn"[Mesh])) AND ("spike glycoprotein, COVID-19 virus" [Supplementary

Concept] OR "COVID-19" [Supplementary Concept] OR "severe acute respiratory syndrome coronavirus 2" [Supplementary Concept]). There are 11 results, 4 of them are comments, 3 of them are related to epidemiology globally, 1 of them focused on health care of nurses, and 1 of them reported a case of a 7-year-old child. Finally, 2 papers are included.

Science Direct database: Using the following search terms 'COVID-19', 'coronavirus', 'breastmilk', 'infant', 'pregnan*', and 0 paper is identified as relevant.

Oxford Academic: Using the following search terms 'COVID-19', 'coronavirus', 'breastmilk', 'infant', 'pregnan*'.

Embase: 'COVID-19', 'coronavirus', 'breast', 'milk', 'infant', 'pregnan*'