

## ORIGINAL ARTICLE

**MATERNAL AND NEONATAL CLINICO-DEMOGRAPHIC PROFILE AND OUTCOMES DURING THE COVID-19 PANDEMIC AT THE CHINESE GENERAL HOSPITAL AND MEDICAL CENTER**Maria Ronallaine d.L. Bello, MD<sup>1</sup>Shirley Kwong-Buizon, MD, MDH, FPPS, FPSAAI<sup>1,2</sup><sup>1</sup> Chinese General Hospital and Medical Center<sup>2</sup> Research Committee Chairman, Department of Pediatrics, Chinese General Hospital and Medical Center

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The authors declare that the data presented are original material and has not been previously published, accepted or considered for publication elsewhere; that the manuscript has been approved by all authors, and all authors have met the requirements for authorship.

**ABSTRACT**

**Background:** COVID-19 is an ongoing health concern that hospitals have struggled to keep up with, given its increasing burden with the passage of time. Considerations for the management of COVID-19 should be made especially for pregnant patients and their neonates.

**Objectives:** To determine COVID-19 prevalence and the clinical profile of mothers admitted for childbirth at Chinese General Hospital and Medical Center from May 2020 to July 2020. The profile and outcomes of neonates born to these mothers were likewise studied.

**Materials and Method:** A descriptive cross-sectional study was done that included mothers admitted for childbirth who had SARS-CoV-2 RT PCR swab test and their neonates. A total of 408 medical records of mother and neonate dyads were reviewed. Relevant variables such as the patients' demographic profile, clinical characteristics, co-morbidities and the maternal and neonatal outcomes were obtained. Frequency distributions were made to assess the prevalence of COVID-19 among the patients, as well as maternal and neonatal outcomes.

**Results:** Twenty-two (5.39%) mothers tested positive for COVID-19, while all neonates (n = 22) that underwent RT-PCR swab at the 24<sup>th</sup> hour of life had negative results. Of the 22 COVID-19 positive mothers, 2 (9.09%) were symptomatic upon admission while 20 (90.09%) were asymptomatic. The following were the key trends among those mothers who tested positive for COVID-19: (1) 81.82% were from ages 20-39 years old, (2) 72.73% were multigravida mothers, (3) 54.55% had normal spontaneous delivery, (4) diabetes mellitus was the only noted comorbidity. Key findings on the neonatal outcomes observed in the study population of both COVID-19 positive and negative cases, include: (1) majority of neonates had an APGAR score of greater than 7 at 1<sup>st</sup> and 5<sup>th</sup> minute of life; (2) higher frequency of neonates with Ballard's score of more than 37 weeks AOG; (3) more male neonates as compared to female neonates; (4) a normal birth weight for majority of cases; (5) 45.45% of neonates born to COVID positive mothers had a length of stay of <48 hours as compared to 72.8% of neonates born to COVID negative mothers; and (6) neonatal pneumonia as the most common comorbid condition in both cases.

**Conclusion:** This study noted a prevalence of 5.39% COVID-19 positive mothers. SARS-CoV-2 virus was not detected in all of the neonates born to COVID-19 affected mothers. Neonates delivered to COVID-19 positive mothers had similar trends in the neonatal outcomes when compared to neonates delivered to mother who were COVID-19 negative.

**KEYWORDS:** *COVID-19, Neonatal Outcomes, Maternal Outcomes, COVID-19 Pregnant Women*

## INTRODUCTION

On December 31, 2019, a pneumonia case with an unknown etiology was discovered in Wuhan, China, and was reported to the WHO Country Office in China. Then known as the novel coronavirus (nCOV), an increase in the cases of this coronavirus prompted the WHO to declare this outbreak a Public Health Emergency of International Concern on January 30, 2020. Furthermore, the disease was finally named as COVID-19 on February 11, 2020. In the Philippines, there has been a total of approximately 1 million cases recorded as of April 2021, of which, approximately 70,000 are active cases, 925,000 have recovered from the disease and approximately 17,000 deaths were recorded.<sup>1</sup> Of the 1 million COVID-19 positive cases, there has been approximately 95,000 recorded cases among the pediatric population. Since the recording of the first case in the country in January 30, 2020, the government has imposed community quarantine protocols akin to the lockdown protocols established by other countries in hopes to curb further spread of the virus. As of this time, these community quarantine protocols have been eased to accommodate the growth of a vital part of the Philippine economy, but the cases have not decreased.

There are some studies that reported on how COVID-19 presents in relatively vulnerable population group. A systematic review by de Rose et al. shows that cases in the pediatric population subgroup have been relatively few and seem to have a more favorable clinical course as compared with other age groups. It is further noted that there are a fewer cases reported in neonates. In the same study by de Rose et al, it has been cited that clinical features of COVID-19 in newborns and infants can be non-specific and may include acute respiratory distress syndrome, temperature instability, gastrointestinal, and cardiovascular dysfunction as some of its more common signs and symptoms.<sup>2</sup> None of the neonates included in the study population were reported to have severe complications. Zimmerman et al. had the same findings in that COVID-19 presents a milder disease

course in the pediatric population but suggests that children are similarly likely to develop infection as with the predisposition in adults. There were some data in the study that pertained to mothers being admitted to the intensive care unit for contracting COVID-19 during their pregnancy, and a subset of data also reported that there were neonatal complications of COVID-19 infection. Maternal complications described in the study by Zimmerman et al. include premature rupture of membranes, pre-eclampsia, gestational hypertension, and gestational diabetes while neonatal complications described were respiratory distress or pneumonia, low birth weight, disseminated intravascular coagulation, asphyxia and perinatal death.<sup>3</sup>

Although the primary focus has been on vulnerable groups, particularly the elderly and individuals with underlying medical conditions, pregnant women and newborns are also at higher risk for COVID-19 complications. To date, there were several studies on the clinical features of COVID-19 in the pediatric and neonatal population. A local study by Po described the outcomes of infants born to mothers with SARS-CoV-2 Infection in a public tertiary hospital that included 47 neonates. Among the 47 neonates, 72.3% neonates had no symptoms and were sent home immediately with a reliable caregiver while 27.7% were symptomatic and the predominant causes were feeding intolerance, neonatal pneumonia and transient tachypnea of the newborn.<sup>4</sup>

However, there is still limited data published in the Philippine setting, hence there is a need for these data in the local setting so that there will be a deeper understanding of the COVID-19 situation in the country, as well as to determine features that will help a pediatrician conduct evidence-based decision making for an accurate and sound treatment for a vulnerable population group for this disease. This study aims to determine COVID-19 prevalence among mothers admitted for childbirth and their neonates, clinical profile of mothers admitted for childbirth and the outcomes of neonates delivered at Chinese General Hospital and Medical Center from May 2020 to July 2020.

Specifically, it aims to describe the mothers admitted for childbirth in terms of: age; parity; mode of delivery; presence of maternal comorbidities, presence of COVID symptoms, SARS-CoV-2 RT-PCR swab result and to determine the clinical profile and outcomes of neonates delivered in terms of: APGAR Score; gender; birth weight; Ballard's Score; SARS-CoV-2 RT PCR Swab Result; length of stay and neonatal morbidity.

## MATERIALS AND METHODS

### Study Design: Descriptive Cross-Sectional Design

Chinese General Hospital (CGH) is a 600-bed capacity private tertiary hospital located in Manila and is delegated by the national government to be one of the healthcare facilities to provide COVID-19 diagnostic and admission services.

**Study Population:** Mothers admitted for childbirth and neonates delivered at Chinese General Hospital and Medical Center from May 2020 to July 2020

### Inclusion Criteria:

- All mothers who were considered Non-COVID, COVID Suspect, COVID Probable or COVID Positive admitted for childbirth who underwent COVID-19 RT PCR swab test.
- All neonates delivered whose mother underwent COVID-19 RT PCR swab test

### Exclusion Criteria:

- Mothers with RT-PCR not done at Chinese General Hospital
- Mothers with invalid or indeterminate RT-PCR results
- Mothers and neonates with incomplete charts

**Sample size:** Based on the total number of mothers admitted for childbirth from May 2020 to July 2020 of 416 patients, with a confidence limit of 5%, a confidence interval of 95%, and hypothesized frequency of outcome factor of 50%, the sample size computed for this study is 200.

**Data Collection Methods:** Medical records from May 2020 to July 2020 of all mothers admitted for childbirth and all neonates delivered were obtained and reviewed. Data were collected by the researcher

using a data collection form. The following data were obtained from the medical records:

- I. Maternal Data: age of mother, gravida, mode of delivery, maternal comorbidity, presence of COVID symptoms, SARS-CoV-2 RT-PCR test result
- II. Neonatal Data: APGAR score, gender, Ballard's score, birthweight, length of stay, SARS-CoV-2 RT-PCR test result, neonatal morbidity

**Statistical Analysis:** For the analysis of data, SPSS version 25 was used. As a statistical software, this generated the frequency distributions of the different variables pertaining to the clinical profile and neonatal outcomes of the study population. The prevalence of COVID-19 from this study population was also calculated by this software. Microsoft Excel was used to form graphs of the result.

**Ethical Considerations:** The protocol of this study adhered to the ethical consideration and ethical principles set out in relevant guidelines, including the Declaration of Helsinki, WHO guidelines, International Conference on Harmonization-Good Clinical Practice, Data Privacy Act of 2012, and National Ethics Guidelines for Health Research.

*Data Safety, Privacy, and Confidentiality.* Subject information was kept confidential. All identifiable information and data was given a code number. A master list linking the code number and subject identity was kept separately from the research data. The investigator and all key personnel have completed the Good Clinical Practice (GCP) training on the responsible conduct of research with human data. Pursuant to the Data Privacy Act of 2012, the gathering, storage, and eventual disposal of the data used in this study will minimize, if not eliminate, any risk for the revelation of any personal information pertaining to the patient records that was retrieved. Necessary procedures for the procurement of informed consent from the patients were also observed, though it was not necessary since the study only involved the review of medical records. Nonetheless, this study fully complied with any additional measure the ethics review committee gave regarding the

ethical conduct of this study and its relevant data collection procedures.

The study commenced upon the approval of the Research Ethics Review Board of Chinese General Hospital and Medical Center. As the RERB gave the period of ethical clearance of the study, the proponent saw to it that the study protocol and all its related procedures was done before the expiry date of the ethical clearance given to the study, and filed the necessary documentation to the RERB once the study has ended. The authors of this study certify that they have no affiliations with or involvement in any organization or entity with any financial interest, or non-financial interest in the subject matter or materials discussed in this study.

## RESULTS

From May to July 2020, a total of 416 pregnant mothers were admitted for childbirth at the study site, 8 mothers did not undergo RT-PCR swab test hence a total of 408 records of mothers and neonates were included. 22 out of the 408 mothers tested positive in the RT-PCR test, resulting in a COVID-19 prevalence of 5.39% in the study population. The 22 neonates born to COVID-19 positive mothers were tested with COVID-19 RT-PCR at 24<sup>th</sup> hour of life and all 22 neonates had negative results. Table 1 shows the clinical profile of the mothers admitted for childbirth. The following key trends among those mothers who tested positive for COVID-19 in the study population were seen: (1) a more notable frequency of cases from 20-39 years (81.82% of all COVID-19 positive mothers); (2) a higher frequency of multigravida mothers (72.73%) as compared to primigravida mothers (27.27%); (3) a slightly higher frequency of patients underwent normal spontaneous delivery (54.55%); and (4) diabetes being the only noted comorbidity.

For the COVID-19 negative mothers, almost the same trends were observed, though the counts are higher in terms of the comorbidities recorded by these patients. Urinary Tract Infection (10.36%) was the most frequent comorbid condition recorded among COVID-19 negative mothers, followed by hypertension (8.55%), and diabetes (7.51%).

Table 1: Profile of Mothers Admitted for Childbirth at CGH from May 2020-July 2020 as to SARS-CoV-2 RT PCR test result (N=408)

Clinical Parameters	SARS-CoV-2 PCR Result of Mother			
	Positive (n= 22)	%	Negative (n= 386)	%
<b>Mother's Age (years)</b>				
15-19	0	0	9	2.33
20-24	4	18.18	39	10.10
25-29	6	27.27	119	30.83
30-34	5	22.73	122	31.61
35-39	7	31.82	77	19.95
40-44	0	0	19	4.92
>44	0	0	1	0.26
<b>Gravida</b>				
Primigravid	6	27.27	157	40.67
Multigravid	16	72.73	229	59.33
<b>Mode of Delivery</b>				
Normal Spontaneous Delivery	12	54.55	185	47.93
Cesarean Delivery	10	45.45	201	52.07
<b>Maternal Comorbidity</b>				
Hypertension	0	0	33	8.55
Diabetes	1	4.55	29	7.51
Cardiovascular Disease	0	0	2	0.52
Thyroid Disorders	0	0	9	2.33
Urinary Tract Infection	0	0	40	10.36
Upper Respiratory Tract Infection	0	0	4	1.04
Bronchial Asthma	0	0	10	2.59
*Others	0	0	9	2.33

*\*Other Maternal Comorbidities: Acute Gastroenteritis, Bell's Palsy, Rubella Infection, Gingivitis, Vaginitis, Antiphospholipid Antibody Syndrome, Hyperemesis Gravidarum, Autoimmune Urticaria*

Key findings on the neonatal outcomes and variables observed in the study population of both COVID-19 positive and negative mothers, include: (1) majority of neonates had an APGAR score of greater than 7 at 1<sup>st</sup> and 5<sup>th</sup> minute of life; (2) higher frequency of neonates with Ballard’s score of more than 37 weeks AOG; (3) more male neonates as compared to female neonates; (4) a normal birth weight for majority of cases; (5) 45.45% of neonates born to COVID positive mothers had a length of stay of <48 hours as compared to 72.8% of neonates born to COVID negative mothers; and (6) neonatal pneumonia was the most common comorbid condition in both cases. However, the trend is slightly different for the second most commonly reported comorbid condition-prematurity for COVID-19 positive mothers (18.18%), and neonatal sepsis for COVID-19 negative mothers (13.21%).

Table 2: Clinico-demographic Profile and Outcomes of Neonates Born to Mothers that Delivered at CGH from May 2020-July 2020 as to Mother’s SARS-CoV-2 PCR Test Results (N=408)

Clinical Parameters	SARS-CoV-2 RT PCR Result of Mother			
	Positive (n=22)	%	Negative (n= 386)	%
<b>APGAR Score</b>				
> 7 at 1 <sup>st</sup> minute of life	22	100	370	95.85
<7 at 5 <sup>th</sup> minute of life	22	100	383	99.22
<b>Ballard’s Score</b>				
< 37 weeks AOG	4	18.18	24	6.22
> 37 weeks AOG	18	81.82	362	93.78
<b>Gender</b>				
Male	15	68.18	210	54.4
Female	7	31.82	176	45.6
<b>Birthweight (grams)</b>				
<2500	5	22.73	38	9.84
2500-3499	17	77.27	297	76.94
3500 and more	0	0	51	13.21
<b>Neonatal SARS-CoV-2 RT-PCR Swab Result</b>				
Positive	0	0	Not tested	Not tested
Negative	22	100	Not tested	Not tested

<b>Length of Stay</b>				
<48 hours	10	45.45	281	72.8
>48 hours	12	54.54	105	27.2
<b>Neonatal Morbidity</b>				
Neonatal Pneumonia	10	45.45	63	16.32
Respiratory Distress Syndrome	0	0	3	0.78
Prematurity	4	18.18	24	6.22
Neonatal Sepsis	3	13.64	51	13.21
Neonatal Jaundice	2	9.09	14	3.63
Congenital Heart Disease	0	0	3	0.78
**Others	0	0	2	0.52
<b>Neonatal Mortality</b>	0	0	1	0.26

\*\*Others: Persistent Pulmonary Hypertension, Spina Bifida

The prevalence of asymptomatic COVID-19 positive mothers was 90.91% (20/22 mothers) compared to symptomatic positive mothers at 9.09% (2/22 mothers) among all mothers who tested positive for COVID-19 infection. The overall prevalence of positive test result among asymptomatic patients was 5.1% (20/392 asymptomatic mothers) as compared to the prevalence of positive test among symptomatic patients at 33% (2/6 symptomatic mothers). See Table 3. No asymptomatic mother who tested negative developed further symptoms or required further testing during their hospital stay.

Table 3: SARS-CoV-2 RT-PCR Results of Mothers Admitted for Childbirth, Stratified as to the Presence of COVID Symptoms (N=408)

Screening Characteristic	SARS-CoV-2 PCR Result	Mothers screened (n = 408)	
		Total	%
Asymptomatic Mothers on Admission	Positive	20	5.1%
	Negative	382	94.9%
Symptomatic Mothers on Admission	Positive	2	33%
	Negative	4	73%

## DISCUSSION

The study findings revealed a wealth of data on the maternal and neonatal outcomes of mothers and neonates who were screened for COVID-19. The prevalence of COVID-19 among pregnant females noted in this study is 5.39% which is lower than the reported prevalence in New York City, USA, which had a prevalence of COVID-19 positive pregnant patients at 38%.<sup>5</sup>

This study also did not record any neonatal COVID-19 infection in the study population, in contrast to findings by Patil et al. where out of the 45 neonates that they tested for COVID-19 using RT-PCR swab, 42 neonates tested negative while 3 neonates tested positive.<sup>5</sup> In their study, RT-PCR nasopharyngeal swab were done after birth following their first bath. The 3 neonates who tested positive were monitored in their NICU, until 2 consecutive tests obtained at least 24 hours apart were negative and all of them remained asymptomatic, thus suggesting transient colonization. A systematic review and meta-analysis of 27 studies conducted last July 2020 by Dubey et al. also noted a low prevalence of COVID-19 infected neonates at only 1%, noting a rare transmission of infection to babies from mothers, although, more research is needed to examine the long-term outcomes of maternal infection and its interactions with neonates born to COVID-19 positive mothers.<sup>6</sup> Another study published last July 2020 by Salvatore et al. studied 120 neonates delivered to COVID-19 positive mothers.<sup>7</sup> Of the 120 neonates, all tested negative for SARS-CoV-2 by RT PCR nasopharyngeal swabs taken at 24 hours, 5-7 days and 14 days of life. These findings are the same with the results shown in our study although we only tested the neonates once at 24<sup>th</sup> hour of life. In contrast to a systematic review done last March 2020 by Chi et al. where they noted that 8.8% of the tested neonates were positive for SARS-CoV-2, indicating that the risk of vertical transmission should be considered.<sup>8</sup> The same literature reported that 8 out of the 14 studies included found no evidence of vertical transmission and could not detect the virus in amniotic fluid, cord blood, breast milk, serum, feces, placenta,

nasopharyngeal, rectal or vaginal swabs of neonates that were tested. Wang et al. also reported that there was no positive RT-PCR result in neonate specimens obtained within 24 hours post-birth, implying no virologic evidence for congenital infection.<sup>9</sup> However, the serologic characteristics of infants reported showed 3 neonates with elevated IgM antibodies to SARS-CoV-2 born to mothers with COVID-19, suggesting a possible vertical transmission of SARS-CoV-2 from mother to newborn. They suggested that this inconsistency may be due to the disruption of the placenta or amniotic barrier caused by the inflammatory mediators from mothers that, induced by SARS-CoV-2, facilitates the transfer of IgG and IgM. Virologic evidence for supporting the in-utero transmission should be diagnosed based on RT-PCR test results of the samples from neonates but not IgM detection due to a high incidence of false-positive and false negative results. Further studies are warranted to draw a definite conclusion as to the transmission of infection from mothers to neonates.

Most of the COVID-19 positive mothers in our study population were between the ages of 20-39 (cumulative prevalence of 81.82%). A retrospective study done by Ayed et al. reported a maternal median age of 31 years old, with an age range of 22-40 years old for those diagnosed with COVID-19. Besides this being the noted age where most pregnancies occur, this is also the reported age by WHO where most COVID-19 cases occur.<sup>1,10</sup> These age groups are the most common members of the workforce, and being required or necessitated to be out of their homes for work signifies that they will be exposed more significantly to the virus as compared to the other age ranges. Studies done by Dubey et al., Chi et al. and Chamseddine et al. noted a higher rate of cesarean section among mothers who were COVID-19 positive, in contrast to our study where 54.55% of COVID-19 positive mothers had vaginal delivery.<sup>6,8,11</sup>

This study reported a prevalence of asymptomatic COVID-19 positive mothers at 90.09%, which supports the findings of Patil et al. where they noted that the majority of the SARS-CoV-2 positive

mothers (n = 27, 60%), were asymptomatic.<sup>5</sup> This was also similar to the study of Wang et al. where universal SARS-CoV-2 screening for women admitted for delivery found that all women with positive test results were asymptomatic at the time of testing.<sup>9</sup> The same study also noted that the clinical characteristics of COVID-19 infection in pregnancy were similar to those reported for non-pregnant adults with COVID-19 infection. In brief, Wang et al. reported the typical symptoms in positive pregnant women, includes fever, cough, myalgia, malaise and sore throat, and none of them developed severe COVID-19 pneumonia or died.<sup>9</sup> Salvatore et al. also noted 18 of the 22 mothers who were symptomatic within 7 days of delivery, that 18 (82%) had cough, 9 of whom also reported a fever.<sup>7</sup> These findings were similar to our study wherein 2 out of the 22 COVID-19 positive mothers presented with mild symptoms, both had cough as a presenting symptom upon admission.

One of the COVID-19 positive mothers had diabetes as comorbidity. According to one systematic review and meta-analysis by Allotey et al. that determined clinical manifestations, risk factors, and maternal and perinatal outcomes of COVID-19, they reported that maternal risk factors associated with severe COVID-19 were increasing age, high body mass index, chronic hypertension and pre-existing diabetes, which are known risk factors in the general population.<sup>12</sup> In another systematic review by Chamseddine et al., they also noted that the rates of gestational diabetes, hypertensive disorders of pregnancy and pre-eclampsia did not appear to be higher in pregnant women with COVID-19 compared to pregnant women without.<sup>11</sup> Fortunately, the mother in our study did not develop any complications of COVID 19.

Although this study did not report any COVID-19 infection among the neonates included, it is still important to know the neonatal outcomes of neonates born to COVID-19 positive mothers. All of our neonates born to COVID-19 positive mothers had an APGAR Score of >7 at their 1<sup>st</sup> and 5<sup>th</sup> minute of life, which is similar to the findings of the systematic review by Juan et al. that reported an

APGAR score of 7 to 10 at 1<sup>st</sup> and 5<sup>th</sup> minute of life of neonates born to COVID-19 positive mothers.<sup>13</sup> Ayed et al. and Chamseddine et al. noted a prevalence of 35.3% (71/201 neonates) and 26.8% of preterm delivery, whereas, our study reported a prevalence of 18.18% of preterm delivery, however, those studies were not consistently clear whether early delivery was induced in light of obstetric complications or maternal SARS-CoV-2 infection.<sup>10,11</sup> Majority of the neonates in this study had a normal birth weight (77.27%), which is the same with other published literatures.<sup>7,10</sup>

This study showed that 45.45% (10/22) of neonates born to COVID-19 positive mothers were symptomatic at birth (presenting with tachypnea, subcostal retractions) and were treated as cases of neonatal pneumonia. All 10 neonates tested negative for SARS-CoV-2 using RT-PCR at 24<sup>th</sup> hour of life, chest x-ray showed signs of pneumonia, most required oxygen supplementation via nasal cannula or oxygen hood, and none required mechanical ventilation. Unfortunately, this population only had one swab done. 54.54% of neonates in this study required to be admitted for >48 hours in the isolation area/NICU for further management of comorbidities, but more importantly all neonates were eventually discharged improved. For the most part, some of the findings in this study were similar to those already reviewed in literature, including the presentation of neonatal pneumonia as a comorbid condition in 45.45% of neonates in this study and 26.5% in the study by Yoon et al.<sup>14</sup> The same study also reported other neonatal morbidities such as low birth weight (15.65%), small for gestational age (8.3%), respiratory distress syndrome (6.4%). However, all reported cases were discharged healthy or were still hospitalized in stable condition. A study by Flaherman et al. which included 263 neonates reported that adverse outcome, including preterm birth, NICU admission, and respiratory disease, did not differ between those born to mothers testing positive for SARS-CoV-2 and those born to mothers testing negative.<sup>15</sup>

## CONCLUSION

In conclusion, this study noted a prevalence of 5.39% COVID-19 positive mothers in the study population. From the study findings, it could be observed that pregnant patients with COVID-19 display similar trends in the clinical features and maternal outcomes as with those who do not have the infection. SARS-CoV-2 virus was not detected in all of the neonates born to COVID-19 affected mothers. This study also noted that the neonates delivered to COVID-19 positive mothers had similar trends in the neonatal outcomes when compared to neonates delivered to mother who were COVID-19 negative. Mothers and care givers should be taught on proper isolation precautions, safe distancing, personal protective equipment use, safe breastfeeding and pumping of breastmilk to reduce the risk of transmission of COVID-19 to the newborn.

## RECOMMENDATIONS

This study has several limitations. Since the study is a retrospective chart review, we were not able to follow up the patients after discharge to assess the mother and child for their well-being, presence of symptoms or any repeat testing done. A larger sample size and a follow up period with repeat testing might be needed to confirm that perinatal transmission is unlikely to occur if correct protective strategies are used. Further studies that would explore which maternal variables and neonatal outcomes that may be significantly associated with the risk of COVID-19 infection, which would then enable the determination of any significant predictors from these factors. This would greatly help clinical practice in the treatment and management of COVID-19 cases especially in this population and would also be a significant contribution to experts in the field of epidemiology, to be able to formulate preventive strategies based on any significant predictors that may be noted in future studies.

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