

Type of article: Scoping Review



Neonatal Outcomes in Children of Mother's infected with COVID-19 during pregnancy: A Scoping Review

Running Title: Neonatal Outcomes of COVID 19 infection of mother during pregnancy

Contributors

1. Dia Ghoshal

Intern, Manav Rachna Dental College School of Dental Sciences, MRIIRS, Faridabad, India.

Email: diaghoshal8@gmail.com

2. Divya Singh Chauhan

Intern, Manav Rachna Dental College School of Dental Sciences, MRIIRS, Faridabad, India.

Email: dscsinghchauhan@gmail.com

3. Arti Devi

Intern, Manav Rachna Dental College School of Dental Sciences, MRIIRS, Faridabad, India.

Email: yadav.aarti199903@gmail.com

4. Diksha Bhardwaj,

Intern, Manav Rachna Dental College, School of Dental Sciences, MRIIRS, Faridabad, India.

Email: dikshabhardwaj007@gmail.com

5. Dr. Meena Jain,

Professor and Head, Department of Public Health Dentistry and Research & Innovation catalyst, Manav Rachna Dental College, School of Dental Sciences, MRIIRS, Faridabad, India.

Email- drmeenabansal@gmail.com

6. Dr. Roomani Srivastava

Assistant professor Manav Rachna Dental College, School of Dental Sciences, MRIIRS, Faridabad, India

Email- dr.roomani@gmail.com

Corresponding Author

Corresponding address

Dr. Meena Jain

Professor & Head, Department of Public Health Dentistry, Manav Rachna Dental College, Sector – 43, Delhi, Suraj Kund Badkhal Rd, Faridabad, Haryana 121004

Phone: +91997029492

Email: drmeenabansal@gmail.com

ABSTRACT

Objective: This scoping review aims to review the existing literature to determine neonatal outcomes in children born to mothers who were infected with SARS-CoV-2 during pregnancy.

Introduction: The COVID-19 pandemic has drastically affected humans all across the world with certain groups such as women and elderly being affected more than the general population. This scoping review explores the effects on neonates born to females who got infected with COVID-19 during pregnancy. During the pandemic, pregnant females had an increased risk of getting infected with COVID-19 since majority of hospitals were packed with COVID-19 patients. Also, a number of countries had ambiguous policies on regarding vaccination of pregnant women. This review article is based on data collected from other articles that studied pregnant females that got infected, their symptoms, complications of the same as well as the neonates born to them, their APGAR scores, any COVID-19 symptoms seen, NICU admissions etc.

Inclusion Criteria: All articles exploring neonatal outcomes of COVID 19 infection in Pregnant mothers were included in the study. Thus, the participants were pregnant women with COVID 19 infection. The concept being explored was neonatal outcomes in the context of COVID-19 affected females during their period of pregnancy.

Method: Literature search was performed on databases such as PubMed, EMBASE and MEDLINE. Relevant keywords were used with appropriate Boolean markers. The period of search was from 1st August 2022 till 31st December 2022. No time filter was considered in this literature search. There was no language limitation. On the basis of the inclusion criteria, data was collected from several articles and was tabulated describing study characteristics. The final data from these tables gives us the prevalence of complications in females and their neonates.

Results: According to the data collected on the pregnant females, majority of the females had given birth vaginally. And most of the infected pregnant females were asymptomatic. Out of the symptomatic pregnant females, fever was the most common symptom. Majority of neonates had normal APGAR scores. Perinatal symptoms/ complications were seen in nearly one-fifth of the neonates born to females infected with COVID-19 during pregnancy. 21.60% of neonates did show the transfer of antibodies or vertical transmission of COVID-19 infection. This does prove how a significant number of neonates get effected by the presence of COVID-19 infection in their mothers during gestation.

Conclusion: COVID-19 Vaccination along with the booster dose regimens are essential for everyone including pregnant women. Lack of proper policy for COVID19 vaccination for pregnant women lead to morbidity and mortality among them their neonates in spite of this being completely preventable. In the future we do hope that there are proper schedules and regimes for all the doses of COVID-19 Vaccination for pregnant females all across the globe.

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Keywords: COVID 19, Neonatal Outcome, Pregnant Women, APGAR Score, Policy

INTRODUCTION

Infectious diseases have played an important role in causing debility ever since life came into being. From Black Death caused by Bubonic Plague to Spanish flu caused by Influenza, spread of infectious diseases to countries and across continents has occurred throughout history. In the current era, along with the existence of lifestyle diseases, cancers, mankind also has to deal with infectious diseases. With the COVID-19 pandemic being the most recent example of a pandemic caused by an infectious disease having a devastating effect all over the world with implications on the health sector, financial sector and on the society as a whole.

According to the World Health Organisation, Corona-virus disease (COVID-19) is an infectious disease caused by SARS-CoV-2 virus [1]. The virus infects the respiratory tract by inhalation of droplets generated by cough and sneezes of infected persons [1]. The severity of symptoms caused by SARS-CoV-2 can range from none (the infected person being asymptomatic) to having runny nose, fever, sore throat, shortness of breath, pneumonia, and sometimes even death [1].

Majority of people infected by this virus show mild to moderate symptoms and recover without requiring any special treatment. However, in a few cases involving people having systemic diseases like diabetes, persons on immune-suppressants, etc may develop serious illness and require urgent medical assistance [1].

The SARS-CoV-2 pandemic is believed to have started on 12 December 2019 where a cluster of patients in the city of Wuhan, Hubei Province in China began to experience symptoms of an atypical pneumonia like illness. On 10 January 2020 the WHO announces that the outbreak in Wuhan, China is caused by the 2019 Novel Corona-virus (2019-nCoV) [2].

The WHO on 11 March 2020 declared the novel corona-virus (COVID-19) outbreak a global pandemic [3].

According to WHO, a confirmed case of SARS-CoV-2 infection is defined as -

A. A person with a positive Nucleic Acid Amplification Test (NAAT), regardless of clinical criteria OR epidemiological criteria [4].

B. A person meeting clinical criteria AND/OR Epidemiological criteria (suspect case A) with a positive professional use or self-test SARS-CoV-2 Antigen-RDT [4].

Clinical criteria:

- Acute onset of fever AND cough (ILI) [4].

OR

- Acute onset of **ANY THREE OR MORE** of the following signs or symptoms: fever, cough, general weakness / fatigue, headache, myalgia, sore throat, coryza, dyspnoea, nausea / diarrhoea / anorexia [4].

Epidemiological criteria:

- Contact of a probable or confirmed case, or linked to a **COVID-19 cluster** [4].

According to WHO the total death toll due to COVID-19 up to 27 August 2022 in the WHO Regions include one hundred seventy four thousand two hundred and forty two deaths in Africa to two million eight hundred twelve thousand five hundred fourteen deaths in Americas [5]. The deaths caused in South-East Asia include seven hundred ninety five thousand ninety six deaths [5].

Rationale

According to Worldometer, as of 28 October, 2022 the total number of people affected by SARS-CoV-2 was 634,610,959 [6].

This number also includes many pregnant females with pregnancy itself being a sensitive period in which both the mother and the foetus are vulnerable. The COVID-19 pandemic was a very critical period for majority of pregnant females. During the pandemic the number of C-sections, complications during pregnancy, and ICU admissions had also increased ^[7] with pregnant women having 5 times higher risk of being admitted to the ICU as compared to non-pregnant women [7].

To know the further effects of the SARS-CoV-2 infection on the neonates born to mothers who got infected with COVID-19 during pregnancy, the transfer of the infection including the placental transmission of antibodies and the perinatal implications of it. This scoping review aims to look into the same and check for the after-effects caused by COVID-19 infection on neonates born to females infected during pregnancy.

REVIEW QUESTION

This scoping review was conducted to know the further effects of COVID-19 on the neonates born to females infected with SARS-CoV-2 during pregnancy, APGAR Score, NICU Admission, Number of children that died during 24 hours of birth, Transfer of antibodies or vertical transmission of COVID-19 infection, Perinatal symptoms/complications born to females infected to COVID-19 during pregnancy (fever, respiratory distress, placental abruption, intrauterine growth restriction, pneumonia).

INCLUSION CRITERIA

Out of the total articles studied females with the following traits have been selected. The females who had not been previously infected with COVID 19 were included.

Participants: The population considered for this study were the females who were infected with COVID-19 during pregnancy.

Concept: The concept of this article was the effects seen on the neonates, be it through vertical transmission, born to females who were infected with COVID-19 during pregnancy.

Context: The context of this article was COVID-19 that had affected the females during their period of pregnancy.

Types of sources: This scoping review considered 21 articles for inclusion, out of which 13 were retrospective studies and 8 were prospective studies.

METHODS

This scoping review was conducted in accordance with JBI methodology [8] for scoping reviews and in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) [9]. This review was conducted in accordance with an a priori protocol [10].

Literature search-

We carried out a thorough search in multiple databases including PubMed , Google Scholar, and WHO COVID 19 database using the following keywords : (SARS-CoV-2) OR (COVID-19) AND (Pregnan*) OR (Pregnant) OR (Pregnancy) OR (Neonat*) OR (Neonate) OR (Neonates) . The search took place in August 2022.

The literature search was divided amongst all 4 authors. And together they found 2071 articles from 1st August 2022 to 31st December 2022.

Selection criteria:

We searched for studies which investigated the potential effects of COVID-19 on neonates and the vertical transmission of SARS-CoV-2, if any. Original articles published in English and one in Spanish were taken into consideration if they included females who contacted COVID-19 infection during pregnancy irrespective of the trimester they were in.

Eligibility criteria:

Out of the total articles studied females with the following traits have been selected. The females who had not been previously infected with COVID 19 were included. The population considered for this study were the females who were infected with COVID-19 during pregnancy. The concept of this article was the effects seen on the neonates, be it through vertical transmission, born to females who were infected with COVID-19 during pregnancy. The context of this article was COVID-19 that had affected the females during their period of pregnancy. Types of sources- This scoping review considered 21 articles for inclusion, out of which 13 were retrospective studies and 8 were prospective studies.

The exclusion criteria were studies where the pregnant female had a history of COVID 19 vaccination or had a history of COVID 19 infection. Articles were searched on scientific databases PubMed, Google Scholar, World Health Organization (WHO) COVID-19 databases, using the following keywords : (SARS-CoV-2) OR (COVID-19) AND (Pregnan*) OR (

Pregnant) OR (Pregnancy) OR (Neonat*) OR (Neonate) OR (Neonates). The results included 2071 articles. After removing duplicate articles, 1529 articles were left, which were screened. Out of these, 1433 articles were excluded, since they were either not related to the topic, or were not providing data on pregnant females having COVID-19 infection, or the neonatal outcomes, or they were review articles. Of the remaining 96 articles, their full texts were screened and only 21 articles were eligible for data extraction from primary search and additional searches.

Data analysis and presentation

The data that was extracted from the articles that were reviewed included specific details regarding the females that had COVID-19 during pregnancy and the effects that were seen in the neonates due to this SARS-CoV-2 infection.

From the data collected on females who got infected with COVID-19 during pregnancy, it was seen that majority of the females were asymptomatic. And out of all the COVID-19 symptoms seen in the symptomatic females, fever was the most common symptom (Table 2). According to the data collected on neonates born to females who had COVID-19 during pregnancy, majority of the neonates had normal APGAR scores. Nearly a quarter of the neonates had to be admitted to the NICU after birth. In a little more than one-fifth of neonates the transfer of antibodies or vertical transmission of COVID-19 Infection was seen. Perinatal symptoms/ complications were seen in nearly one-fifth of the neonates born to females infected with COVID-19 during pregnancy (Table 3).

RESULTS

Study inclusion:

The initial number of articles that all 4 authors researched and collected from different databases was 2071 and after removing the duplicate records, the number came to about 1529. The number of articles that were excluded was 1433 (Out of which 258 articles were not related to topic, 531 articles not providing data of pregnant females, 477 articles not providing data of neonatal outcomes, 167 were review articles). After the full texts of articles were screened for eligible articles reporting data on COVID-19 positive pregnant females and the neonatal outcomes of their pregnancies which brought down the number to 96 articles. Finally, after data extraction of eligible articles from primary search and additional searches, 21 articles were included.

Out of the 21 articles reviewed, 13 were retrospective studies and 8 were prospective studies [11-31].

Characteristics of included studies:

Table 1 describes the characteristics of the articles i.e. authors, date of publication, purpose of the study, study design, duration of study and the study setting.

Review findings:

Table 2 describes the maternal characteristics i.e. number of COVID-positive women included in the study, method of delivery (vaginal delivery or C-section), number of COVID-positive

pregnant females that died after birthing, COVID 19 symptoms seen in females during pregnancy (cough, fever, dyspnea, other symptoms) and the number of asymptomatic females.

Table 3 describes the neonatal characteristics i.e. number of children born, APGAR Scores (acceptable and abnormal scores), NICU admissions, number of children that died within 24 hours of birth, transfer of antibodies or vertical transmission of COVID-19 infection, perinatal symptoms/complications seen in neonates born to females infected with COVID-19 during pregnancy (fever, respiratory distress, placental abruption, intrauterine growth restriction, pneumonia) and other symptoms.

According to the data collected on females who had COVID-19 Infection during pregnancy, 4.76% females had died after birthing. 32.15% of females had cough, 32.77% females had fever, 11.58% females had dyspnea as a symptom. 24.89% of females had other COVID symptoms. 64.56% of females were asymptomatic (Table 2).

According to the data collected on neonates born to females who had COVID-19 during pregnancy, 99.13% had acceptable APGAR scores, 0.86% of neonates had abnormal APGAR score. 25.28% of neonates were admitted to NICU. 1.91% of neonates had died within 24 hours of birth. In 21.60% of neonates, the transfer of antibodies or vertical transmission of COVID-19 infection was seen. 0.46% of neonates had fever, 4.71% had respiratory distress, 2.27% had placental abruption, 2.27% had intrauterine growth restriction, 0.88% had pneumonia, 9.94% had other symptoms (Table 3).

The results of this review suggest that a little more than a fifth of the neonates born to females who got infected with COVID-19 during pregnancy show the transfer of antibodies or the vertical transmission of COVID-19 infection.

DISCUSSION

During the peak of the pandemic, pregnant females in India were not allowed to get themselves vaccinated against COVID-19 [32]. However, with time it became evident that the benefits of vaccination outweighs its potential risks. Eventually, commencing from July 2021 pregnant females in India became eligible for COVID-19 vaccination during gestation [32].

The pregnant female is provided with information about the risks, the benefits, the side effects of COVID-19 vaccines as well as the types of vaccines available, so that she can make an informed decision regarding getting herself vaccinated [33].

In the US, vaccination against COVID-19 infection was available for pregnant females. It was optional for pregnant females to avail it during gestation. In the UK it is highly advised that the pregnant females get themselves vaccinated. It is not compulsory, but a choice. 1st, 2nd and booster doses are recommended in pregnancy ^[34]. The Joint Committee on Vaccination and Immunization on 16th December 2021 said that within the vaccination program of COVID-19, pregnant females are considered a 'vulnerable' group and it was emphasized that the COVID-19 vaccination should be done on an urgent basis [34].

The booster dose would help reduce the chances of admission of pregnant females to hospitals with COVID-19 infection [35]. Over 250,000 females in the UK were vaccinated before giving birth, mainly with Moderna and Pfizer vaccines [35]. The safety profile of these vaccines is good in pregnant females and their neonates. There is no live virus in the COVID-19 vaccine and therefore it does not infect a pregnant female or her foetus [35].

In Australia, pregnant females are allowed to take the vaccinations against COVID-19 as well as the booster dose [36]. Along with that, pregnant females between 30 to 50 years of age have the option to receive an additional dose aka a fourth dose of COVID-19 vaccination after a discussion with their general practitioner, to see if it is right for their individual health needs [36]. Continued surveillance and reporting are critical to ascertain whether maternal mortality and morbidity have increased during the pandemic and which populations were affected most severely.

In this review article it was seen that the number of C-sections done in pregnant females with SARS-CoV-2 was very high even though till date there is no evidence that showed any relation of C-section to lowered risk of transmission of SARS-CoV-2 or improvement of maternal health.

One of the limitations of this scoping review article is that most of the articles that were included were in English and one was in Spanish. Another limitation of this study was that the number of articles included in this study was few i.e. the number of prospective, retrospective and comparison studies were limited.

While the short and medium-term consequences of the impacts of COVID-19 are emerging, the long-term consequences are currently not known, and need further careful research and documentation.

CONCLUSION

Based on the results of this scoping review, it has been seen that majority of the neonates born to females who had COVID-19 infection during pregnancy had normal APGAR scores. In nearly one-fifth of the neonates born to such females, perinatal symptoms/complications were seen. Nearly a quarter of the neonates were admitted to the NICU after birth. And in a little more than one-fifth of the neonates the transfer of antibodies or vertical transmission of COVID-19 infection was seen.

Implications for research:

Although there still are not any booster policies for pregnant females in India. It has been shown that booster vaccination during pregnancy protects both the pregnant person as well as the neonate [37]. In the future, we hope to see proper booster schedules, as well as COVID-19 vaccination schedules for pregnant females in India as well as other countries all over the world.

FUNDING:

No funding was received for this review.

CONFLICTS OF INTEREST:

The authors declare no conflict of interest.

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TABLE 1 : DESCRIPTION TABLE (Table 1 describes the characteristics of the articles i.e authors, date of publication, purpose of the study, study design, duration of study, study setting)

AUTHORS	DATE OF PUBLICATIONS	PURPOSE OF THE STUDY	STUDY DESIGN	DURATION OF STUDY	STUDY SETTING
Maryam Sadat Hosseini, Afsanah Hosseini et al.	31.05.2021	Evaluation of clinical outcomes of neonates born to mothers with Corona virus (COVID-19) in Shahid Beheshti hospitals	Case study	21.02.20 to 30.11.20	Hospitals of Shahid Beheshti University of Medical Sciences, Tehran, Iran ^[11] .
Dinesh Munian, Rituparna Das et al.	23 July 2021	To evaluate the Outcome of Neonates Born to COVID-Positive Women at 6 Months of Age	Case control studies	The data of SARS-CoV-2 positive status were collected for all neonates born to SARS-CoV-2 positive mothers during May to July 2020. Later on a follow-up data at 6 Months for Neonates	Medical College and Hospital, Kolkata, West Bengal, India ^[12] .

				Born to SARS-CoV-2 Positive Mothers	
S. Khan, L. Jun et al.	8 April 2020	To evaluate Association of COVID-19 with pregnancy outcomes in health-care workers and general women.	Case series study	25 January 2020 to 15 February 2020	Hubei general hospital (Renmin hospital), Hubei, China ^[13] .
Hui Zeng, Chen Xu, Junli Fan et al.	26 March 2020 (online)	To evaluate Antibodies in Infants Born to Mothers With COVID-19 Pneumonia	Retrospective study	16 February 2020 to 6 March 2020	ZhongnanHospital, Wuhan University, China ^[14] .
Mohsen A. A. Farghaly, Fernanda Kupferman, et al.	3 September 2020	To evaluate Characteristics of Newborns Born to SARS-CoV-2-Positive Mothers: A Retrospective Cohort Study	Retrospective Cohort Study	From March to May 2020	Performed at Brookdale Hospital Medical Center in New York City, New York, USA ^[15] .
Camille Daclin , Marie Carbonnel et al. .	25 March 2022 (published online)	To evaluate Impact of COVID-19 infection in pregnancy and neonates : A case control study .	Case control retrospective study	From March 2020 to February 2021	Obstetrical department of west Parisian area, France ^[16] .
Zahra Akbarian-Rad, Mohsen	03 June 2021	To evaluate short – term	A retrospect	From February	Ayatollah RohaniHospital

HaghshenasMojaveri et al.		outcomes (4 weeks postdischarge) and symptoms in neonates born to mothers infected with COVID-19 : A retrospective cohort study	ive cohort study.	10 to May 20 , 2020	,Babol, Iran ^[17] .
Yan-Ting Wu, Jun Liu , Jing-Jing Xu et al.	17 July 2020	To evaluate neonatal outcomes in 29 pregnant women with COVID-19 : A retrospective study	A retrospective study	From January 13 to March 10 , 2020	Renmin Hospital, Wuhan University, and Central Hospital of Wuhan, Tongji Medical College, Huazhong University of Science and Technology, China ^[18] .
Wei Liu, Hongbin Cheng et al.	6 September 2020 (Online)	To evaluate and Clinically Analyze Neonates Born to Mothers with or without COVID-19.	Retrospective study	17 January 2020 to 4 March 2020	Tongji Hospital and Huang Shi Maternal and child Healthcare Hospital, China ^[19] .
Anita Dileep, Sham ZainAlAbdin et al.	22 February 2022 (To evaluate and Investigate the association between severity of COVID - 19 infection during	Retrospective cohort study	January to December 2020	Women health clinics of Dubai hospital, Latifa hospital, and a Primary healthcare Clinic located in Dubai, UAE ^[20] .

		pregnancy and neonatal outcomes			
Luming Xu, Qianqian Yang et al.	28 April 2020	To evaluate the clinical presentations and outcomes of SARS-CoV-2 infected pneumonia in pregnant women and the health status of their neonates	Retrospective study	21 January 2020 to 9 February 2020	Wuhan Union Hospital, Wuhan, China ^[21] .
Huijun Chen, Juanjuan Guo, et al.	17 March 2020 (online)	To evaluate the Clinical characteristics and intrauterine vertical transmission potential of COVID-19 infection in nine pregnant women	Retrospective study	20 January 2020 to 31 January 2020	Zhongnan hospital of Wuhan University, China ^[22] .
Lu Zhang, Lan Dong et al.	08/07/2020	To evaluate the Severe acute respiratory syndrome coronavirus 2(SARS-CoV-2) infection during late pregnancy	Retrospective Cohort study	30/01/2020 to 1/03/2020	Renmin Hospital of Wuhan University, China ^[23] .
Dustin D. Flannery, Alvaro	July 2022	To evaluate perinatal	Prospective	March 2020 to	2 academic birth hospitals at

Zevallos Barboza et al.		Covid-19 maternal and neonatal outcomes at 2 academic birth hospitals.	observational study	March 2021	Philadelphia, Pennsylvania, USA ^[24] .
Dustin D. Flannery, Sigrid Gouma et al.	29/1/2021(online)	Assessment of Maternal and Neonatal Cord Blood SARS-CoV-2 Antibodies Placental Transfer Ratios	Cohort Study	9 April 2020 to 8 August 2020	Pennsylvania hospital in Philadelphia, Pennsylvania, USA ^[25] .
Dani Dumitriu, Ukachi N. Emeruwa, et al.	12/10/2020 (online)	To evaluate Outcomes of Neonates Born to Mothers With Severe Acute Respiratory Syndrome Coronavirus 2 Infection at a Large Medical Center in New York City	Cohort analysis	13 March 2020 to 24 April 2020	2 affiliate hospitals at a large academic medical center in New York, New York, USA ^[26] .
Lina Antoun, Nashwa El Taweel et al.	September 2020	To study Maternal COVID-19 infection, clinical characteristics, pregnancy, and neonatal outcome: A prospective cohort study	Prospective cohort study	February 2020 to April 2020	Large tertiary maternity unit within a university hospital ^[27] .

José Villar, Shabina Ariff, et. al.	22 April 2021 (online)	To evaluate the Maternal and Neonatal Morbidity and Mortality Among Pregnant Women With and Without COVID-19 Infection.	Cohort Study	From March to October 2020	Involved 43 institutions in 18 countries(Argentina, Brazil, Egypt, France, Ghana, India, Indonesia, Italy, Japan, Mexico, Nigeria, North Macedonia, Pakistan, Russia, Spain, Switzerland, UK, and the US) ^[28] .
Mikael Norman, Lars Navér et al.	29 April 2021 (Online)	To evaluate the Association of Maternal SARS-CoV-2 Infection in Pregnancy With Neonatal Outcomes.	Prospective Cohort Study	From 11 March 2020 to 31 January 2021.	Pregnant women in antenatal care received information regarding processing of personal data by the Swedish national quality registers with an option to opt out ^[29] .
Emily H. Adhikari, Wilmer Moreno, et al.	19 November 2020	To evaluate of Pregnancy Outcomes among Women With and Without Severe Acute Respiratory Syndrome Coronavirus 2 Infection	Observational Cohort study	18 March 2020 to 22 August 2020	Parkland Health and Hospital Systems, Dallas, Texas, USA ^[30] .
Wei Liu, Jing Wang et al.	13 April 2020 (Online)	To evaluate the Clinical characteristics of 19 neonates	Prospective Cohort	31 January 2020 to 29 February 2020	Tongji Hospital and Union Hospital West, Wuhan, China ^[31] .

		born to mothers with COVID-19.			
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TABLE 2 : MATERNAL TABLE (Table 2 describes the maternal characteristics i.e number of COVID positive women included in the study, method of delivery (vaginal or C-section), Number of COVID positive pregnant females that died after birthing, COVID 19 symptoms seen in females during pregnancy (cough, fever, dyspnea, other symptoms) and asymptomatic females)

Name of the authors	Number of Covid positive pregnant females included in the study	Method of delivery		Number of Covid positive pregnant female that died after birthing	COVID-19 symptoms seen in females during pregnancy				Asymptomatic
		Vaginal delivery	Cesarean delivery		Cough	Fever	Dyspnea	Other symptoms	
Maryam Sadat Hosseini, Afsanah Hosseini et al.	42	10	32	2	26	11	1	29	-
Dinesh Munian, Rituparna Das et al.	127	80	47	-	-	-	-	-	-
S. Khan, L. Jun et al	17	-	17	-	6	3	2	6	-
Hui Zeng, Chen Xu, Junli Fan	6	0	6	-	-	-	-	-	-
Mohsen A.	15	5	10	-	4	1	2	-	-

A. Farghaly, Fernanda Kupferman, et al									
Camille Daclin , Marie Carbonnel et al .	86	56	30	-	19	15	5		-
Zahra Akbarian-Rad, Mohsen Haghshenas Mojaveri et al.	-	-	-	-	-	23	-	-	-
Yan-Ting Wu, Jun Liu , Jing-Jing Xu et al.	29	2	27	-	9	8	-	6	15
Wei Liu, Hongbin Cheng et al.	15	1	14	-	6	10	-	1	-
Anita Dileep, Sham ZainAlAbdin et al.	200	-	-	-	-	-	-	53	147
Luming Xu, Qianqian Yang et al.	5	1	4	-	1	3	2	1	-
Hujin Chen, Juanjuan Guo, et al.	9	-	9	-	4	13	1	8	-
Lu Zhang, Lan Dong et	18	1	17	-	3	18	2	18	-

al									
Dustin D. Flannery, Alvaro Zevallos Barboza	209	150	59	-	-	-	-	-	167
Dustin D. Flannery, Sigrid Gouma et a	83	64	19	-	-	-	-	33	50
Dani Dumitriu, Ukachi N. Emeruwa, et al.	99	44	55	-	-	-	-	22	77
Lina Antoun, Nashwa El Taweel et al	19	3	16	-	-	-	-	-	-
José Villar, Shabina Ariff, et. Al	706	360	346	-	-	199	89	48	-
Mikael Norman, Lars Navér et al.	2286	1828	495	-	-	-	-	-	-
Emily H. Adhikari, Wilmer Moreno, et al.	252	174	72	-	-	-	-	145	107
Wei Liu, Jing Wang et al.	19	1	18	-	5	11	-	2	-
TOTAL	4242	2780	1293	2/42	83/255	315/961	104/898	372/1494	563/872

n(%)				2(4.7 6%)	82(32. 15%)	315(32. 77%)	104(11. 58%)	372(24. 89%)	563(64.5 6%)
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TABLE 3 : NEONATAL TABLE (Table 3 describes the neonatal characteristics i.e Number of children born, APGAR Score(acceptable and abnormal score), NICU Admission, Number of children that died during 24 hours of birth, Transfer of antibodies or vertical transmission of COVID-19 infection, Perinatal symptoms/complications born to females infected to COVID-19 during pregnancy(fever, respiratory distress, placental abruption, intrauterine growth restriction, pneumonia) other symptoms)

Name of the authors	Number of children born	APGAR Score		NICU admissions	Number of children that died within 24 hours of birth	Transfer of antibodies or the vertical transmission of COVID-19 infection	Perinatal symptoms/ complications seen in neonates born to females infected with COVID-19 during pregnancy					Other symptoms
		Acceptable score	Unacceptable score				Fever	Respiratory distress	Placental abruption	Intrauterine growth restriction	Pneumonia	
Maryam Sadat Hosseini, Afsanah Hosseini et al.	44	41	3	-	2	-	-	5	1	1	-	15
Dinesh Munian, Rituparna Das et al.	133	-	-	-	-	-	-	28	-	-	9	75
S. Khan, L. Jun et	17	17	-	-	-	-	-	-	-	-	5	-

al												
Hui Zeng, Chen Xu, Junli Fan	6	6	0	-	-	-	-	-	-	-	-	-
Mohsen A. A. Farghaly, Fernanda Kupferman, et al	15	15	0	-	-	-	-	6	-	-	-	-
Camille Daclin , Marie Carbonnel et al .	86	86	0	5	-	-	-	5	-	-	-	-
Zahra Akbarian -Rad, Mohsen Hagshe nasMoja veri et al.	8	8	-	-	-	-	-	2	-	-	-	3
Yan-Ting Wu, Jun Liu , Jing-Jing Xu et al.	30	-	-	-	-	5	-	-	-	-	-	3
Wei Liu, Hongbin Cheng et al.	15	15	-	15	-	-	-	1	-	-	-	-
Anita Dileep, Sham ZainAlAbdin et al.	200	-	-	66	-	-	-	-	-	-	-	34
Luming Xu,	5	5	-	-	-	-	-	-	-	-	-	2

Qianqian Yang et al.												
Hujin Chen, Juanjuan Guo, et al.	9	9	-	-	-	-	-	-	-	-	-	-
Lu Zhang, Lan Dong et al	18	-	-	-	-	-	-	-	-	-	5	6
Dustin D. Flannery, Alvaro Zevallos Barboza	217	217	-	45	3	-	1	22	-	-	-	6
Dustin D. Flannery, Sigrid Gouma et a	83	-	-	-	-	72	-	-	-	-	-	-
Dani Dumitriu , Ukachi N. Emeruwa , et al.	101	-	-	-	-	-	-	-	-	-	-	30
Lina Antoun, Nashwa El Taweel et al	20	19	1	-	-	-	-	-	-	-	-	-
José Villar, Shabina Ariff, et. Al	-	-	-	-	-	-	-	-	-	-	-	-

Mikael Norman, Lars Navér et al.	2323	-	-	-	-	-	-	65	-	-	3	61
Emily H. Adhikari, Wilmer Moreno, et al.	248	-	-	-	-	1	-	-	-	-	-	96
Wei Liu, Jing Wang et al.	19	19	-	-	-	-	-	-	-	-	-	-
TOTAL	3597	457/461	4/461	131/518	5/261	78/361	1/217	134/2841	1/44	1/44	22/2491	331/3327
n(%)		457(99.13%)	4(0.86%)	131(25.28%)	5(1.91%)	78(21.60%)	1(0.46%)	134(4.71%)	1(2.27%)	1(2.27%)	22(0.88%)	331(9.94%)

Figure 1 Literature Search and process of exclusion of articles

