Original Article

Maternal and neonatal outcomes during COVID-19 pandemic and pre-pandemic in an urban slum in North India – A community-based ambispective cohort study

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Abstract

Background: Coronavirus disease 2019 (COVID-19) has affected millions of people globally since its first case reported on December 2019 in Wuhan, China. The maternal and neonatal outcomes during COVID-19 pandemic were not much reported in low- and middle-income countries. Therefore, we aimed to assess the maternal and neonatal outcomes during COVID-19 and compared them with those of the pre-pandemic period (i.e., 2019). **Materials and Methods:** We obtained data from the cohort of pregnant women who delivered during COVID-19 pandemic and women who delivered in the pre-pandemic period. All registered antenatal mothers resident of the selected dispensary who delivered in health care facilities from January 2019 to June 2019 and from January 2021 to June 2021 were included in the study for assessing the socio-demographic, antenatal, natal, post-natal, and new-born characteristics. A semi-structured questionnaire was used for obtaining details regarding pregnancy and COVID-19 status. The neuro-development assessment of the newborn was done in the community using Trivandrum Developmental Screening Chart (TDSC). Chi-square test and Fischer exact test were used to draw association between the maternal and neonatal outcomes during COVID-19 pandemic and the pre-COVID-19 period. A *P* value of <0.05 was considered statistically significant. **Results:** A total of 158 and 220 women delivered in pre-COVID and during COVID, respectively. Out of them, 83 mothers (47.4%) who delivered in 2019 (pre-COVID) and 158 mothers (76.4%) who delivered in 2021 (during pandemic) were contacted. The mean age was 25 ± 3.9 years. The prevalence of anemia was significantly higher during COVID pandemic. The proportion of Rh-negative mothers and other antenatal investigation reports was similar in both the groups. The proportion of high-risk pregnancy is high among mothers who delivered during COVID than the pre-COVID period. On applying multivariate analysis, developmental delay at 3 months was found to be significant among children who were born during pandemic. **Conclusion:** A simple tool was used for assessing development milestones, and we have found that newborns delivered during COVID-19 pandemic were reported to have inappropriate developmental milestone at 3 months post-delivery. However, further research needed to assess the neuro-developmental status and follow-up of children born during COVID-19 pandemic for comprehensive neuro-developmental assessment. It is important to identify children with developmental delays associated with the pandemic and provide them with support for learning, socialization, physical and mental health, and family support.

Keywords: COVID-19, maternal outcomes, neonatal outcomes, neuro-development, pregnancy

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Introduction

Coronavirus disease 2019 (COVID-19) has affected millions of people globally and caused a detrimental effect on every aspect of human life. With its indiscriminate and sustained spread across

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continents, we saw pregnant women with COVID-19 affected across all trimesters of pregnancy.[1] Pregnancy alters the body's immune system and response to viral infections in general, which can occasionally be related to more severe symptoms, and this will be the same for COVID-19.[2] From the literature, it is evident that reported cases of COVID-19 pneumonia in pregnancy were milder and with good recovery.[3] Emerging evidence states that vertical transmission was possible; however, the proportion of pregnancies affected and its effect on development milestones of the children were not determined yet.[4] At present, there are no recorded cases of vaginal secretions or breast milk being tested positive for COVID-19. There is no evidence currently that the virus is teratogenic. Long-term data, however, are needed.[5] The evidence shows that severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) can be isolated from asymptomatic individuals, and affected patients continue to be infectious 2 weeks after cessation of symptoms. Hence, there is a possibility of pregnant women with SARS-CoV-2 infection without any symptoms. A study conducted in Boston-area hospitals found 14% prevalence of asymptomatic COVID-19 infections among pregnant women.[6,7] Hence, this study was planned to include all pregnant women resident of urban slum who delivered at primary, secondary, and tertiary care facilities to assess the maternal outcomes such as pre-term labor, abortion, sepsis, and neonatal outcomes such as health status of the newborn, period of gestation, birth weight, birth defect, and developmental delay during COVID-19 pandemic and compared them with the deliveries that occurred in the pre-COVID-19 period, that is, 2019.

Materials and Methods

This ambispective cohort study was conducted in an urban slum in Chandigarh, which is a community health service program in areas of the Department of Community Medicine and School of Public Health of a Tertiary care hospital in North India. It has a migratory population that keeps on moving in and out of the area mainly for livelihood. The total population of the area was 25,242 as per Annual Health Survey (AHS) 2018–19. The study was conducted from January 1, 2021 to December 30, 2021. All registered antenatal mothers resident of sector 25 who delivered in health care facilities from January 2019 to June 2019 and from January 2021 to June 2021 were included in the study for assessing the socio-demographic, antenatal, natal, post-natal, and new-born characteristics [Figure 1]. A semi-structured data extraction tool was used to extract the data about the demographic characteristics, gestational characteristics, maternal complications and period of gestation, place of delivery, type of delivery, duration of delivery, post-natal complications, birth weight, birth defect, intrauterine growth restriction, and pre-term birth. All newborns were assessed in their home by a Public Health Nursing Officer (PHNO) at 3 months and 6 months of age to assess developmental milestones by using Trivandrum Developmental Screening Chart (TDSC).[8] Ethical clearance was obtained from the Institute Ethics Committee. Written informed consent was obtained from all study participants prior to data collection. The data were collected and entered in Microsoft Excel 2019 and analyzed in SPSS v 24. The categorical data were represented as frequencies and percentages. Chi-square test and Fischer exact test were used to draw association between the maternal and neonatal outcomes during COVID-19 pandemic and the pre-COVID-19 period. A multi-variate regression analysis was used to determine the association during COVID-19 pandemic and pregnancy outcome. A *P* value of <0.05 was considered statistically significant.

Results

From the data available in the hospital, a total of 158 and 220 women delivered in pre-COVID-19 and during COVID-19, respectively. Out of them, 75 mothers (47.4%) who delivered in 2019 (pre-COVID) and 168 mothers (76.4%) who delivered in 2021 (during pandemic) were contacted. As this slum has a migrant population, most of them migrated out (32.2%), some houses were locked even after three visits (12.0%) as they have gone for job/went out of station, and some of them denied (5.0%).

The mean age of mothers was 25 ± 3.9 years, and around 88.0% were educated less than higher secondary. Most of the mothers were housewives (98.2%), and they belong to a lower-middle socio-economic class (44.0%) [Table 1]. Out of mothers who

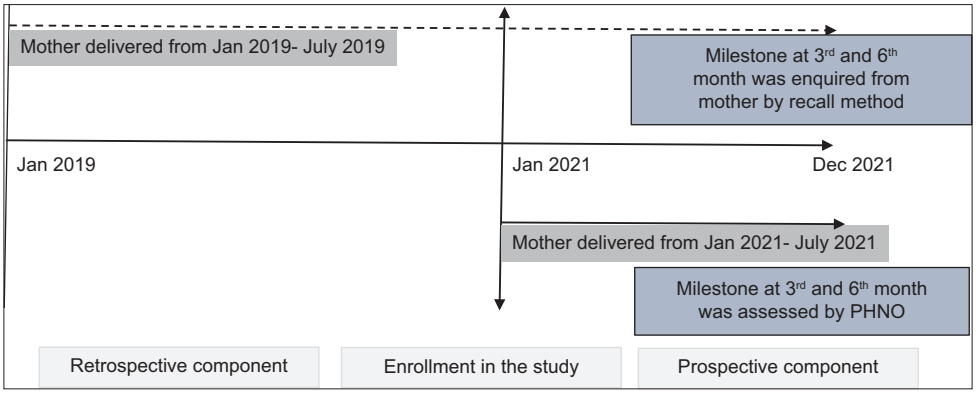

Figure 1: Study time line

delivered during pandemic, almost 95% have done COVID-19 testing while admission for delivery and none of them were found infected with COVID-19 during delivery.

A significantly higher proportion of pregnant women (23.8%) during the COVID-19 period belonged to the below-poverty line than the pre-COVID19 period. The higher rate of young pregnancy and nulliparity is seen during both the periods. The prevalence of anemia is significantly higher during COVID-19 pandemic. The proportion of Rh-negative mothers and other antenatal investigation reports was similar in both the groups. The routine antenatal investigations like blood sugar, urine for

Table 1: Details related to antenatal care among mothers who delivered during pre-COVID-19 and COVID-19 pandemic

Antenatal details	Pre-COVID-19 (*n*=75)%	COVID-19 (*n*=168)%	Chi-square/Fisher exact value*	*P*
BPL				
Yes	8 (10.7)	40 (23.8)	5.65	0.017
No	67 (89.3)	128 (76.2)		
Age category				
≤30 years	61 (81.3)	151 (89.9)	3.4	0.065
>30 years	14 (18.7)	17 (10.1)		
Gravida				
Primigravida	45 (60.0)	86 (51.2)	1.62	0.203
≥2	30 (40.0)	82 (48.8)		
Abortion				
0	63 (84.0)	132 (78.6)	1.004	0.605
1	10 (13.3)	29 (17.3)		
≥2	2 (2.7)	7 (4.2)		
Full TT immunisation				
Yes	75 (100.0)	168 (100.0)	1.356*	0.555
No	0 (0.0)	0 (0.0)		
IFA/Calcium supplementation				
Yes	75 (100.0)	161 (95.8)	3.218*	0.103
No	0 (0.0)	7 (4.2)		
Past obstetric history				
Not significant	74 (98.7)	161 (95.8)	5.408	0.144
Intrauterine death	0 (0.0)	1 (0.6)		
Low-birth-weight baby	0 (0.0)	6 (3.6)		
Congenital malformation	1 (1.3)	0 (0.0)		
Blood group				
Rh-negative	2 (2.7)	5 (3.0)	0.018	1
Rh-positive	73 (97.3)	163 (97.0)		
Hemoglobin				
Normal	60 (80.0)	106 (63.1)	7.96	0.047
Mild anemia	8 (10.7)	24 (14.3)		
Moderate anemia	3 (4.0)	22 (13.1)		
Report not available	4 (5.3)	16 (9.5)		
High-risk pregnancy				
Yes	32 (42.7)	58 (34.5)	1.474	0.225
No	43 (57.3)	110 (65.5)		

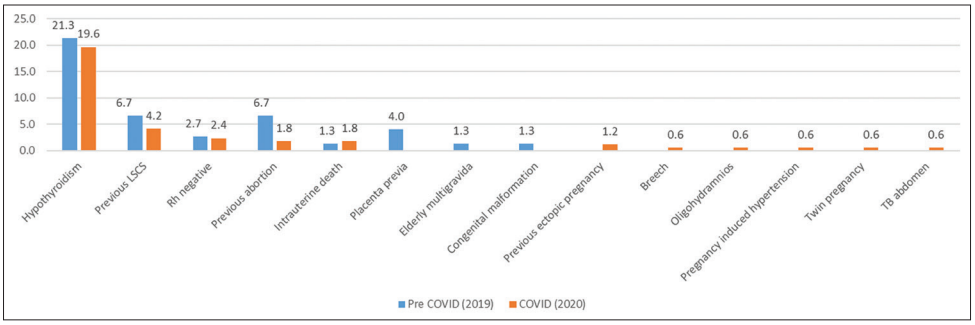

Figure 2: Causes of high-risk pregnancy during pre-COVID-19 and COVID-19

albumin and sugar, HIV, HbsAg, HCV, and VDRL were found to be normal and non-reactive.

The proportion of high-risk pregnancy is high among mothers who delivered during COVID-19 compared to the pre-COVID-19 period [Figure 2]. Nearly similar prevalence of hypothyroidism was observed in both the periods, but the previous abortion was high (6.7%) during pre-COVID compared to the COVID period. High risk factors such as pregnancy-induced hypertension and TB abdomen were observed exclusively among mothers who were pregnant during pandemic.

The percentage of lower-segment cesarean section (LSCS) delivery was almost double high during the COVID-19 period when compared to pre-COVID-19 [Table 2]. There were no major differences in neonatal outcomes in pre-COVID-19 and COVID-19 except for the percentage of jaundice, which was double in the COVID-19 period when compared to pre-COVID-19 [Table 2]. On applying multivariate analysis, developmental delay at 3 months was found to be significant among children who were born during pandemic [Table 3].

Discussion

The main goal of this article was to study the ongoing impact of the COVID-19 pandemic on pregnancy control and outcomes; this was a joint analysis of two cohorts (pre-pandemic cohort and pandemic cohort). With the majority of studies reporting on neonatal outcomes, no serious adverse outcomes have been observed in neonates born to COVID-19-positive mothers.[9-12] Similarly, our study shows that among 168 women who delivered during COVID-19, 94% were subjected to COVID-19 test and 100% were found to be negative for COVID-19. Our study did not observe any reported complications during delivery, and there were only one reported neonatal death and one still birth among the mothers who delivered during the COVID-19 pandemic.

A number of studies have reported high rates of pre-term birth, although none had a denominator population for comparison. Where the cause of pre-term birth was given, all were iatrogenic because of deteriorating maternal conditions.[13-16] Conversely, observational data from Ireland and Denmark have seen dramatic decreases in population level rates of pre-term birth during the COVID-19 pandemic, the cause of which is unclear.[17] The risk of pre-term births was higher only when the women were infected with SARS-CoV-2 during late pregnancy, particularly among symptomatic women.[18,19] Our study did not report any COVID-19 positive during the time of delivery, and our findings also show that the gestational age of the new-born was no statistically significant between before and during COVID-19 pandemic. In fact, the proportion of term deliveries was higher (88%) during COVID-19 when compared to those of pre-COVID-19 times (81%) for reasons unknown.

A number of studies reported that during COVID-19 pandemic, there was a decrease in the incidence of pre-term and low-birth-weight babies for reasons unknown.[17-21] Similarly, our study findings show that there was a decline in pre-term and low-birth-weight babies in the intra-pandemic period. The reasons could be greater focus on hygiene and home confinement, less work-related strain, more opportunities for rest and nutritional support, the support systems provided during the lockdown, reduced exposure to infection, and the postponement or suspension of medical interventions, leading to iatrogenic pre-term delivery. According to Ranjbar *et al.*, the COVID-19 pandemic-induced lockdown is likely to have caused socio-environmental changes and behavioral modifications and thus exert a beneficial impact on pregnancies during this period.[22] Other reasons from our study indicate the proportion of anemia was higher in intra-COVID-19 pandemic when compared to pre-pandemic pregnancies and this may have a negative outcome during delivery and is found to be statistically significant. In contrast, Wood *et al.* observed no reduction in pre-term birth rates.[23] Other studies reported no changes during the COVID period.[24-27]

From the literature, we found that COVID-19 infection *per se* is not an indication for cesarean section (C-section) and studies have highlighted there was higher incidence of C-section among COVID-19 cases when compared to the controls.[28] Our study also shows that the incidence of C-section was doubled from 16% before COVID-19 to 30% during COVID-19 pandemic and this was found to be statistically significant. This was contrary to the findings from a study which showed that C-section and instrumental delivery were less frequent in pandemic years when compared to pre-pandemic years.[29] We now know that COVID-19 is not an indication for C-section; however, with limited personal protective equipment (PPE) early on, fear among providers and clients as well as absence of clear guidelines may have contributed to the increased rates of C-section.

Although studies investigating the transmission of SARS-CoV-2 have not reported evidence of vertical contamination from mothers to infants,[30,31] the infection caused by SARS-CoV-2 during pregnancy may cause the same immune activation with long-term effects since brain development is a dynamic process that extends into adolescence.[32] Our study highlighted that milestone development at 3 months was inappropriate among the newborns delivered during COVID-19 pandemic and this was found to be statistically significant. Similar results were found in a study conducted in Brazil, which shows that the motor development was delayed among the newborns delivered during COVID-19 pandemic.[33]

The main strengths associated with this study are that it provides novel data related to maternal and neonatal outcomes, especially long-term outcomes (i.e. developmental milestone) associated with COVID-19 infection in a community setting in pre-pandemic and pandemic periods. Another strength was that we have used a simple screening tool for assessing any developmental delays among the newborns delivered during COVID-19 pandemic. Since we have compared deliveries that

Table 2: Details related to intrapartum events and newborn characteristics during pre-COVID-19 and COVID-19

Variables	Pre-COVID (*n*=75)%	COVID (*n*=168)%	Chi-square/Fisher Exact value*	*P*
Type of delivery				
Normal	63 (84.0)	116 (69.0)	6.249*	0.046
LSCS	12 (16.0)	51 (30.4)		
Abortion	0 (0.0)	1 (0.6)		
Single/twin				
Single	75 (100.0)	166 (99.4)	0.902*	1
Twin	0 (0.0)	1 (0.6)		
Outcome of pregnancy				
Live birth	75 (100.0)	166 (98.8)	1.359	1
Still birth	0 (0.0)	1 (0.6)		
Neonatal death	0 (0.0)	1 (0.6)		
Complications during delivery				
No complications	67 (89.3)	166 (98.8)	-	-
Meconium-stained labour	5 (6.7)	0 (0)		
Cord around baby neck	1 (1.3)	0 (0)		
Postpartum hemorrhage	2 (2.7)	0 (0)		
Sex of newborn				
Male	50 (66.7)	76 (44.6)	10.28	0.006
Female	25 (33.3)	92 (55.4)		
Birth weight (mean+SD)	2.73±0.45	2.77±0.46	0.699^	0.485
Low birth weight				
Present	15 (20.0)	25 (14.9)	0.988	0.32
Absent	60 (80.0)	143 (85.1)		
Gestational age of newborn				
Term	61 (81.3)	148 (88.1)	3.04*	0.23
Preterm	11 (14.7)	18 (10.7)		
Post-term	3 (4.0)	2 (1.2)		
Baby cried immediately after birth				
Yes	75 (100.0)	166 (98.8)	0.9	0.571
No	0 (0.0)	2 (1.2)		
Respiration				
Present	75 (100.0)	167 (99.4)	0.9	0.571
Absent	0 (0.0)	1 (0.6)		
Jaundice				
Present	15 (20.0)	102 (60.7)	37.506*	0.0001
Absent	60 (80.0)	66 (39.3)		
Breastfeeding/Activity/Passed urine within 24 h/Passed stool within 48 h				
Present	75 (100.0)	166 (98.8)	0.9	0.571
Absent	0 (0.0)	2 (1.2)		
Milestone				
3 months	(*n*=75)	(*n*=166)		
Appropriate	74 (98.7)	128 (76.2)	23.26	0.001
Not appropriate	1 (1.3)	38 (22.6)		
6 months				
Appropriate	74 (98.7)	156 (92.9)	2.823	0.116
Not appropriate	1 (1.3)	9 (5.4)		

^Independent *t*-test

occurred in both pre-pandemic and pandemic periods, it offers a good comparison in the defined population over the time.

However, our study also has a few limitations: due to COVID-19-induced lockdown or local restriction, it was difficult for the authors to track the pregnant women. There will be a possibility of social desirability bias which makes the mother not to respond negatively for development-related questions. There is a possibility of recall bias among women who delivered in pre-pandemic period. The participants contacted during COVID-19 pandemic were nearly double when compared to the pre-pandemic period. This is due to the migration of the pregnant women who delivered in the pre-pandemic period. The study did not measure maternal stress during pregnancy, which may adversely affect the neuro-development of the fetus.

Table 3: Regression analysis for factors associated with pregnancy outcome due to pandemic

Variables	*P*	Odd's ratio	95% Confidence Interval	
			Lower	Upper
Mean age	0.034	0.917	0.846	0.993
APL category	0.093	0.453	0.18	1.142
Primigravida	0.006	0.375	0.185	0.759
Anemia	0.037	2.402	1.056	5.462
Rh-negative blood group	0.934	1.081	0.172	6.787
No high-risk pregnancy	0.389	1.347	0.684	2.652
Normal delivery	0.025	0.386	0.168	0.889
Abortion	0.184	1.778	0.76	4.159
Term baby	0.219	1.926	0.677	5.481
Normal birth weight	0.272	1.667	0.669	4.15
Appropriate development at 3 months	0.002	0.015	0.001	0.222
Appropriate development at 6 months	0.292	4.875	0.257	92.638

Conclusion

This study highlights the need for assessing the development milestones in newborns who were born in the COVID-19 period. Reassuringly, we found no major differences in the pregnancy and neonatal outcome except for a higher proportion of LSCS delivery and neonatal jaundice who were delivered in COVID-19 pandemic. A simple tool was used for assessing development milestones, and we have found that newborns delivered during COVID-19 pandemic were reported to have inappropriate developmental milestone at 3 months post-delivery. However, further research needed to assess the neuro-developmental status and follow-up of children born during COVID-19 pandemic for comprehensive neuro-developmental assessment. It is important to identify children with developmental delays associated with the pandemic and provide them with support for learning, socialization, physical and mental health, and family support.

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Conflicts of interest

There are no conflicts of interest.

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