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## Original Article

# Comparing pregnancy outcomes between symptomatic and asymptomatic COVID-19 positive unvaccinated women: Multicenter study in Saudi Arabia



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## ABSTRACT

**Introduction:** COVID-19 infection in pregnancy ranges from asymptomatic infection to severe disease. However, the maternal and pregnancy outcomes are primarily favorable. Acute Respiratory Illness (ARI) score is a Visual Triage Checklist for Acute Respiratory symptoms created by the ministry of health of Saudi Arabia<sup>12</sup> to screen the patient for acute respiratory infection with MERS-CoV. It has been used during the COVID-19 pandemic to identify suspected cases and place patients in isolation precautions if the score is  $\geq 4$ . **Method:** This study is a cross-sectional study of all pregnant women who tested positive for COVID-19 in four medical centers located in four different cities in Saudi Arabia. The study period was from 1/3/2020 until 31/10/2020. Outcomes investigated were the prevalence of COVID infection in pregnant women at the time of delivery. Rate of asymptomatic disease, different maternal and pregnancy outcomes. Women were divided into symptomatic and asymptomatic groups according to the ARI score. The two groups were compared in maternal, perinatal, and neonatal outcomes. Furthermore, the cohort was divided according to maternal age into two groups: women of advanced maternal age  $\geq 35$  years and younger. The two groups were compared in maternal, perinatal, and neonatal outcomes.

**Results:** During the study period, 9573 women gave birth at KAMCs, and 402 pregnant women were identified as COVID positive. Out of all COVID-positive women, only 394 women gave birth at KAMCs. The screening for COVID infection differed between the centers, but the testing was the same by the Nasopharyngeal polymerase chain reaction (PCR) swab. In Riyadh, screening was based on ARI scoring at the beginning of the pandemic. Then, it became universal. In Jeddah, the screening was based on ARI scoring. Any woman who scored four or more was labeled as suspected, and she was tested. Finally, in Madinah and Dammam, the screening was universal throughout the study.

The prevalence of COVID-19 infection among women who gave birth at KAMCs was 4.2% (402/9573). (CI 3.8–4.6%). At the time of diagnosis, most women (62%) were asymptomatic. The most common symptoms were cough and shortness of breath. Twenty-two women (5.5%) had Pneumonia, and five women (1.3%) needed admission to Intensive care units (ICU). One woman died due to respiratory failure.

When pregnancy outcomes were compared between symptomatic and asymptomatic women, pregnancy in symptomatic women was more likely to be complicated by Abortion (6 versus 2% p-value 0.00), fetal death (3 versus 1.3%), and cesarean delivery (30.8 versus 22.4%, p-value 0.001). COVID-positive pregnant women of advanced maternal age (AMA) were more likely to be symptomatic, have Abortion (5 versus 1%, p-value 0.01), and have Preterm delivery (17 versus 11% p-value 0.01) than younger women. In

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addition, neonatal death was more common in AMA COVID-positive women than younger (4 versus 0%), regardless of COVID-related symptoms.

**Conclusion:** Most of the COVID-infected pregnant women are asymptomatic. Therefore, the ARI scoring system does not help to triage patients. Symptomatic women, especially those older than 35, tend to have a higher maternal and pregnancy complication rate.

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## Introduction

SARS-CoV-2 is the strain of coronavirus causes COVID-19. In December 2019, a cluster of cases of Pneumonia due to COVID-19 was identified in Wuhan, China [1]. On March 12, 2020, the world health organization (WHO) defined the outbreak as a pandemic [2]. By the end of March, 2022, there were more than 490,000,000 reported cases of COVID and more than 6,000,000 deaths worldwide [3]. In Saudi Arabia, there have been 750,000 reported cases and 9039 related deaths.

Pregnant women are less likely to acquire the infection than the general population [4].

COVID-19 infection in pregnancy ranges from asymptomatic infection to mild disease (no evidence of Pneumonia or hypoxia) to moderate disease (viral Pneumonia) until severe disease (severe pneumonia, e.g., with SpO<sub>2</sub> below 90% on room air) and critical illness (acute respiratory Distress Syndrome, sepsis, septic shock, or complications such pulmonary embolism or acute coronary syndrome) [5]. Most pregnant women infected with SARS-CoV-2 are asymptomatic [6]. Most symptomatic women experience only mild or moderate cold/flu-like symptoms [7]. Maternal mortality is rare; the estimated SARS-CoV-2 associated maternal mortality rate is 2.4 per 100 000 (95% CI 1.3–4.0) [8].

The severe illness appears to be more common in later pregnancy. 83% of symptomatic women were diagnosed at or beyond 28 weeks, with 52% diagnosed at or beyond 37 weeks [9]. Pregnant women had higher odds of Pneumonia (OR 1.99, 95% CI 1.81–2.19) [10], admission to intensive care (OR 2.13, 95% CI 1.53–2.95), and requirement of invasive ventilation (OR 2.95, 95% CI 2.28–2.94) [6] and higher odds of death (OR 1.84, 95% CI 1.30–2.61) [10]. The maternal risk factors associated with severe COVID-19 are age 35 years and older, OR 1.83 (95% CI 1.27–2.63); BMI 30 kg/m<sup>2</sup> and above, OR 2.37 (95% CI 1.83–3.07); for chronic hypertension, OR 2.0 (95% CI 1.14–3.48); and for pre-existing diabetes, OR 2.12 (95% CI 1.62–2.78) [6]. Maternal COVID-19 is also associated with an increased cesarean delivery (CD) rate. The rate of CD was 49% in women with symptomatic COVID-19 and 29% for a historical control group before the COVID-19 pandemic [9].

The overall outcomes for babies born to women with COVID-19 were favorable, with over 95% born in good condition [6]. When COVID-19 infected pregnant women were compared to non-infected pregnant women, there was an increased risk of low birth weight (OR 1.89 95% CI 1.14–3.12) [11] and stillbirth (OR 2.84, 95% CI 1.25–6.45) [6].

In Saudi Arabia, The first positive COVID-19 case was confirmed in March 2020, with more cases sporadically appearing in the following weeks [3]. COVID vaccine became available in Dec 2020 and became a requirement to enter the workplace in Aug 2021. Acute Respiratory Illness (ARI) score is a Visual Triage Checklist for Acute Respiratory symptoms (Fig. 1). It was created by the ministry of health of Saudi Arabia [12] to screen the patient for acute respiratory infection with MERS-CoV and identify suspected cases and place them in isolation precautions if the score is  $\geq 4$  [13]. It has been used during the COVID-19 pandemic. MOH recommended patient isolation if the score was  $\geq 6$ . In KAMC, the cut-off of 4 has been used to

screen patients and label people with ARI scores equal to or more than four as suspects.

This study aimed to compare pregnancy outcomes between symptomatic and asymptomatic COVID-19 infected pregnant women before vaccination was available.

## Method

This study is a cross-sectional study of all pregnant women who tested positive for COVID19 in four King Abdulaziz medical centers (KAMC) in the ministry of national guard health affairs (MNGHA) located in 4 different cities, Saudi Arabia. Riyadh, Jeddah, Madinah and Dammam. The study period is from 1/3/2020 until 31/10/2020.

The primary outcome is to calculate the prevalence of COVID-19 infection among pregnant women tested in KAMC. The secondary outcomes are to study the maternal characteristics of COVID-positive pregnant women delivered at KAMCs and their pregnancy outcomes, including maternal, fetal, and neonatal outcomes.

Maternal characteristics include age, Body mass index (BMI), Gravidity, parity, the ARI score at presentation, and past medical history. The maternal outcomes are symptoms upon presentation, rate of the asymptomatic carrier, maternal disease diagnosed during pregnancy, therapy required, admission to intensive care unit (ICU), respiratory support, cesarean delivery (CD), and postpartum complications. Secondary outcomes also included fetal outcomes such as Abortion, intrauterine fetal death after 20-week gestation, and preterm delivery before 37-week gestation. Preterm rupture of membrane before 37-week gestation and Neonatal outcomes such as gestational age at the time of delivery, birth weight, and disease diagnosed before discharge. The cohort was divided into symptomatic and asymptomatic groups according to the ARI score. Symptomatic women who had an ARI score of 4 or more. A comparison was made between the two groups in maternal, fetal, and neonatal outcomes. Furthermore, the cohort was divided into women of Advanced maternal age  $\geq 35$  years and younger group. The two groups were compared in different maternal and pregnancy outcomes.

## Statistical analysis

Numerical variables were reported as means and medians, while categorical variables were reported as percentages. Association between ARI scores among Covid positive pregnant women and Maternal and fetal outcomes were tested using Chi-square and Fisher's exact test. In addition, the association between maternal age among Covid positive pregnant women and Maternal and fetal outcomes was tested using Chi-square and Fisher's exact test.

## Results

During the study period, 402 pregnant women were identified as COVID positive during the study period in four KAMC centers, Riyadh, Jeddah, Madinah, and Dammam. Analysis was done on 394 women. 8 women were excluded from analysis because they delivered outside those facilities. (Fig. 2). The prevalence of COVID-19 infection among women presented to KAMC facilities was 4.2%. (CI

Visual Triage Checklist

Visual Triage Checklist for Acute Respiratory Illness

Date: \_\_\_\_\_ Time: \_\_\_\_\_ MRN: \_\_\_\_\_  
 Name: \_\_\_\_\_ ID#: \_\_\_\_\_ Hospital: \_\_\_\_\_

	Points (adults)	Pints (children)	Score
<b>A. Clinical symptom/sign</b>			
Fever	2	1	
Cough (New or worsening)	2	1	
Shortness of breath (New or worsening)	2	1	
Nausea, vomiting, diarrhea	1	-	
Sore throat and/or runny nose	1	-	
Chronic renal failure, CAD/heart failure	1	-	
<b>B. Risk of exposure to MERS</b>			
Exposure to a confirmed MERS case in the last two weeks	3	3	
Exposure to camel or products (Direct or indirect*) in the last two weeks	2	2	
Visit to a healthcare facility that had MERS case in the last two weeks	1	1	
<b>Total Score</b>			

\* Patient or household

A SCORE ≥ 4, PLACE PATIENT IN AN ISOLATION ROOM AND INFORM MD FOR ASSESSMENT

MERS COV TESTING SHOULD BE DONE ONLY ACCORDING TO CASE DEFINITION

Staff name: \_\_\_\_\_ ID number: \_\_\_\_\_

Fig. 1. Visual triage checklist for acute respiratory illness (ARI score).<sup>13</sup>

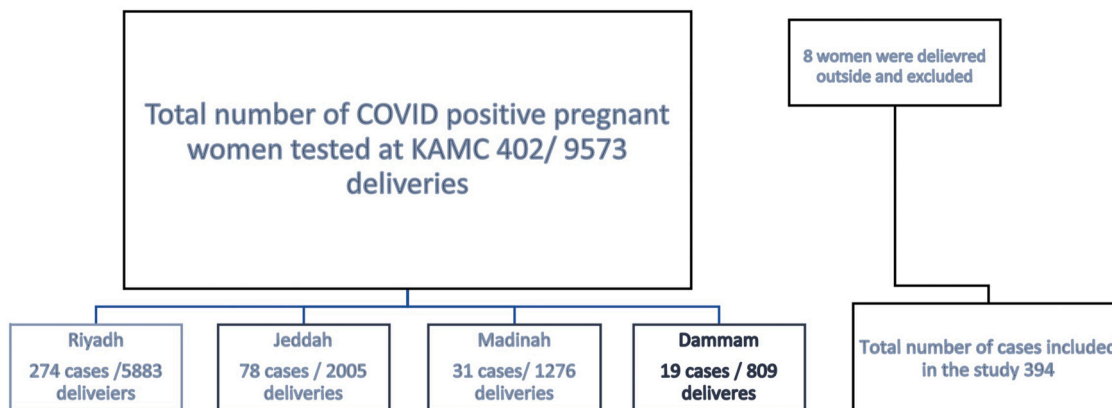


Fig. 2. Study's patient population.

**Table 1**  
Baseline characteristic.

Characteristic	Number (%)	Confidence interval (CI) or Interquartile range (IQR)
Maternal Age in years at Time of Delivery (mean)	30.8	CI 0.6
BMI (mean)	30.57	CI 0.6
Gravida (Median)	3	IQR 2
Para (median)	2	IQR 2
Gestational age at diagnosis (median)	38	IQR 6
Medical disease diagnosed before pregnancy	96 (24)	
• Endocrine (DM & hypothyroidism)	20 (5)	
• Hematological (Anemia & Thrombophilia)	7 (1.8)	
• Respiratory disease	6 (1.5)	
• Cardiac disease (including hypertension)	6 (1.5)	
• Connective tissue disease	3 (0.8)	
• Psychiatric disease	2 (0.5)	
• Gastrointestinal Disease	2 (0.5)	
• Renal disease	1 (0.3)	
• Musculoskeletal disease	1 (0.3)	
• Multiple illness	5 (1.3)	

3.8–4.6%). The prevalence varied slightly between the cities—the prevalence was in Riyadh at 5%, Jeddah at 3.8%, Madinah and Dammam at 2.4%.

Baseline Maternal characteristics: (Table 1).

The mean maternal age was 30.8 years; the mean BMI was 30.6. median gestational age at the time of diagnosis was 38 weeks. Three hundred eighty-five women carried a singleton, eight twins, and one triplet. Most women were healthy. Only 24% had a positive past medical history. The most common past medical disorder was Endocrine disorder (Diabetes mellitus & hypothyroidism).

Maternal outcome (Table 2).

At the time of diagnosis, most women (62%) were asymptomatic. The majority of women (55%) had an ARI score of 0. The most

**Table 2**  
Maternal outcome.

Acute Respiratory Infection (ARI) Score upon Presentation (median)	0 (IQR 4)
Asymptomatic (ARI score less than 4)	248 (62%)
Symptomatic (ARI score 4 or more)	146 (38%)
ARI Score 0	223 (56%)
COVID related symptoms upon presentation	Frequency (%)
• Cough	39 (9.7)
• Shortness of breath	29 (7.2)
• Fever	28 (7)
• Sore throat	19 (4.7)
• Runny nose	15 (3.7)
• Diarrhea	13 (3.2)
• Vomiting	13 (3.2)
• Headache	10 (2.5)
• Loss of taste	7 (1.7)
• Body ache	4 (1.3)
Admission to hospital	329 (83)
Pneumonia	22 (5.5)
Maternal disease diagnosed during pregnancy	89 (23)
• Hematological disease	7 (2)
• Thyroid disease	3 (1)
• Cardiac disease	1 (0.3)
• Thrombophilia	1 (0.3)
• Antepartum bleeding	2 (0.5)
• Diabetes	53 (13)
• Abnormal placental location	8 (2)
• Hypertensive disease in pregnancy	5 (1.3)
Therapy	
Any Therapy	63 (16)
• Antibiotic	22 (5.6)
• Steroids	5 (1.3)
• Other medications	35 (9)
• Multiple therapy	17 (4)
Respiratory support	
Intensive care unit (ICU) admission and Respiratory support	5 (1.2)
Extracorporeal Membrane Oxygenation (ECMO)	2 (0.5)
Maternal Death	1 (0.3)

common COVID-related symptoms were cough, shortness of breath, and fever. The cohort was divided into two groups Asymptomatic with an ARI score of less than 4 (146 women) and symptomatic with a higher ARI score (248 women).

Most women were admitted to hospital (83%) either because of pregnancy or COVID-related symptoms. Twenty-two women (5.5%) were diagnosed with Pneumonia based on symptoms and positive radiological findings. Only 15% of all women required some treatment. The most common treatment given was antibiotics (5.5%). In addition, five women (1.3%) needed ICU admission, and two women required extracorporeal membrane oxygenation (ECMO). One woman died in ICU due to respiratory failure. She was 23 years old, previously healthy, and She had spontaneous twin gestation. During her second trimester, she presented with respiratory symptoms and was diagnosed with COVID. She was transferred to KAMC-J ICU intubated in respiratory failure.

Pregnancy outcome: (Table 3).

Among women identified with COVID in pregnancy, 13 women had a miscarriage. Seven (2%) pregnancies were complicated by Intrauterine fetal death. Preterm delivery before 37 weeks occurred in 47 women (13%). The median gestational age at the time of delivery was 39 weeks. The rate of CD was 24%. Elective repeat CD and Abnormal fetal monitoring were the most common indications for CD. (26% each).

Neonatal outcome (Table 4).

All neonates were admitted to the neonatal intensive care unit to ensure proper isolation of newborns. Breastfeeding was not allowed.

**Table 3**  
Pregnancy outcome.

Singleton	385
Twins	8
Triplet	1
Gestational Age at time of delivery (median)	39 (IQR 3)
Abortion (%)	13/393 (3.5)
Stillbirth (%)	7 /354 (2)
Preterm delivery	47/354 (13)
Preterm premature rupture of membrane	4/354 (1.3)
Fetal complication (hydrops, anomalies, abnormal amniotic fluid growth restriction)	16/378 (4.2)
Cesarean delivery (CD)	102 (25%)
Indication for CD (%)	
• Elective repeat	27(27)
• Abnormal CTG	27(27)
• Failure to progress	6 (6)
• Declined Trial of labor after CS	10(10)
• Twins	3 (3)
• Maternal request	1 (1)
• Malpresentation	1 (1)
• Failed operative delivery	5 (5)
• Other indications	22 (21)



**Table 4**  
Neonatal outcome.

Disease	Cases (%)
Neonatal death	4 (1)
low birth weight	20 (5)
Jaundice	61 (15.2)
Respiratory	17 (4.2)
Genito-urinary	14 (3.5)
Cardiac	11 (2.7)
Musculo-skeletal	5 (1.2)
Gastrointestinal	3 (0.7)
Multiple anomalies	3 (0.7)
Skin	2 (0.5)
others	1 (0.2)
	Inborn error of metabolism
	Hypoxic ischemic encephalopathy
	1
Multiple disease	16 (4)

20 (5%) newborns had Low birth weight. Four neonates died in the neonatal period due to prematurity complications. All mothers of Neonatal deaths (NND) were older than 35 years of age and had COVID-related symptoms. The most common neonatal disease was neonatal jaundice (15%). Other neonatal outcomes such as birth weight and neonatal complications were similar in both groups. None of the neonates had COVID positive testing by throat swab.

*Comparing symptomatic to asymptomatic women*

Maternal characteristics (Table 5).

Age, parity, and Gravidity were almost the same, but symptomatic women were more likely to be of advanced maternal age (45 versus 33%).

Maternal complication (Table 6).

Symptomatic women were more likely to require treatment and respiratory support and were diagnosed with Pneumonia in 22 (5.5%), five patients (1%) were admitted to ICU, and one patient died.

Pregnancy outcome (Table 7).

Symptomatic women had a higher rate of Abortion (6 versus 2% p-value of 0.001) and fetal death (3 versus 1.3%) than symptomatic women. Prenatal complications were more common among symptomatic than asymptomatic women (28.5% versus 20%). Gestational diabetes (GDM) was the most common complication (17.5 versus 11.6) among asymptomatic women. Symptomatic women were more likely to have CD at 30.8% versus 22.4% (p-value 0.001).

Neonatal outcome: (Table 8).

Neonatal death was higher in the symptomatic group 4/146 (3%). All NND occurred in women with AMA.

**Table 5**  
Comparing maternal characteristics between symptomatic to Asymptomatic women.

Variable	Symptomatic N = 146 (%)	Asymptomatic N = 248 (%)	P value
Maternal age at time of delivery (Mean)	31.02	30.67	
Advanced maternal age	65 (45)	83 (33)	0.024
Body mass index	29	31	0.001
Gravidity	3.77	3.45	
Therapy required	44	18	0.001
Respiratory support	5	0	0.019
Gestational age at time of delivery (Mean)	37.45	38.12	SD 4
Past medical history			
Respiratory disease	1	1	
Hematological disease	1	6 (3)	
Thyroid disease	3 (2)	0	
Cardiac disease	1	0	
Diabetes mellitus	0	2	
Thrombophilia	1	0	

Comparing COVID positive women of Advanced Maternal Age to younger women (Table 9).

Women with advanced maternal age were more likely to have higher BMI, Gravidity, and parity. In addition, they were more likely to be symptomatic. Pregnant women younger than 35 years had lower median ARI scores (0 versus 0, p-value of 0.03) than older women. AMA women had a higher rate of Abortion (5 versus 1%, p-value 0.01), Preterm delivery (17 versus 11% p-value 0.01), and lower mean gestational age at delivery (36 versus 38.4 weeks) when compared to younger women. Neonatal death was more common in AMA than in the younger group (4 versus 0%). There was no difference between women of AMA and younger women in the mode of delivery or birth weight.

**Discussion**

*Maternal symptoms*

Most of the COVID-19 positive women (56%) were asymptomatic at diagnosis. This finding is similar to data from London and New York centers, where all pregnant women admitted to birthing units had routine swabs for polymerase chain reaction (PCR) testing for COVID-19. It was found that 88% of the women who tested positive were asymptomatic [14,15]. The most common COVID-related symptoms were cough, shortness of breath, and fever, like the finding of a systematic review of 24 studies, including a total of 324 pregnant women who tested positive for COVID [16].

In the UKOSS study [9], COVID-19 infection appears to be more common in later pregnancy. Most women were hospitalized in the third trimester or peripartum (bearing in mind that Admission at term to give birth will contribute to this distribution). Symptomatic COVID-19 was principally diagnosed in the third trimester: 83% of symptomatic women were diagnosed At or beyond 28 weeks, 52% were diagnosed at or beyond 37 weeks.

*Acute respiratory infection scoring system*

Using the ARI scoring system did not help triage patients. 62% of patients had an ARI score of less than 4, which is the cut-off for recommended isolation by MOH. This study could not calculate the sensitivity or specificity because it did not include non-COVID women. Mimish et al. [17]. tested the sensitivity and specificity of the ARI scoring system in MERS-CoV cases. A cut of 4 had a sensitivity of 74% and a specificity of 19%. The sensitivity and specificity of the scoring system did not improve even with giving more weight to the history of exposure to positive cases over the last two weeks. Jazieh et al. [18]. investigated the yield of using the ARI scoring system as a screening tool for COVID-19 infection in cancer patients. The positive predictive value was only 18.24%, with a confidence interval (CI) of 0–32 with fluctuating results parallel to the prevalence of the disease and a negative predictive value of 96 (86–99%).

*Maternal hospital admission*

In this study, most women were admitted (83%). The reason for admission was the policy of admitting all pregnant at the beginning of the pandemic or COVID-related symptoms later in the pandemic. In the UKOSS study [9], admitting asymptomatic women were principally to give birth (68%). For symptomatic women, the reasons for admission were symptomatic COVID-19, giving birth, and other reasons.

**Table 6**  
Comparing maternal and pregnancy outcome between symptomatic to Asymptomatic women.

Outcome	Symptomatic N=146 (5)	Asymptomatic N= 248 (%)	p-value
Pneumonia	22	0	0.001
Intensive care unit admission	5 (3.4)	0	0.01
Perinatal complication			
Any perinatal complication	57(40)	85(35)	0.262
Gestational Diabetes	25(17)	26(11)	
Hypertensive disease in pregnancy	4 (3)	1	
Preeclampsia	3 (2)	1 (0.4)	
Postpartum complication			
Any postpartum complication	12 (9)	20 (8)	0.848
Postpartum hemorrhage	4 (3)	12 (5)	
Worsening of respiratory status	1 (1)	0	
Wound infection	2 (2)	1 (0.4)	
Fever	2 (2)	3 (1)	
Anal sphincter tear	0	1 (0.4)	
Anemia	0	2 (1)	

**Table 7**  
Comparing perinatal outcomes between symptomatic to Asymptomatic women.

Outcome	Symptomatic 146 (%)	Asymptomatic 248 (%)	p-value
Abortion	8 (6)	5 (2.1)	0.001
Fetal death	4 (3)	3 (1.3)	0.001
Preterm delivery	27 (11)	20(15)	0.4
PPROM	1 (1)	3 (1)	0.4
Low birth weight	6 (4)	14 (6)	0.4
Fetal complications (hydrops, anomalies and IUGR)	4 (3)	12 (5)	0.4
Cesarean delivery	45(31)	55(22)	0.001
Indication			
Repeat	12 (8)	24 (10)	0.104
for CS			
Abnormal CTG	16 (11)	10 (4)	
Failure to progress	4 (3)	2 (1)	
Twins	2	1	
Maternal request	0	1	
Failed operative delivery	1 (1)	0	
Malpresentation	2 (1)	3 (1)	
Other indications	9(6)	13 (5)	

**Maternal pneumonia**

Seventy women needed a chest x-ray (CXR), and only 30% had abnormal findings. The maternal disease was mainly mild. Only 2% required respiratory support, and one had mortality. Five women in this cohort were admitted to ICU with one mortality. In a meta-analysis of studies including 753 women pregnancies of COVID-positive women, 78 women (10%) were admitted to ICU. Among the 1100 pregnant women, five cases of maternal death were reported [19].

**Abortion**

Pregnancy loss before 20 weeks occurred in 3.4% of cases. It was statistically more common in symptomatic women (6 versus 2%) and more common in women with AMA 5.2 versus 1.2%. Seasonal influenza has been associated with higher rates of miscarriage [20]. The relationship between influenza and birth rates during the 1918

**Table 8**  
Comparing Neonatal outcomes between Symptomatic to Asymptomatic women.

	Symptomatic N= 146 (%)	Asymptomatic N= 248 (%)	
Any Neonatal Complication	50 (34)	87 (35)	0.650
Neonatal death	2 (1.4)	2 (0.8)	0.6
Birth weight (gm)	2935	2625	0.001

**Table 9**  
Comparing COVID positive women with advanced maternal age (AMA) to younger women.

	AMA N = 120	Non-AMA N = 274	P value
Age (mean)	38	27	
BMI (mean)	32.5	30	0.001
Gravidity (median)	5 (IQR 1)	2 (IQR 2)	0.001
Parity (median)	3 (IQR3)	1 (IQR 2)	0.001
ARI score at presentation (median)	2 (IQR4)	0 (IQR4)	0.03
Abortion	6 (5.2)	3 (1.1)	0.01
GA at delivery (mean in weeks)	36.6 (SD6)	38.4 (SD3.7)	0.001
Preterm delivery before 37 weeks	20 (17)	29 (11)	0.01
Cesarean delivery	36 (33%)	65 (24%)	0.115
Birth weight in gm (median)	3030 (IQR 710)	3000 (IQR 640)	0.3
Neonatal death	4	0	

pandemic in the United States, Denmark, Sweden, and Norway was investigated by examining monthly birth rates from 1911 through 1930. Birth rates declined in study populations in spring 1919 by a mean of 2.2 births per 1000 persons, representing a 5 –15% drop below baseline levels ( $P < 0.05$ ). The 1919 birth rate reached its trough 6.1–6.8 months after the Autumn pandemic peak, suggesting that missing births were attributable to excess first trimester miscarriages in ~1 in 10 women who were pregnant during the height of the pandemic. Pandemic-related mortality was insufficient to explain observed patterns [21].

**Preterm labor before 37 weeks**

Preterm delivery before 37 weeks occurred in 13% of this study group. Women with COVID infection and AMA had a statistically significant higher rate of preterm delivery when compared to younger women (17 versus 11%). The pooled proportion of preterm birth < 37 weeks was 41% (CI) 25–57 in a systematic review, and a meta-analysis of 6 studies included 32 COVID-positive pregnant women [22]. In India, the overall proportion of babies born preterm (i.e., before 37 weeks gestation) increased from 8.3% in the pre-lockdown period to 10.4% in the post-lockdown period [23].

Regardless of the status of documented COVID infection. Similar findings were also reported in Nepal [24].

Most of the preterm labor in the Indian study [25] was spontaneous. The rate of spontaneous preterm delivery increased from 63% in the pre-lockdown cohort to 67% in the lockdown cohort. By contrast, the proportion of iatrogenic preterm births decreased from 13% in the pre-lockdown cohort to 7% in the lockdown cohort. This reduction is most likely due to the number of antenatal visits pre-lockdown compared with post-lockdown, which might have led to a decrease in the identification of pregnancies requiring medically indicated preterm birth, resulting in a decreased rate of iatrogenic preterm births [25].

#### Cesarean delivery

CD rate was 24% in this study population. This rate is 11% lower than the rate reported in the same institution before the pandemic [26]. Cesarean delivery was more common in symptomatic women (31 versus 22%). CD in India during the COVID-19 lockdown period was 37%, significantly higher than the rate during the pre-lockdown period of 33.0% ( $p=0.04$ ) [25]. The rate of CD was 91% in a Meta-analysis of 6 studies that included 41 positive women. The most common indication for CD in this cohort was an elective repeat CD and abnormal fetal monitoring.

#### Intrauterine fetal death

The rate of IUFD in the study population was 2%, and it was more common among symptomatic women (3 versus 1.3%). This rate is similar to the rate reported in India.

2.2–3.2% [25] and Nepal [24] 1.4–2% during the pandemic. The IUFD rate during the study period was much higher than the reported rate of 3.42/1000 in Riyadh, Saudi Arabia, before the pandemic in 2017 [27].

The UK Obstetric Surveillance System reported a stillbirth rate of 12.1 per 1000 births in women with confirmed coronavirus disease COVID-19 versus the national rate of 4–5 per 1000 [28].

During the COVID pandemic, the stillbirth rate increased regardless of whether the pregnant women were diagnosed with COVID infection. In a study done by Khalil et al. [1], the stillbirth rate was compared between 1681 birth in the pre-pandemic period and 1718 birth in the pandemic period, the overall incidence of stillbirth was significantly higher during the pandemic period (9.31 per 1000 births); none associated with COVID-19; than during the pre-pandemic period (2.38 per 1000 births) the difference, 6.93 per 1000 birth [95% CI, 1.83–12.0];  $P=0.01$  [29].

#### Neonatal complication

NND occurred in 4 cases (1%) of 394. This rate is similar to the rate reported, during the pandemic, in Saudi Arabia at 3/288 [30], China at 2/155 [16], and Italy at 3/444 [19].

#### COVID-19 vaccination

This study was done before the availability of the COVID vaccine. More than 347 150 women in the UK and USA have had a COVID-19 vaccine during pregnancy with no concerning safety signals. There is excellent evidence of vaccine efficacy with 98% of women admitted to hospital and getting severe infections have not had the vaccine [31] A recent meta-analysis evaluated evidence from 23 studies including 117,552 COVID-19 vaccinated pregnant people, almost exclusively with mRNA vaccines. The risk of stillbirth was significantly lower in the vaccinated cohort by 15% (pooled OR 0.85; 95% CI 0.73–0.99). There was no evidence of a higher risk of adverse outcomes, including miscarriage, earlier gestation at birth, placental

abruption, pulmonary embolism, postpartum hemorrhage, maternal death, intensive care unit admission, lower birth weight, or neonatal intensive care unit admission [32].

#### Conclusion

Most of COVID infected pregnant women were asymptomatic. Therefore, the ARI scoring system did not help triaging patients. Symptomatic women older than 35 tend to have a higher maternal and pregnancy complication rate.

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#### Ethical approval

The research was approved by Ethical board of King Abdulaziz International Research Center.

#### Contribution statement

Taghreed Shams owns the research idea, supervised data collection and wrote the manuscript. Hashem Alhashemi did the data cleaning and analysis. All other authors contributed to data collection.

#### Data availability

Data is available upon request.

#### Conflict of interest

None.

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