# Clinical and Evolutionary Characteristics of Pregnant and Postpartum Women with COVID-19 Admitted to a Hospital in the Central Region of Brazil

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## Abstract

**Objective:** This study aims to describe the demographic and evolutionary characteristics of pregnant and postpartum women with the novel coronavirus disease (COVID-19) who were admitted to a medium-sized hospital in Brazil. **Methods:** This descriptive and retrospective study collected data from medical records at a hospital in Cuiabá (MT) from March 2020 to October 2021. **Results:** Pregnant and postpartum women with COVID-19 who needed hospitalization were predominantly mixed-race, from metropolitan areas, and carriers of moderate and severe forms of the disease. The most prevalent comorbidities in this group were pre-gestational diabetes, hypertension, asthma, and autoimmune disease, with the primary risk factors being overweight and obesity. Furthermore, elevated lactate dehydrogenase (LDH), C-reactive protein (CRP), and D-dimer levels were the relevant laboratory findings in this group of patients. The most frequent maternal outcomes were respiratory failure, invasive ventilatory support, thromboembolic phenomena, sepsis, and preterm labor. Maternal death occurred in 6.4% of pregnant women. Preterm birth and the need for neonatal intensive care units (NICU) were significant complications in neonates; stillbirth/neonatal mortality rate is 11.0%. **Conclusion:** This study's findings revealed that the clinical conditions at hospitalization were associated with worse living conditions and lack of access to healthcare, resulting in an increased likelihood of severity and deteriorating outcomes in this group of women and neonates.

## 1. Introduction

The first published studies on the novel coronavirus disease (COVID-19) demonstrated no increased risk of morbidity and mortality in the obstetric population [1] [2]. However, new research indicates that COVID-19 may have more adverse effects in pregnant women than nonpregnant women, leading to an increased maternal mortality rate and neonatal complications in the former [3] [4].

Critical meta-analysis studies have identified that pregnant women with COVID-19 are more asymptomatic than nonpregnant women of the same age group who have also been diagnosed with COVID-19. However, the mortality rate is significantly higher in pregnant women with COVID-19 owing to an increased risk of fatal complications associated with the disease [4] [5].

In addition to the increased risk of maternal morbidity and mortality, perinatal and neonatal outcomes are significantly worse in children born to pregnant women with COVID-19, such as a threefold increase in neonatal intensive care units (NICU) admissions [6] [7].

In 2020, the Pan American Health Organization (PAHO) reported a significant increase in the number of COVID-19-infections in pregnant and postpartum women and COVID-19-related maternal mortality in 12 countries. Brazil had the most deaths and an alarming maternal mortality rate of 7.2%, more than double the current mortality rate of the country's general population, which is 2.8% [8].

The Brazilian Obstetric Observatory COVID-19 reported that 18,881 pregnant and postpartum women had COVID-19-induced SARS in January 2022, with a fatality rate higher than that reported by PAHO in 2021 (11.5%); mortality was higher in the third trimester (37.8%) and the puerperal period (32.8%). Notably, 20.1% of pregnant or puerperal women who died had no access to an intensive care unit (ICU), and 32.3% had no access to invasive ventilatory support [9].

This study examines the demographic, clinical, laboratory, and evolutionary characteristics of pregnant and postpartum women with COVID-19 who were admitted to a medium-sized hospital in central Brazil between 2020 and 2021.

## 2. Patients and Methods

This is a descriptive and retrospective study of the clinical characteristics and evolution of pregnant and postpartum women hospitalized for COVID-19 from March 2020 to October 2021 in a university hospital in Cuiabá (MT). All preg-

nant and postpartum women admitted to the Hospital Universitário Júlio Müller (HUJM) after the reverse transcription-polymerase chain reaction (RT-PCR) test for COVID-19 or computerized tomography (CT) of the chest were included in the analysis.

For this study, a specific database was prepared to record the demographics, clinical and laboratory data, and maternal and fetal outcomes of all pregnant and postpartum women hospitalized for COVID-19 during the study period. The data were obtained by reviewing all electronic and physical records available in the institution's electronic system.

For qualitative data, we employed percentages, while for quantitative data, we employed means and standard deviations. Information on preexisting comorbidities and the incidence of complications during hospitalization was based on the identification of these events in the medical records. COVID-19 severity was measured using WHO guidelines [10]. Invasive respiratory support depended on the patient's need for mechanical ventilation, either by an orotracheal tube or tracheostomy tube [11]. Chest tomography and echocardiography were used to identify pulmonary and cardiac abnormalities. The International Classification of Diseases, Version 10 (ICD-10) was used to chart the development of obstetrics and maternal and fetal outcomes [12].

This study was approved by the Ethics and Research Committee of the Hospital Universitário Júlio Müller/Universidade Federal do Mato Grosso (opinion number: 4.622.295; CAAE number: 44693621.0.0000.5541).

## 3. Results

From March 2020 to October 2021, 126 pregnant and postpartum women with COVID-19 verified by RT-PCR at the hospital were admitted to HUJM. None of these patients was vaccinated against COVID-19. The women were predominantly mixed-race (89.7%), married (41.3%), or in a stable union (26.2%). The places of origin of these patients were equally distributed between the metropolitan area (50.8%) and the interior of the state (49.2%). Only 51 patients (40.5%) had no comorbidities. Diabetes mellitus (19%) and arterial hypertension (17.5%) were the most common among conditions. Moreover, overweight and obesity were diagnosed in 20.2% and 44.4% of patients. The mean (SD) age was 29.7 (6.1) years (Table 1).

On admission, laboratory tests revealed anemia, with a mean (SD) hemoglobin level of 10.7 (1.6) g/dL and mild leukocytosis with a mean (SD) cell count of 11,738 (5546) cells/μL. We observed an evident elevation of acute inflammation markers, such as C-reactive protein (CRP) with a mean (SD) of 45.9 (66.0) mg/dL and lactate dehydrogenase (LDH) with a mean of (SD) 440.8 (850.0) U/L. More than half the women (57.2%) had peripheral oxygen saturation levels below 95%. The high elevation of serum D-dimer levels was striking, with a mean (SD) of 3224 (8568) mg/L (Table 1).

The severity of COVID-19 upon admission was used to categorize the pregnant and postpartum women in this study into mild (28.6%), moderate (31%),

**Table 1.** Demographic, clinical, and laboratory characteristics of 126 pregnant and post-partum women with COVID-19 who were admitted to a medium-sized hospital in the central region of Brazil, 2020-2021.

| Variable | | n (%) |
|---|---|---|
| Color | White | 13 (10.3) |
| | Mixed-race | 113 (89.7) |
| Marital Status | Married | 52 (41.3) |
| | Stable Union | 33 (26.2) |
| | Single | 40 (31.7) |
| | Widow | 1 (0.8) |
| Source | Cuiabá metropolitan area | 64 (50.8) |
| | Interior | 62 (49.2) |
| Comorbidities | No | 51 (40.5) |
| | Diabetes | 24 (19.0) |
| | Hypertension | 22 (17.5) |
| | Asthma | 6 (4.8) |
| | Autoimmune disease | 5 (4.0) |
| | Heart Disease | 3 (2.4) |
| | Hypothyroidism | 3 (2.4) |
| | Other | 12 (9.4) |
| Nutritional status | Low weight | 7 (7.1) |
| | Appropriate weight | 28 (28.3) |
| | Overweight | 20 (20.2) |
| | Obesity | 44 (44.4) |
| $O_2$ saturation | <95% | 57.2 |
| | >95% | 42.8 |
| | **Reference intervals** | **Mean (SD)** |
| Age (years) | - | 29.7 (6.1) |
| Hemoglobin (g/dL) | 13.5 - 17.5 | 10.7 (1.6) |
| Leukocytes (cells/µL) | 4.000 - 11.000 | 11.738 (5.546) |
| Lymphocytes (cells/µL) | 855 - 5.280 | 1.322 (743) |
| C-reactive protein (mg/L) | 0 - 0.5 | 45.9 (66.0) |
| Lactate dehydrogenase (U/L) | 135.0 - 214.0 | 440.8 (850.0) |
| Platelets (cells/µL) | 140.000 - 400.000 | 237.296 (93.813) |
| D-dimer- | <0.5 mg/L | 3224.5 (8.5678) |
| pH | 7.35 - 7.45 | 7.37 (0.10) |
| $pCO_2$ (mmHg) | 35 - 45 | 38.0 (12.7) |
| $HCO_3^-$ (mEq/L) | 21 - 26 | 21.8 (5.8) |

SPO$_2$: peripheral oxygen saturation; pH, blood hydrogen potential; pCO$_2$, partial pressure of carbon dioxide; $HCO_3^-$: bicarbonate.

and severe (40.5%) cases. As many as 86 (68.3%) and 55 (43.6%) patients required ICU hospitalization and invasive ventilatory assistance, respectively. It was possible to perform chest tomography on 90 patients, and the analysis revealed that all of them (100%) had pulmonary involvement. A similar pattern was noticed in 28 patients who underwent echocardiography, where alterations were observed in 78.6% of the examinations. During their entire hospital stay, the following complications were identified in 46% of patients: respiratory failure associated with stroke, pulmonary edema, thromboembolic phenomena, and sepsis (Table 2).

Among the primary obstetric complications reported after the diagnosis of COVID-19, premature labor (19.0%) had the most impact on the sample analyzed. However, 44 (34.9%) patients continued their pregnancies after hospitalization and were discharged while they were pregnant. During hospitalization, preterm births occurred in 57 (45.2%) pregnant women with COVID-19, whereas only 23 (18.3%) pregnant women achieved term delivery. Abortion was reported in only two cases (Table 2). After a mean (SD) hospitalization period of 20 (15.9) days, 118 (93.6%) patients were discharged, and 8 (6.4%) died. The primary causes of mortality were as follows: septic shock, hypovolemic shock, acute renal failure, myocarditis, and severe acute respiratory syndrome. Details of the clinical and laboratory characteristics of the eight deceased women upon admission are displayed in Table 3.

This study's analysis of fetal outcomes in pregnant and postpartum women revealed 67 (81.7%) cesarean deliveries and 15 (18.3%) vaginal deliveries. The mean (SD) of 5' appearance, pulse, grimace, activity, and respiration (APGAR) of the conceptuses of these deliveries was 6.9 (3.1), and the mean (SD) birth weight was 2280 (830) grams. Because of the fetal outcome, 40 (48.8%) neonates were discharged immediately, 33 (40.2%) were admitted to the NICU, and nine (11%) were classified as stillborn. The results of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) ribonucleic acid (RNA) research on newborns' gastric aspirates were negative in 85.7% and positive in 14.3% (Table 4).

## 4. Discussion

This study discovered that COVID-19 was most common among the mixed-race pregnant and postpartum women hospitalized in a medium-sized hospital in the state of Mato Grosso, residents of the metropolitan area of the capital, obese or overweight women, and those with diabetes mellitus and arterial hypertension as the main comorbidities. Moderate and severe COVID-19 was the primary causes of hospitalizations, with elevated LDH, CRP, and D-dimer levels being the predominant laboratory changes. Maternal mortality was observed in 6.4% hospitalized women, and stillbirth/neonatal mortality in 11.0% of conceptuses.

The predominance of mixed-race women was consistent with the national data from a widely disseminated study, which showed worse disease prognosis among Black women and women of color [13]. The authors attributed this finding

**Table 2.** Evolutionary characteristics of the pregnant and postpartum women with CO-VID-19 who were admitted to a medium-sized hospital in the central region of Brazil, 2020-2021.

| Features | | n (%) |
|---|---|---|
| Clinical classification | Light | 36 (28.5) |
| | Moderate | 39 (31.0) |
| | Severe | 51 (40.5) |
| Need for intensive therapy | No | 40 (31.7) |
| | Yes | 86 (68.3) |
| Ventilatory support | No | 33 (26.2) |
| | Yes, non-invasive | 38 (30.2) |
| | Yes, invasive | 55 (43.6) |
| Pulmonary involvement (Computerized Tomography) | No | 0 (0.0) |
| | Yes | 90 (100.0) |
| Cardiac involvement (echocardiogram) | No | 6 (21.4) |
| | Yes | 22 (78.6) |
| Complications | No | 68 (54) |
| | Respiratory insufficiency | 6 (4.8) |
| | Respiratory failure + stroke | 1 (0.8) |
| | Respiratory failure + Pulmonary Edema | 15 (11.9) |
| | Respiratory failure + DVT/VTE | 12 (9.5) |
| | Respiratory failure + Sepsis | 15 (11.9) |
| | Respiratory failure + Surgical infection | 9 (7.1) |
| Obstetric complication | No | 96 (76.2) |
| | Premature labor | 24 (19.0) |
| | Subaponeurotic/intracavitary hematoma | 3 (2.4) |
| | Postpartum hemorrhage | 2 (1.6) |
| | Placental remains | 1 (0.8) |
| Obstetric evolution | Preterm delivery | 57 (45.2) |
| | Gestation in progress | 44 (34.9) |
| | Full-term birth | 23 (18.3) |
| | Abortion | 2 (1.6) |
| Maternal outcome | Death | 8 (6.3) |
| | High | 118 (93.7) |
| **Mean ± SD** | | |
| Time of onset of symptoms (days) | | 7.8 ± 4.5 |
| Hospitalization time (days) | | 20 ± 15.9 |

**Table 3.** Clinical and laboratory characteristics of pregnant women who died from COVID-19 admitted to a medium-sized hospital in the central region of Brazil, 2020-2021.

| | Case 1 | Case 2 | Case 3 | Case 4 | Case 5 | Case 6 | Case 7 | Case 8 |
|---|---|---|---|---|---|---|---|---|
| **Clinical conditions upon admission** | | | | | | | | |
| Age | 37 | 38 | 36 | 28 | 20 | 27 | 26 | 25 |
| Color/ethnicity | Mixed-race | White | Mixed-race | White | Mixed-race | Mixed-race | Mixed-race | Mixed-race |
| Gestational age at admission | 26 s | 32 s | 9 s | 26 s | 37 s | 38 s | 26 s1 | 24 s |
| Comorbidities | No | No | Cardiopathy | No | SAH + PE | No | No | No |
| Gravity at admission | Moderate | Severe | Severe | Severe | Severe | Severe | Severe | Severe |
| Time from onset of symptoms to the hospitalization | 7 days | 5 days | 4 days | 5 days | 12 days | 4 days | 5 days | 7 days |
| $SPO_2$ on admission | 93% | 82% | 97% | 90% | 96% | 83% | 90% | 86% |
| The respiratory rate at admission | 35 | 38 | 34 | 28 | 24 | 36 | 24 | 20 |
| Respiratory upon admission | Ambient air | Nasal catheter | Nasal catheter | MV | MV | MV | MV | MV |
| Place of hospitalization on admission | Infirmary | Infirmary | ICU | ICU | ICU | ICU | ICU | ICU |
| The interval from admission to death | 16 days | 5 days | 3 days | 14 days | 12 days | 18 days | 37 days | 15 days |
| Obstetric intervention | Induction of labor | Cesarean section | No | Induction of labor | Postpartum | Postpartum | Cesarean section | Cesarean section |
| Indication of obstetric intervention | Fetal death | Maternal IOT | - | Fetal death | PE | - | Fetal death | PCR |
| Vaccination against SARS-CoV-2 | No | No | No | No | No | No | No | No |
| **Laboratory tests upon admission** | | | | | | | | |
| Hemoglobin (g/dL) | 13 | 11.3 | 12.5 | 11.1 | 7.0 | 8,8 | 7,3 | 9,3 |
| Leukocytes: 4000 to 11,000/μL | 13.840 | 25.170 | 11.600 | 18.970 | 6.650 | 16.620 | 21.270 | 10.120 |
| Lymphocytes: 855 to 5280/μL | 790 | 1510 | 1516 | 1138 | 1463 | 1828 | 1276 | 1113 |
| CRP: <0.5 mg/L | 158.1 | 239.0 | 47.3 | 18.14 | 134.1 | 167,4 | 191,4 | 3,41 |
| LDH: 135.0 to 214.0 U/L | | | 473 | 656.0 | 318 | | 7854 | 383 |
| Platelet: 140,000 to 400,000/μLs | 241.000 | 286.000 | 230.000 | 284.000 | 397.000 | 405.000 | 116.000 | 214.000 |

**Continued**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| D-dimer: <0.5 mg/L | 0.1 | | 7.9 | 2.3 | 5.7 | | 10,0 | 0,9 |
| Fibrinogen: 200 to 400 mg/dL | NR | | NR | 546 | NR | | 122 | 590 |
| Urea: 21.0 - 45.0 mg/dL | 13 | 12 | 32 | 17 | 34 | 66 | 89 | 89 |
| Creatinine: 0.6 - 1.1 mg/dL | 0.5 | 0.5 | 1.0 | 0.9 | 0.5 | 1,0 | 0,6 | 2,7 |
| PTT (25" - 45") | 34.9" | 41.6" | 64.8" | 28.8" | 16.6" | 26,1" | 32,6" | 26,6" |
| APTT–RNI (0.8 - 1.2) | 1.02 | 0.83 | 4.72 | 1.02 | 1.19 | 1,18 | 1,65 | 0,96 |
| pH (7.35 - 7.45) | 7.48 | 6.93 | 7.15 | 7.25 | 7.33 | 7,43 | 7,09 | 7,41 |
| $pO_2$ (80 - 100) mmHg | 88.0 | 44.0 | 130.0 | 131.0 | 35.0 | 77,0 | 125,0 | 104,0 |
| $pCO_2$ (35 - 45) mmHg | 29.0 | 53.0 | 16.0 | 55.0 | 50.0 | 48,0 | 27,0 | 58,0 |
| $HCO_3^-$ (21 - 26 mmol/L) | 21.6 | 11.0 | 8.4 | 24.6 | 26.3 | 31,8 | 8,4 | 36,8 |
| The immediate cause of death | Acute renal failure | Septic shock | Septic shock | Septic shock | Acute Myocarditis | Septic shock | Septic shock | Hypovolemic shock |

CRP, C-reactive protein; LDH, lactate dehydrogenase; PTT, prothrombin time; APTT, activated partial thromboplastin time; pH, blood hydrogen potential; $pCO_2$, partial pressure of carbon dioxide; $HCO_3^-$ —bicarbonate.

Table 4. Fetal outcomes of pregnant and postpartum women with COVID-19 admitted to a medium-sized hospital in the central region of Brazil, 2020-2021.

| Outcomes | | n (%) |
|---|---|---|
| | | Mean (SD) |
| APGAR Score 5' | | 6.9 (3.1) |
| Birth weight (g) | | 2280.8 ± 830.7 |
| Mode of delivery | *Vaginal* | 15 (18.3) |
| | *Cesarean section* | 67 (81.7) |
| Fetal outcome | *Neonatal intensive care,* | 33 (40.2) |
| | *Stillbirth/neomortality* | 9 (11.0) |
| | *Hospital Discharge* | 40 (48.8) |
| Viral RNA in gastric aspirate | *Positive* | 6 (14.3) |
| | *Negative* | 36 (85.7) |

to the effect of racism and sexism as structural determinants of worse living and working conditions (facilitating transmission) and the lack of access to healthcare (determining worse prognosis) of this group of women [13]. This pattern can also be observed in the United States, where 58.4% of patients were Black or Hispanic. In the United Kingdom, 55% were from Black, Asian, and other minority communities [14] [15].

Although this study's participants were equally from the state's interior and the capital's metropolitan area, most women who died were from the interior. As

a reference hospital at the state level, pregnant or postpartum women with severe COVID-19 are systematically brought to the state capital, including those living in municipalities more than 1,000 km away. This protracted displacement worsens the patient's clinical condition and poses a greater risk of death. The most frequently found comorbidities were pregestational diabetes and hypertension, followed by obesity and asthma, although these were not associated with a higher risk of death [16]. Metz *et al.* pointed out that pregnant women with a worse prognosis were carriers of asthma, chronic obstructive pulmonary disease, chronic hypertension, or pregestational diabetes [17]. In the UK, pregnant women with COVID-19 had associated comorbidities, such as gestational diabetes, pregestational diabetes, hypertension, and asthma [15]. Mendez-Rodriguez *et al.* reported that asthma and immunological impairment increased the likelihood of developing pneumonia, obesity, and diabetes, increasing the risk of hospital death [18]. In Iran, pregnant women with comorbidities, such as hypothyroidism, diabetes mellitus, and hypertension, were associated with worse outcomes [3]. In a multicenter study conducted in Spain, Carrasco *et al.* discovered that gestational hypothyroidism, obesity, gestational diabetes, hypertension, autoimmune illnesses, and asthma were the most prevalent comorbidities among pregnant women with COVID-19 [19]. Many patients, including women from Mexico, the United States, Turkey, and England, were diagnosed with overweight and obesity [7] [18] [20]. When describing the outcomes of 214 pregnant women with COVID-19 admitted to hospitals in Northern Europe, Engjon *et al.* discovered that 158 of them were discharged after delivery and only 56 required continued hospitalization because of COVID-19, of which 32.1% were attributable to obesity-related complications [21].

Among the laboratory alterations observed, discrete anemia and leukocytosis were expected in gravid conditions, although their relationship with COVID-19 remains unclear. However, the elevation of acute inflammation markers (LDH and CRP) and the anticoagulant marker D-dimer were evident. In France, Biguenet *et al.* reported a significant increase in LDH and CRP levels during the first 10 days of symptom onset [22]. Similar results for serum D-dimer concentrations have been reported in studies from Turkey, Spain, and China [19] [23] [24]. As these inflammatory and anticoagulant indicators may be linked to a deterioration of the patient's clinical condition, it is believed that they should be dynamically analyzed during the course of COVID-19.

At the time of hospital admission for pregnant women with COVID-19, moderate and severe clinical manifestations of the disease were predominant. With a low average time between the onset of symptoms and admission, a significant portion of pregnant and puerperal women still presented with moderate disease presentation. This demand profile is a consequence of the hospital's status as a reference service for pregnant women with COVID-19. Very few patients were on mechanical ventilation on admission due to the precariousness of health services. The precarious structural and technical conditions of intensive care services in Brazil's interior justify this massive and early referral of patients with

COVID-19. This could be attributed to higher mortality rates of patients with COVID-19 that have already been observed when treatment was performed in hospitals and ICUs in interior cities [25].

The main complications identified during hospitalization were the need for intensive care for respiratory failure, invasive ventilatory support, thromboembolic phenomena, and sepsis. These findings were worse than those observed by Sentilhes *et al.* in France, who pointed out that 68.5% of the hospitalized pregnant women had mild to moderate or severity. Furthermore, only 9.3% required intensive care, with invasive ventilatory support in about 5.0% [26]. Studies in Chile, the United States and several European, American, Asian and African countries also classified the majority of pregnant women with COVID-19 as mild and moderate cases of the disease, with low need for intensive care and supportive invasive ventilation, as well as a low frequency of lung involvement on CT [7] [17] [27]. Notably, in the studies mentioned above, the motivation for hospitalization was the beginning of labor [17] [23] [27]. Simultaneously, regardless of gestational age, the women in this study experienced negative/unfavourable progression of COVID-19. These changes most likely explain the worse severity profiles in the women studied here. These findings are consistent with the reports from the Center for Disease Control and Prevention, suggesting that pregnant women face a threefold increased risk of ICU admission and mechanical ventilation, as well as a 70% risk of maternal mortality [17].

Among the women studied, preterm labor was one of the main obstetric complications recorded after the diagnosis of COVID-19. Maternal mortality due to COVID-19 in this study was lower than that recorded for the state of Mato Grosso (8.4%), the Midwest Region (8.9%), and Brazil (11.5%) for the same period [9]. It has been established that Brazil has the highest fatality rate of COVID-19 globally, followed by other developing countries, such as Mexico and Iran [3] [18]. It is essential to highlight that the high fatality observed here was not associated with comorbidities, corroborating the findings published by the United Kingdom Obstetric Surveillance System (UKOSS), which is the obstetric surveillance system of the United Kingdom [15].

Most preterm births and cesarean deliveries among the pregnant women analyzed in this study were prompted by COVID-19-related clinical complications, and anticipatory delivery was assumed. In the San José Maternity Hospital in Santiago de Chile, we observed that 16% of pregnant women with COVID-19 continued their pregnancies, 23% of deliveries were preterm, 46.1% of deliveries were C-sections, and 6% of them miscarriages [27]. In the GESNEO-COVID (ANO) study in Spain, it was identified that 20.6% of deliveries were preterm and 36.2% cesarean—all associated with a worsening maternal clinical condition. However, there were no maternal deaths in this study [19]. Vizheh *et al.* reported that in Iranian pregnant women, 44.5% continued the pregnancy, 29.1% had to give birth prematurely, and 7.3% had a spontaneous abortion; 83.3% of the births involved cesarean sections [3]. In a study conducted in Nordic countries, 25% of deliveries were preterm, 14.28% of pregnancies were full-term, and

41.75% were cesarean sections—mostly (85%) emergency cases [21].

This study's most common fetal and neonatal outcomes were admission to the neonatal care unit, fetal and neonatal death, and SARS-CoV-2 RNA positivity in gastric aspirates within the first 24 h of life. These findings were associated with the need for early delivery due to the clinical deterioration of the pregnant woman. In addition, a tertiary care hospital in Mexico made a similar discovery. A total of 44% of newborns from mothers with COVID-19 saw a high rate of admission to the NICU, wherein 8% were stillborn, and 30% were positive for SARS-CoV-2 [20]. Similarly, Vizheh *et al.* reported that in Iran, the neonatal outcomes were premature births in approximately 25%, neonatal ICU admissions in 29.3%, and 15.7% of neonates were positive for SARS-CoV-2 in the first 24 h, with 3.9% neonatal mortality [3]. In a maternity hospital in Chile, 23% of deliveries were premature, only 13.6% required NICUs, 10% of newborns tested positive for SARS-CoV-2 in the first 24 h, and fetal/neonatal mortality was 5.7% [27]. Other studies conducted in the United States, Spain, and the United Kingdom have reported similar fetal and neonatal outcomes [15] [17] [19].

This descriptive study revealed that pregnant and postpartum women with COVID-19 who required hospitalization were predominantly mixed-race, married, from metropolitan areas, and carriers of moderate and severe forms of the disease. The most prevalent comorbidities in this group were pre-gestational diabetes, hypertension, asthma, and autoimmune disease, with the primary risk factors being overweight and obesity. Moreover, relevant laboratory results in this group of patients included elevated LDH, CRP, and D-dimer levels. The most frequent maternal outcomes were respiratory failure, invasive ventilatory support, thromboembolic phenomena, sepsis, and preterm labor. Further, maternal mortality occurred in 6.4% of pregnant women. We verified that this group's likelihood of severe and deteriorating outcomes was greater than those of the general population. Preterm birth and the need for a NICU were significant complications for neonates, resulting in the stillbirth/neonatal mortality rate of 11.0%.

This study had some limitations. The number of premature births, NICU admissions, and fetal/neonatal deaths occurred due to increased iatrogenic deliveries by maternal indications. As for 14.3% of positive cases for SARS-CoV-2 in newborns, the criteria determined at the onset of the pandemic were used, which may be associated with premature delivery during the acute phase of infection or even delivery.

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## Conflicts of Interest

The authors declare no competing financial interests.

## Contributors

Kubiszeski EH, Carmo MAMV, Carmo AV and Galera MF contributed to the study conception and design, while Kubiszeski EH and Carmo MAMV analyzed and interpreted the data. Kubiszeski EH and Galera MF contributed to the preliminary writing of the manuscript. Kubiszeski EH, Carmo MAMV, Carmo AV, and Galera MF participated in the critical review of the manuscript's intellectual content. All authors haveapproved the final version of the manuscript and are responsible for all aspects of the work. They ensure its accuracy and integrity.

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