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A Systematic Review of Literature on the Characteristics of Obstetric Patients with SARS-CoV-2 Infection by Country of Study Publication

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Abstract

SARS-CoV-2, the novel coronavirus responsible for the global COVID-19 pandemic, affects individuals across all demographics. Pregnant women have been recognized as a vulnerable population for SARS-CoV-2 infection; however, data on the precise impact of COVID-19 in this group remain limited. To address this, we performed a systematic review summarizing maternal and fetal outcomes in pregnant women with SARS-CoV-2 infection, aiming to characterize obstetric patients based on the country of publication. Thirty-eight studies were included, encompassing 2,670 patients from seven countries, with China contributing 20 studies (52.6%). Significant differences were observed across countries in median maternal age, with Spain reporting the highest average age (34.6 years); smoking prevalence; proportion of symptomatic patients at triage; imaging modalities (with China and France performing CT scans universally, compared to chest X-rays in other countries); rates of cesarean delivery (83.9% in China versus 35.9% in Spain, $p < 0.001$); maternal mortality; proportion of patients requiring treatment; and the use of antivirals, antibiotics, and anticoagulants, as well as neonatal measurements. Overall, perinatal outcomes were favorable in most countries, with vertical transmission rates remaining very low. The reviewed studies demonstrated moderate to high quality. Most data reflect the first pandemic wave, indicating that SARS-CoV-2 infection in pregnant women generally presents with symptoms in the third trimester, often accompanied by risk factors such as advanced maternal age, elevated body mass index, and additional comorbidities developing during pregnancy. Cesarean delivery rates and prematurity were high, contributing to increased maternal and perinatal morbidity and mortality. Observed differences between countries may reflect regional patient profiles, the timing of pandemic waves influencing management strategies, and variations in local medical practices.

Keywords: Country profile, Gestation, Systematic review, COVID-19, Maternal-perinatal outcomes, Maternal characteristics and COVID-19

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Introduction

COVID-19, caused by the recently identified coronavirus SARS-CoV-2, first emerged in Wuhan, China [1], and has since become a major global health crisis, officially declared a pandemic in March 2020. By 15 December 2020, over 71 million infections and more than 1.6 million deaths had been reported worldwide, with the Americas experiencing the highest burden (approximately 30.6 million cases), followed by Europe (22.1 million) and

South-East Asia (11.4 million) [2]. The virus enters human cells through the angiotensin-converting enzyme 2 (ACE-2) receptor via its spike protein [3], a receptor widely distributed across tissues, whose expression may vary according to age, sex, race, and underlying health conditions [4]. Typical clinical manifestations include fever, persistent cough, fatigue, and respiratory distress, often accompanied by changes in C-reactive protein (CRP), lymphocyte counts, and lactate dehydrogenase [5]. COVID-19 severity ranges from asymptomatic or mild/moderate in the majority of patients (~80%), to severe (15%) and critical (~5%) [6]. Although older adults [7] and those with pre-existing conditions or ongoing treatments [8] are at greater risk, SARS-CoV-2 can affect individuals across all age groups, including children and pregnant women.

Pregnancy may increase susceptibility to COVID-19, potentially resulting in adverse maternal and fetal outcomes such as preterm labor, preeclampsia, cesarean section, and perinatal mortality [9]. This vulnerability is partly explained by the physiological overexpression of ACE-2 and immunological adaptations during gestation, which may facilitate viral entry and propagation [10, 11]. Furthermore, COVID-19 incidence and outcomes appear to vary internationally, influenced by regional characteristics such as population density, median age, economic indicators, and urbanization [12-14]. A review by Figueiro-Filho *et al.* [15], including 10,966 pregnant women across 15 countries, evaluated maternal demographics, clinical presentation, and neonatal outcomes, concluding that pregnant women were not at higher risk of severe respiratory complications compared to the general population. However, the analysis did not explore how maternal profiles differ according to country of study. To fill this gap, we conducted a systematic review examining maternal and perinatal outcomes in SARS-CoV-2-infected pregnant women, with a focus on characterizing patient profiles by country of publication.

Materials and Methods

This systematic review followed PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) [16] and MOOSE (Meta-analyses Of Observational Studies in Epidemiology) guidelines [17], and was registered with PROSPERO (CRD 42020219959).

A literature search was carried out on PubMed/MEDLINE and Web of Science on 28 September 2020, using the terms: “SARS-CoV-2” OR “COVID-19” AND “pregnancy” AND “humans.” References were managed in EndNote X9 (Thomson-Reuters).

Studies were eligible if they were original articles, case reports, case series, or randomized controlled trials reporting on pregnant or postpartum women infected with SARS-CoV-2. Included studies had to specify the country of publication and report at least 10 obstetric cases. No restrictions were placed on publication date or language. Additional relevant studies were identified through manual screening of references.

Exclusion criteria comprised studies lacking case numbers or maternal-perinatal outcome data, systematic reviews, studies including patients from multiple countries, and studies focusing exclusively on severe COVID-19 cases to avoid severity bias.

Two reviewers (YCL and OCV) independently screened titles and abstracts for relevance. Disagreements regarding inclusion were resolved through discussion. Full-text articles meeting eligibility criteria were assessed, and their reference lists were examined to identify further studies for inclusion.

Data collection and variables

Data extraction was conducted using a standardized form. For each included study, the following information was recorded: author(s), year of publication, patient recruitment period, study design and type (single- or multi-center), city and country of the study, total number of patients, and the number of symptomatic versus asymptomatic cases. Data on universal screening (yes/no) were also collected.

Maternal characteristics included age, tobacco use, pre-existing medical conditions, body mass index (BMI), and nulliparity rate. Obstetric variables encompassed timing of symptom onset during pregnancy or postpartum, gestational comorbidities, and gestational age at triage. Complementary maternal assessments recorded included real-time reverse transcription-polymerase chain reaction (RT-PCR) testing and results from oral swabs, type of radiological examination performed, presence of pneumonia, and laboratory abnormalities such as leukocytosis (white blood cell count >10,000/mm³), lymphocytopenia (lymphocyte count <1,500/mm³), thrombocytopenia (platelet count <150,000/mm³), and elevated lactate dehydrogenase (LDH >250 U/L).

Maternal management variables included therapeutic interventions (antivirals, antibiotics, corticosteroids, low-molecular-weight heparin, interferon), admission to intensive care units (ICU), oxygen supplementation, and mechanical ventilation. Maternal-perinatal outcomes recorded included maternal mortality, gestational age at delivery, delivery mode (cesarean or vaginal), preterm birth (<37 weeks gestation), neonatal ICU (NICU) admission, birthweight, Apgar score at 5 minutes, neonatal asphyxia, perinatal mortality, vertical transmission, and breastfeeding.

A confirmed SARS-CoV-2 infection was defined as a positive result via high-throughput sequencing or RT-PCR from nasal or pharyngeal swabs. According to the seventh edition of the Chinese National Health Commission guidelines for COVID-19 diagnosis and treatment [18], disease severity was classified as follows:

1. Mild: mild clinical symptoms without radiographic evidence of pneumonia.
2. Moderate: fever and respiratory symptoms accompanied by radiographic pneumonia.
3. Severe: any of the following:
   - Respiratory distress with ≥30 breaths per minute.
   - Oxygen saturation ≤93% at rest in room air.
   - Arterial oxygen partial pressure to inspired oxygen fraction ratio ≤300 mmHg.
4. Critical: any of the following:
   - Respiratory failure requiring mechanical ventilation.
   - Shock.
   - Multi-organ failure necessitating ICU care.

A descriptive analysis was performed for all included studies. Additionally, an analytical comparison was conducted evaluating maternal and obstetric characteristics, complementary maternal assessments, management strategies, and maternal-perinatal outcomes based on the country of publication. Graphical representations were also created to illustrate key maternal-perinatal variables, such as cesarean section rates and prematurity, stratified by country of study.

Risk of bias assessment and statistical methods

The potential for bias in the included studies was independently evaluated by both authors, focusing on adherence to the predefined inclusion criteria. Study quality was assessed using the framework for case series and case reports proposed by Murad MH *et al.* [19], which examines four key domains: participant selection, verification of exposure and outcomes, causality of observed results, and completeness of reporting. Studies could earn up to eight stars in total—one each for selection and reporting, two for ascertainment, and four for causality [19, 20].

All extracted information was compiled into an Excel database (Microsoft Office, version 16.42, Redmond, WA, USA). Statistical analyses were performed with Stata 13.1 (StataCorp LLC, College Station, TX, USA). A threshold of $p < 0.05$ was used to define statistical significance. Continuous data were summarized as means with interquartile ranges or 95% confidence intervals (CI), while categorical data were reported as counts and percentages (95% CI). Univariate analyses were conducted using Fisher's exact test, chi-square test, or Student's t-test depending on variable type and distribution.

Results and Discussion

The systematic review process is outlined in **Figure 1**. From the initial searches across the two databases, 38 studies [21–58] satisfied the inclusion criteria. These studies collectively included 2,670 pregnant patients from seven countries: China, the United States, France, the United Kingdom, Spain, Italy, and Portugal.

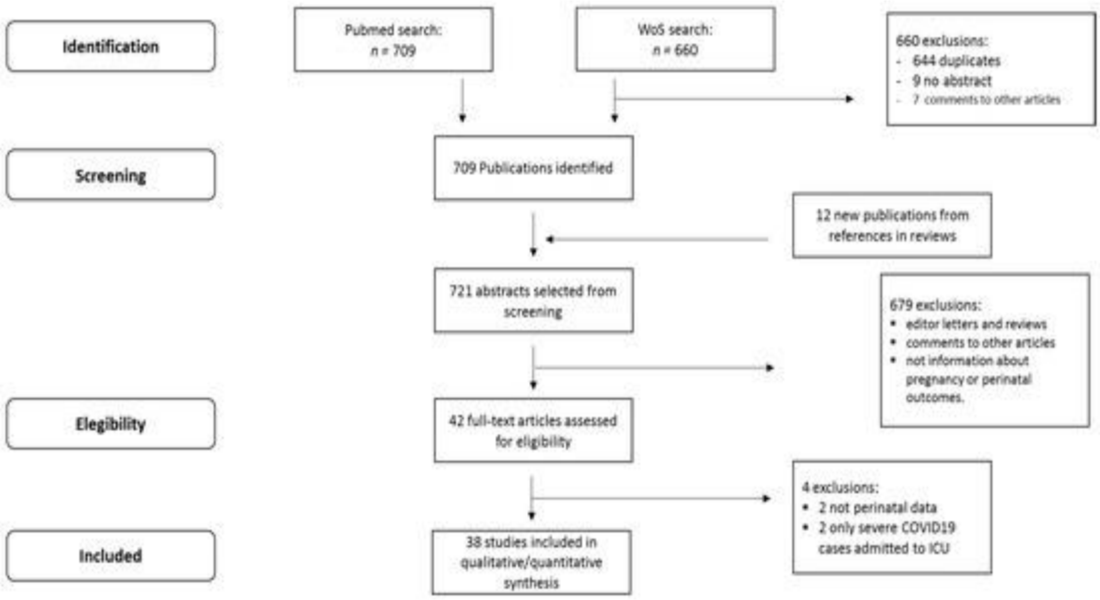

Figure 1. Flow chart of studies retrieved and included in the systematic review

Of the 20 studies from China, 19 (95%) were conducted in Wuhan, Hubei province. In the United States, six out of seven studies (85.7%) were performed on the East Coast, while in France, two of the four studies (50%) originated from Paris. All studies were published in 2020, with the longest patient recruitment period spanning three months [21]. In China, the earliest patient enrollment began on 8 December 2019 [21] and concluded on 24 March 2020 [22], whereas in the USA, recruitment started on 21 January 2020 [45] and ended on 24 April 2020 [43].

Among the total studies, 34 (89.5%) were case series, and 20 (52.6 percent) were conducted at a single center. **Table 1** provides a summary of the data from each study, organized by country of publication, covering maternal and obstetric characteristics, clinical signs and symptoms, maternal outcomes, treatments administered, and perinatal results. Similar to **Figure 2**, countries in the table are arranged in descending order according to the number of studies identified, with grayscale shading representing this hierarchy.

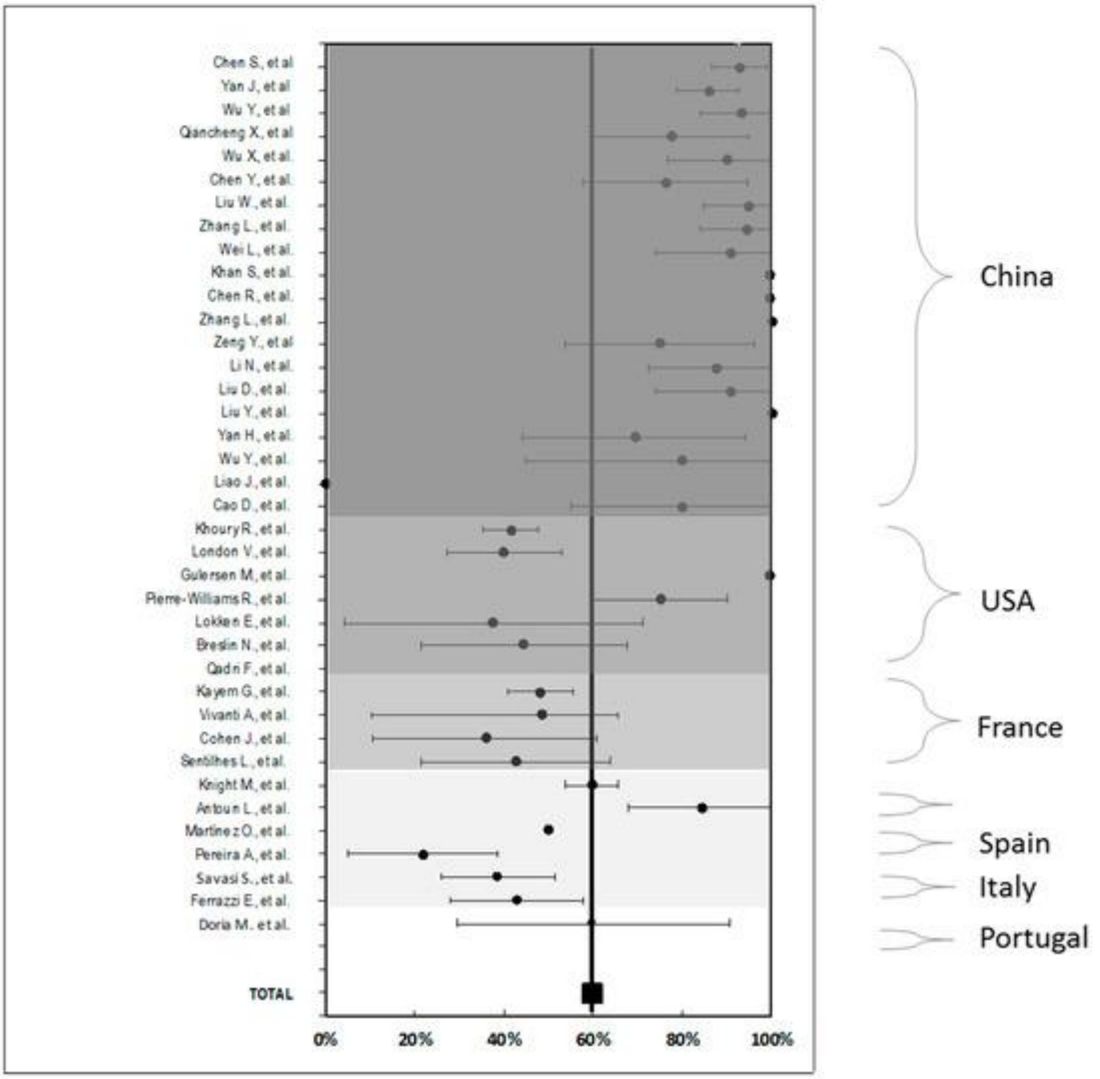

Figure 2. Cesarean section rates observed in the studies, presented with 95% confidence intervals and categorized by country

Table 1. Description of the main variables in the overall series and comparison of the results by countries

	Number (%) of Patients Reporting Results	Overall	China	United States of America	France	United Kingdom	Spain	Italy	Portugal	p Value
n, %	2670 (100)	2670	545 (20.4)	543 (20.3)	859 (32.2)	450 (16.9)	142 (5.3)	119 (4.5)	12 (0.4)	
Articles, n, %	38 (100)	38	20 (52.6)	7 (18.4)	4 (10.5)	2 (5.6)	2 (5.6)	2 (5.6)	1 (2.6)	
Patients with symptoms, n, %	2170 (100)	2170 (81.3)	447 (82.0)	330 (60.8)	738 (85.9)	450 (100)	105 (73.9)	99 (83.2)	1 (8.3)	0.0112
Asymptomatic patients, n, %	492 (100)	492 (18.4)	90 (16.5)	213 (39.2)	121 (14.1)	0 (0.0)	37 (26.1)	20 (16.8)	11 (91.7)	NS
Maternal characteristics										

Maternal age, mean, CI 95%	1610 (60.3)	31.4 (30.9–31.9)	30.9 (30.3–31.4)	31.4 (30.1–32.8)	32.3 (30.3–34.2)	29.8	34.6 (34.3–34.7)	33.0 (32.0–33.9)	32.4	0.005
Tobacco, median, IQR	1064 (39.9)	2.9 (1.0–4.8)	n.r.	2.2	2.5 (1.6–3.3)	n.r.	7.3	1	n.r.	0.022
BMI, mean, CI 95%	713 (26.7)	26.2 (23.6–28.8)	22.8 (20.6–25.0)	31.8 (30.5–33.1)	25 (22.3–27.7)	n.r.	24.4	22.8	n.r.	NS
Maternal morbidities, mean, CI 95%	2143 (80.2)	25.7 (18.3–33.0)	20.9 (5.9–35.9)	32.6 (21.0–44.2)	14.8 (5.9–23.8)	34.0	39	32.0	41.7	NS
Obstetric characteristics										
Nulliparous, mean, CI 95%	1528 (57.2)	39.7 (32.0–47.4)	51.7 (34.5–68.7)	29.7 (26.4–33.0)	27.3	37.5	38.4 (24.3–52.4)	37.9 (33.4–42.4)	n.r.	NS
Obstetric morbidities, mean, CI 95%	2194 (82.2%)	30.6 (20.7–40.5)	39.3 (25.6–53.1)	13.2 (7.4–19.0)	10.6 (5.1–16.0)	30	12.2	14	83.3	NS
Gestational age at triage, mean, CI 95%	1334 (50.0)	34.1 (32.2–36.1)	35.9 (32.8–39.0)	31.5 (27.1–35.9)	30.2 (26.5–34.0=	33.5 (32.4–34.5)	32	37	37.5	NS
Complementary maternal studies										
Symptoms at triage, mean, CI 95%	2654 (99.4)	78.6 (70.8–86.4)	79.8 (70.9–88.7)	67.2 (46.3–88.2)	94.9	100	74.1 (72.3–75.9)	92	8.3	0.008
Radiological exam	2645 (99.1)									<0.001
CT, n, %		1391 (52.6)	532 (100.0)	0 (0.0)	859 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	n.r.	<0.001
Chest X-r		1254 (47.4)	0 (0.0)	543 (100.0)	0 (0.0)	450 (100.0)	142 (100.0)	119 (100.0)	n.r.	<0.001
Pneumonia, mean, CI 95%	1305 (48.9)	71.3 (58.5–84.1)	84.6 (71.9–97.4)	34.7 (0.9–68.4)	83.3	100	29 (27.0–31.0)	57.6 (32.2–83.0)	n.r.	0.011
Leukocytosis, mean, CI 95%	407 (15.2)	31.4 (18.1–44.7)	32.7 (17.7–47.8)	n.r.	n.r.	n.r.	10	38.2	n.r.	NS
Lymphopenia, mean, CI 95%	993 (37.2)	35.9 (26.8–44.9)	37.5 (24.3–50.7)	40.1 (25.4–54.7)	40.3 (31.8–48.8)	n.r.	24.3	26.6 (21.6–31.6)	n.r.	NS
Trhombocitopenia, mean, CI 95%	267 (10)	8.2 (−4.0–20.3)	10.5 (−9.9–30.9)	n.r.	n.r.	n.r.	15	n.r.	n.r.	NS
Elevated LDH, mean, CI 95%	273 (10.2)	28.2 (16.4–40.0)	27.9 (13.2–42.5)	n.r.	n.r.	n.r.	20	39	n.r.	NS
Maternal management										
Maternal treatments, mean, CI 95%	380 (14.3)	86.0 (69.4–102.6)	95.6 (90.0–101.3)	11.6	n.r.	n.r.	65	n.r.	n.r.	<0.001
Antiviral, mean, CI 95%	1040 (39.0)	52.1 (33.4–70.6)	75.4 (57.8–93.0)	14.7 (3.2–26.2)	5.6	2	18.3	38	n.r.	0.011
Antibiotic, mean, CI 95%	752 (28.2)	55.4 (36.6–74.1)	84.0 (66.0–102.0)	20.8 (4.6–37.0)	7.4	n.r.	65	43	n.r.	0.002

Steroids, mean, CI 95%	919 (34.4)	17.2 (10.4–24.0)	21.0 (9.1–32.8)	13.9 (3.2–24.6)	0	20.7 (8.3–33.0)	15	n.r.	n.r.	NS
Anticoagulants, mean, CI 95%	222 (8.3)	39.9 (−5.1–84.9)	4.8	74	n.r.	n.r.	41.7	39	n.r.	<0.001
Admission to ICU, mean, CI 95 %	1664 (62.3)	6.1 (2.9–9.3)	1.8 (−0.1–3.7)	9.1 (−2.7–20.8)	8.7 (7.3–10.0)	13.7 (6.1–21.3)	6.4 (−3.2–15.9)	14.6 (1.0–28.1)	n.r.	NS
Oxygen therapy, mean, CI 95 %	1368 (51.2)	37.8 (20.4–55.2)	63.6 (29.7–97.5)	38.4 (−7.0–83.9)	14.1 (6.1–22.0)	n.r.	11.7 (8.1–15.3)	32.9 (24.6–41.2)	n.r.	NS
Mechanical ventilation, mean, CI 95 %	2254 (84.4)	4.6 (1.8–7.4)	1.8 (−0.1–3.7)	7.5 (−4.1–19.2)	6.4 (3.7–9.1)	11.5 (8.4–14.6)	3.7 (−3.9–11.2)	3.9	n.r.	NS
Maternal-Perinatal outcomes										
Maternal mortality, mean, CI 95%	2523 (94.5)	0.2 (−0.1–0.4)	0.0	0.0	0.1 (−0.1–0.2)	2.8 (−0.4–5.9)	0.0	0.0	0.0	0.000
GA at delivery, mean, CI 95 %	1441 (54.0)	37.9 (37.4–38.3)	37.9 (37.5–38.3)	37.3 (34.4–40.2)	37.7 (37.1–38.2)	38	37.6	39	n.r.	NS
C-section, mean, CI 95 (%)	2605 (97.6)	67.1 (58.3–75.9)	83.9 (74.0–93.8)	45.3 (33.8–57.7)	43.8 (37.7–49.9)	71.9 (46.8–96.9)	35.9 (7.2–64.5)	40.8 (36.4–45.1)	60	0.000
Prematurity (< 37 w), mean, CI 95 %	2526 (94.6)	21.6 (17.6–25.6)	19.3 (14.2–24.5)	24.9 (13.3–36.4)	30.1 (20.9–39.4)	31 (19.2–42.8)	19.6 (−2.6–41.8)	23.6 (18.3–28.9)	0.0	NS
Admission to NICU (%)	1982 (74.2)	36.4 (19.7–53.0)	54.6 (20.9–88.2)	35.3 (4.9–65.8)	20.6 (12.1–29.1)	25.3	26.8	8.1 (6.0–10.1)	n.r.	NS
Birthweight, mean, CI 95%	921 (34.5)	3063.5 (2974.5–3152.4)	3138.2 (3089.0–3187.4)	2769 (2007.9–3530.1)	2800	3139	3049	3122 (3043.0–3201.0)	2691	0.033
Apgar 5 minutes, mean, CI 95%	886 (33.2)	9.4 (9.1–9.7)	9.5 (9.2–9.8)	8.7 (8.1–9.3)	n.r.	9.3	n.r.	10	9.9	NS
Perinatal mortality, mean, CI 95%	2501 (93.7)	0.2 (0.0–0.3)	0.1 (−0.1–0.2)	0.5 (−0.2–1.2)	0.4 (−0.4–1.3)	0.5 (−0.5–1.5)	0	0	0	NS
Vertical transmission, mean, CI 95%	2471 (92.5)	1.8 (0.0–3.6)	2.0 (−1.0–5.0)	1.1 (−0.3–2.5)	1.4 (−0.4–3.1)	2.5 (−2.6–7.6)	1.2 (−1.2–3.6)	3.6 (−3.7–10.8)	0.0	NS
Maternal breastfeeding, mean, CI 95%	290 (10.9)	63.1 (34.0–92.2)	60	50	n.r.	n.r.	71.3 (19.7–122.8)	63.1	n.r.	NS

China was the most frequently represented country in this review, contributing 20 studies (52.6% of all articles), while France accounted for the largest number of patients, with 859 individuals included across just two studies (32.2 percent of the total cases). Considering all collected data, the average maternal age was 31.4 years, and the median gestational age at triage was 34.1 weeks. Among the patients, 2,170 (81.3%) presented with subjective COVID-19 symptoms at triage, 71.3% had clinical or radiological evidence of pneumonia, and the median rate of maternal ICU admission was approximately 6.1%. Overall, cesarean delivery occurred in 67.1% of pregnancies, and the median maternal mortality was 2 per 1,000. Perinatal outcomes showed 21.6% preterm births, perinatal mortality of 2 per 1,000, and vertical transmission in 1.8% of cases.

Comparative analysis of the data in **Table 1** revealed significant differences across countries in the proportion of symptomatic patients, smoking prevalence, maternal age, presentation of symptoms at triage, type of radiological assessment, frequency of pneumonia, cesarean delivery rates, maternal mortality, proportion of patients receiving treatment, and use of antivirals, antibiotics, or anticoagulants, as well as median neonatal birthweight.

Figure 2 illustrates the cesarean section rates reported in each study, grouped by country, with a weighted overall rate of 59.7%. China had the highest reported rate at 83.9%, followed by the UK at 71.9%, while Spain reported the lowest rate at 35.9%. Similarly, **Figure 3** displays the incidence of preterm birth across the included studies, with a weighted mean of 23.9%. The UK had the highest proportion of preterm deliveries (31 percent), closely followed by France (30.1 percent), whereas the case series from Portugal reported no instances of prematurity.

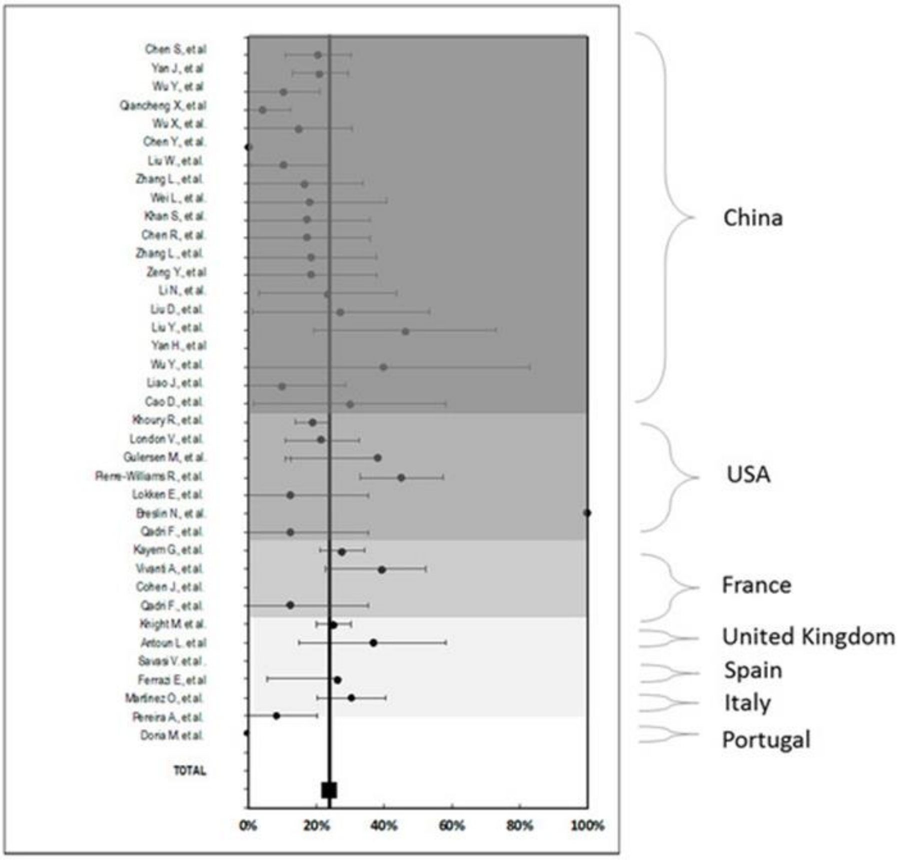

Figure 3. Prematurity rates, with 95% confidence intervals, reported in the studies and grouped by country

A country-specific overview of the studies, considering **Figures 2** and **3**, reveals notable patterns. Chinese studies, representing 52.6% of all included works, enrolled the earliest patients in the course of the pandemic, with the first case recorded on 8 December 2019 [21]. Pregnant women in China were relatively young (mean age 30.9 years) with low BMI (22.8 kg/m²). Most were nulliparous (51.7%), around one-third had additional obstetric complications (39.3%), and 82% presented with symptoms at triage. In China and France, all patients underwent detailed chest CT imaging (100%). Both countries reported the highest rates of pneumonia (China 84.6%, France 83.3%), yet ICU admission and need for respiratory support differed (China: 1.8% ICU, 1.8% oxygen therapy; France: 8.7% ICU, 6.4% oxygen therapy). Chinese series also had the highest proportions of antiviral (75.4%) and antibiotic use (84%) and cesarean deliveries (83.9%). Despite a relatively low prematurity rate (19.3%), NICU admission was the highest among all countries (54.6%). Overall perinatal outcomes were favorable, with low perinatal mortality (0.1%) and vertical transmission (2.0%).

In the USA, patients had the highest BMI (31.8 kg/m²) and maternal comorbidities (32.6%). Median gestational age at triage (31.5 weeks) and the proportion of symptomatic patients at triage (60.8%) were the lowest in the review. Following China, the USA reported the highest rates of maternal oxygen therapy (38.4%) and NICU admissions (35.3%).

Although only four studies were included, France contributed the largest number of cases (859, 32.2% of the total). Maternal comorbidities (14.8%), obstetric complications (10.6%), and nulliparity (27.3%) were among the lowest. Most patients were symptomatic (85.9%), and pneumonia was reported in 83.3% of cases, the third highest after the UK (100%) and China (84.6%). Antiviral (5.6%) and antibiotic use (7.4%) were low, and no corticotherapy was administered. France had the second-highest prematurity rate (30.1%) after the UK (31%), with lower birthweights (mean 2,800 g) comparable to the USA (2,769 g).

The UK, like Italy and Spain, contributed two studies (5.6%), with 450 patients (16.9 percent of the total). The last patient was recruited on 30 April 2020 [43]. Median maternal age was the lowest (29.8 years), yet ICU admissions were the second highest after Italy (14.6%), and cesarean rates were high (71.9%), second only to China (83.9%). The UK was also the first country in this review to report maternal need for respiratory support (11.5 percent) and maternal mortality (2.8 percent).

Spain and Italy, each with two studies, included the oldest patients (34.6 and 33.0 years, respectively) and similar rates of maternal comorbidities (39.2 percent vs. 32 percent). Symptomatic cases were comparable (73.9% vs. 83.2%). However, Italy had almost double the rates of pneumonia (57.6% vs. 29%) and ICU admission (14.6% vs. 6.4%) compared to Spain. Cesarean delivery rates were the lowest in the review (Spain 35.9%, Italy 40.8%), while NICU admission was higher in Spain (26.8%) than in Italy (8.1%). Prematurity was similar (Spain 19.6%, Italy 23.6%), but Italy had the highest rate of vertical transmission in the review (3.6%). No perinatal deaths were reported in either country, similar to Portugal.

Portugal contributed only one study with 12 patients (0.4 percent of the total). Despite limited data, it reported the highest rate of obstetric comorbidities (41.7 percent) and the largest median gestational age at triage (37.5 weeks).

Most works (35 studies, 92.1%) were rated five stars, while three studies (7.9%) from China, the USA, and the UK achieved six out of eight stars, representing the highest quality according to Murad MH *et al.*'s criteria for case series and case reports [19].

This systematic review encompassed 38 studies including a total of 2,670 pregnant women infected with SARS-CoV-2 across seven countries. Given the intense scientific focus prompted by the pandemic, several other systematic reviews have been published with substantial sample sizes, such as those by Khalil *et al.* [59] with 2,567 pregnancies and Diriba *et al.* [60] with 1,360 patients. However, our review represents the largest compilation of obstetric patients to date and provides a unique perspective by profiling patients according to the country of publication.

Analysis of the results suggests that the published cases largely reflect the global impact of the pandemic, with China being the first country to recruit and report cases. Most studies included in this review originate from the cities or regions most affected within each country—for instance, Wuhan in China, the US East Coast, and Madrid in Spain. The data indicate that patient recruitment largely occurred during the first wave of the pandemic, as evidenced by the short recruitment periods (maximum of three months in Chen *et al.* [21]) and the latest collection dates, such as the end of April in Antoun *et al.* [43].

Except for China, where recruitment spanned nearly four months, the other countries included in this review recruited patients over periods not exceeding two months. Recruitment in the USA began on 21 January 2020 and in France on 1 March 2020, approximately 40 and 80 days after the first case in China, respectively. This timing may partly explain observed differences between countries, such as variations in treatment approaches and cesarean delivery rates. For example, studies enrolling patients earlier (December 2019–February 2020) reported higher cesarean rates (77.3% [24] to 100% [28, 30, 31]) compared with studies from countries with later recruitment (March–April 2020), which reported rates ranging from 33.3% [47] to 75% [44].

It is therefore likely that forthcoming publications may include data from the first wave in countries not yet represented or from the second wave in previously studied regions. The global interest in understanding SARS-CoV-2's impact on pregnant women stems from the need to guide clinical management in both maternal and perinatal care, which may correlate with the virus's geographic spread. Continued reporting from additional countries will further enrich this field of study.

As noted, China contributed the largest number of studies (20 studies, 52.6%), whereas France accounted for the greatest number of patients (859, 32.2%). By 30 April 2020, China had reported 84,773 confirmed COVID-19 cases with 4,643 deaths, while France had 127,066 cases and 24,054 deaths [61].

Despite the widespread nature of SARS-CoV-2, this review does not include pregnant women from several other heavily affected countries, such as Brazil, Colombia, Mexico, India, Russia, Argentina, or Iran. One possible explanation is that case series from these countries were often included in multinational studies, such as the WAPM study, which compiled data from 388 pregnant women across 73 centers in 22 countries [62, 63]. Another likely reason is selective reporting bias, with only severe cases or those with poor maternal-perinatal outcomes being published. Examples include 20 maternal deaths reported in Brazil [64], 10 in Mexico [65], and nine in Iran [66].

The global findings from this systematic review indicate a slight increase in maternal age, with an overall mean of 31.4 years, particularly notable in Spain, France, and the USA, when compared to the median ages reported by Eurostat 2017 (30.6, 32.1, and 29.1 years, respectively) [67]. This rise in maternal age may be linked to the higher prevalence of maternal comorbidities observed, as suggested by Aoyama *et al.* [68] and Lisonkoya *et al.* [69]. Clinically, up to 81.3 percent of pregnant women presented with symptoms, a distribution that differs from non-pregnant adult populations [6], largely due to publication bias and the recruitment timing during the first wave, when universal SARS-CoV-2 screening for obstetric patients was uncommon. This high proportion of symptomatic patients likely contributes to the differences observed in patient profiles by country. Symptomatic pregnancies are also associated with worse maternal-perinatal outcomes, including increased preterm delivery rates and a greater need for respiratory support, as reported by London *et al.* [45].

The overall cesarean section rate of 67.1%, both globally and by individual country, was higher than previously documented. A comparison between 2017 country-specific C-section rates [70] and the rates observed in this review is presented in **Figure 4**.

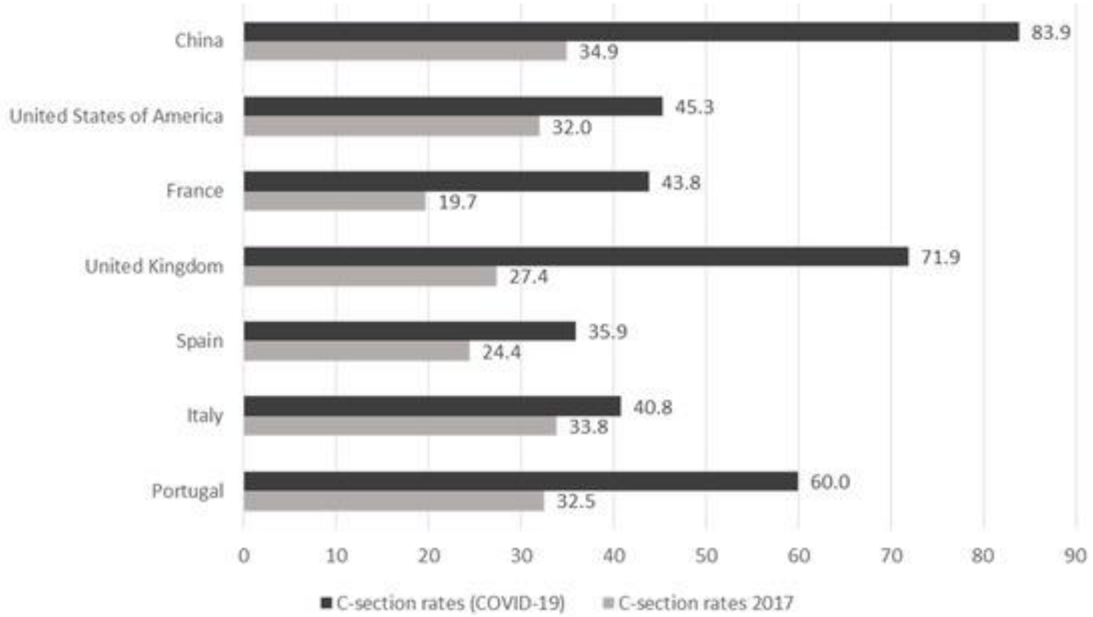

Figure 4. Comparison of 2017 C-section rates by country [70] with the C-section rates observed in this systematic review

Variations in cesarean delivery rates between countries likely reflect differences in pre-pandemic obstetric practices. The rise observed during the COVID-19 pandemic appears to mirror these pre-existing differences, with China showing the largest increase of 49%, exceeding expectations. This may be explained by early patient recruitment, limited understanding of COVID-19 pathophysiology at the time, and concerns about potential vertical transmission. These factors may also have contributed to the incidence of preterm births, suggesting that future studies should examine this trend in greater detail.

Similarly, the overall prematurity rate observed in this review (21.6%) and the country-specific rates were substantially higher than previously reported by Chawanpaiboon *et al.*, which documented a global rate of 10.6%, ranging from 6.3% in the UK, 6.3% in Spain (2014), 9.9% in the USA, to 13.4% in Northern Africa [71]. The increase in maternal and perinatal morbidity during the first wave may be related to rapid respiratory deterioration in pregnant women, necessitating urgent or planned deliveries [72]. With improved understanding of SARS-CoV-2 pathophysiology and broader testing of asymptomatic patients, future reports may show reduced rates of cesarean delivery and preterm birth.

As noted previously, Spain recorded the highest maternal age (34.6 years). This is consistent with Spain's low birth rate, historically influenced by the economic crisis of the 1970s and persistent changes in reproductive behavior despite later economic recovery [73, 74]. The USA had the highest maternal BMI compared to countries such as China or Italy, which aligns with global statistics: in 2016, the mean BMI in women was 29.1 kg/m² in the USA, versus 23.6 kg/m² in China and 24.9 kg/m² in Italy [75]. Elevated BMI is a recognized risk factor for worse outcomes; in non-pregnant populations, individuals with BMI >25 kg/m² have approximately four times the risk of death from COVID-19 [76]. While our data do not allow causal inferences, existing evidence suggests that SARS-CoV-2 infection may not be as mild during pregnancy, particularly in women with obesity [77].

It is noteworthy that all Chinese and French patients underwent chest CT scans for radiological evaluation. Borakati *et al.* [78] compared the diagnostic performance of chest X-ray (CXR) versus CT for COVID-19, reporting a sensitivity and specificity of 0.56 and 0.60 for CXR, and 0.85 and 0.50 for CT, respectively, concluding that CT provides substantially improved diagnostic accuracy and should be strongly considered in the initial assessment of suspected COVID-19 cases [78]. This widespread use of

CT in China and France may reflect both greater availability and the novelty of the disease, prompting more precise imaging for early diagnosis.

Another notable finding is the higher proportion of pneumonia cases reported in the UK, China, and France compared to Italy, the USA, and Spain. Although the reasons for this remain unclear, it may relate to variations in pneumonia diagnostic criteria or to differences in imaging modalities, as countries using CT scans reported higher pneumonia rates.

Maternal outcomes also differed between countries. Severe events such as urgent respiratory support and ICU admission were notably higher in the UK compared with China (11.5 percent and 13.7 percent vs. 1.8 percent and 1.8 percent, $p = 0.393$ and $p = 0.093$, respectively). Maternal mortality was also elevated in the UK relative to the overall series (2.8 percent vs. 0.2 percent, $p = 0.000$). These observations should be interpreted with caution, as they may reflect publication bias, with severe or critical cases being more likely to be reported [79, 80].

Similarly, we observed notable differences in the use and type of maternal treatments across countries. China reported the highest proportion of treated patients (95.6%), predominantly with antivirals and antibiotics, whereas in the USA, only about 10% of patients received any pharmacological intervention, mainly anticoagulants. This discrepancy may reflect the evolving understanding of therapeutic options during the early stages of the pandemic, as well as the timing of SARS-CoV-2 spread in different regions, which influenced clinical practice and treatment decisions.

Regarding maternal-perinatal outcomes, as illustrated in **Figure 2**, cesarean delivery rates varied considerably between countries. China and the UK demonstrated higher rates compared to the global average, whereas France, Italy, and Spain reported lower rates. These differences may be influenced by regional obstetric practices and the severity of COVID-19 in the included cases, as high cesarean rates do not necessarily correspond to women with mild or moderate disease [81].

In terms of prematurity, **Figure 3** shows clinical differences without reaching statistical significance. The UK and France exhibited higher rates than Spain or Portugal. Many of these preterm births may have been iatrogenic, prompted by maternal or fetal indications. Currently, there is insufficient evidence to establish a clear association between COVID-19 infection and spontaneous preterm labor, although isolated cases of preterm prelabor rupture of membranes have been reported [81, 82].

The primary strength of this systematic review lies in its extensive inclusion of pregnant women infected with SARS-CoV-2, representing the largest compilation to date, and its novel analysis of obstetric patient profiles according to the country of publication. Despite the inability to include studies from all countries, the results generally reflect the first wave of the pandemic in the seven examined nations, providing valuable insights into how maternal and perinatal care was managed across different regions.

Nevertheless, this study has limitations. Most conclusions rely on published data, which may not accurately capture the proportion of patients truly from the country of publication, and results may be influenced by unreported variables. Additionally, the included studies were often restricted to specific areas within each country, limiting the generalizability of findings to the entire national population.

When interpreting cesarean rates, we could not account for prior cesarean deliveries or other obstetric conditions that might have increased the likelihood of this procedure. Moreover, given the nature of the primary studies, publication bias may be present, as only studies from two databases were included, and selection or reporting biases cannot be excluded. By excluding studies that focused exclusively on severe COVID-19 cases, we may have underestimated the full spectrum of disease severity.

Other potentially influential factors, such as maternal socioeconomic status (e.g., education level, household income) or access to healthcare, were not analyzed independently in this review but could explain some observed differences between countries. These variables likely affect overall maternal health and disease risk and represent opportunities for future research.

Finally, although SARS-CoV-2 infection appears to have a generally uniform impact worldwide, regional variations in viral characteristics or other factors may contribute to the differences observed across countries. It is also possible that additional studies published after the cutoff date for this review were not included.

Conclusion

Pregnant women infected with SARS-CoV-2 during the first wave of the pandemic, both globally and in the countries included in this review, generally had a higher median age compared to the average in their respective countries, with increased rates of obesity and both baseline and pregnancy-related comorbidities. Most were symptomatic during the third trimester, often required hospitalization and maternal treatment, yet ICU admissions and maternal deaths remained uncommon. Regarding delivery, there was a notably high rate of C-sections and preterm births, likely reflecting the rapid deterioration of maternal health, although neonatal outcomes were generally favorable.

Variations in maternal characteristics between countries appear to reflect differences in baseline maternal profiles (age, BMI, comorbidities), the use of universal versus clinical screening at the time of recruitment, and the initial therapeutic approaches, all guided by the prevailing knowledge of COVID-19.

These results are significant for public health and clinical practice, highlighting that pre-pandemic obstetric patterns, local patient demographics, the timing of pandemic waves, and evolving management strategies likely contributed to the observed differences. Future research is encouraged to build on these findings, offering insight into how countries managed maternal and perinatal health during COVID-19 and identifying effective strategies for healthcare delivery.

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