

Long COVID-19 and pregnancy: A systematic review

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Abstract. The impact of post-acute sequelae of SARS-CoV-2 infection, or Long coronavirus disease 2019 (COVID-19), on pregnant women remains a growing concern. The present systematic review synthesizes current evidence on the prevalence, risk factors and clinical outcomes of Long COVID-19 in pregnant women to improve understanding of its burden and implications for maternal health. A systematic search was conducted in PubMed, Scopus and Google Scholar for studies published between January 2020 and October 2024. Eligible studies included pregnant or postpartum women diagnosed with COVID-19 and followed for at least four weeks post-infection. Data extraction and quality assessment were performed using standardized tools, and the findings were narratively synthesized due to heterogeneity in study designs and outcome measures. A total of 13 studies encompassing 13,729 participants were included. The prevalence of Long COVID-19 varied widely, ranging from 9.3-93%. The most reported symptoms included fatigue, cognitive dysfunction, respiratory symptoms and psychological disturbances, with fatigue being the most prevalent. Severe acute COVID-19, obesity, pre-existing mental health conditions, and non-vaccination were identified as key risk factors for developing Long COVID-19. Several studies reported that women with Long COVID-19 were at a higher risk for adverse maternal and neonatal outcomes, such as preterm birth and increased need for neonatal intensive care. The severity of acute infection and the presence of comorbidities significantly influenced the risk and severity of Long COVID-19. Long COVID-19 is a prevalent condition among pregnant women, with significant variability in reported prevalence rates. It is associated with a range of symptoms that can impact maternal

health and pregnancy outcomes. The findings highlight the need for targeted follow-up and management strategies in this population. Standardized definitions and longitudinal studies are essential to further elucidate the long-term impact of COVID-19 during pregnancy.

Introduction

The coronavirus disease 2019 (COVID-19) pandemic has significantly affected global health, with varying impacts on different population groups (1-4). Pregnant women have been identified as a particularly vulnerable subgroup due to physiological changes in the immune and cardiovascular systems, which may influence their response to severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) infection (5). Recent research has highlighted that not only are pregnant women at a higher risk for severe outcomes during the acute phase of COVID-19, but they may also experience lingering post-acute sequelae of SARS-CoV-2 infection, known as Long COVID-19 syndrome (6,7). This condition, characterized by a range of symptoms persisting beyond four weeks post-infection (8), has raised concerns about its impact on maternal health and pregnancy outcomes.

Long COVID-19 syndrome, also referred to as post-acute sequelae of COVID-19 (PASC), includes a variety of symptoms such as fatigue, cognitive dysfunction, respiratory issues and psychological disturbances (9-12). The prevalence of these symptoms and their intensity appear to vary among pregnant women depending on factors such as the severity of the initial infection, pre-existing health conditions and sociodemographic characteristics (13-15). Studies have reported that pregnant women often experience distinct post-infection symptoms, including dyspnea, fatigue and mood disturbances, which can complicate pregnancy (7,13).

The potential impact of Long COVID-19 on maternal and fetal health is a growing area of research. Early findings indicate that pregnant women with severe COVID-19 are more likely to develop long-term respiratory and neurological symptoms, which could interfere with their ability to perform daily activities and care for their newborns (16). Additionally, the presence of these prolonged symptoms may increase the risk of adverse pregnancy outcomes, such as preterm birth, low birth weight and increased need for intensive care for both the mother and the infant (7,17).

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The aim of the present systematic review is to comprehensively evaluate the prevalence, risk factors and clinical outcomes of Long COVID-19 syndrome in pregnant women. By synthesizing findings from multiple studies, the review aims to provide a clearer understanding of the burden and nature of Long COVID-19 in this unique population. The results will inform healthcare providers and policymakers, facilitating the development of targeted interventions and strategies to support maternal health during and after the pandemic.

Materials and methods

The present systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (18) to evaluate the prevalence, risk factors and clinical outcomes of Long-COVID-19 in pregnant women. Studies were included if they reported original data on post-COVID-19 symptoms and outcomes specifically in the context of pregnancy. The review included studies utilizing prospective, retrospective, pilot, longitudinal and cross-sectional designs to ensure comprehensive coverage of the topic. In addition, the present systematic review has been registered in the International Register of Systematic Review Protocols (PROSPERO) under accession number CRD42024600019 (https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=600019).

Inclusion and exclusion criteria. Studies were included if they met the following criteria: i) reported on pregnant women diagnosed with COVID-19 during pregnancy, ii) provided information on Long COVID-19 or PASC, iii) included a minimum follow-up duration of at least four weeks post-acute infection, and iv) were peer-reviewed articles published in English. Exclusion criteria included review articles, case reports, or studies not focused on Long COVID-19 outcomes. Studies with insufficient data on clinical outcomes or missing critical methodological details were also excluded.

Search strategy. A systematic search was conducted in the PubMed, Scopus and Google Scholar databases, covering literature published between January 2020 and October 2024. Search terms included combinations of 'COVID-19', 'pregnancy', 'Long COVID', 'post-acute sequelae', 'PASC', 'pregnant', 'SARS-CoV-2' and 'maternal outcomes'.

PRISMA process. The PRISMA process is illustrated in Fig. 1. Identification: A total of 1,600 records were identified through systematic searches in PubMed (<https://pubmed.ncbi.nlm.nih.gov/>), Scopus (<https://www.scopus.com/home.uri>) and Google Scholar (<https://scholar.google.com/>). An additional 50 records were identified from reference lists of relevant articles and other databases, resulting in a total of 1,650 records for initial consideration.

Screening: After removing 450 duplicate records, 1,200 unique records were screened based on their titles and abstracts. During this screening phase, 850 records were excluded for not meeting the inclusion criteria. The excluded records comprised review articles, case reports and studies that did not focus on pregnancy or Long COVID-19.

Eligibility: The eligibility assessment included a review of 350 full-text articles. Out of these, 337 articles were excluded based on specific reasons: 150 articles did not focus on Long COVID-19 or PASC, 142 articles lacked sufficient data on pregnancy outcomes, 30 articles had a follow-up duration of <4 weeks post-infection, and 15 articles were excluded because they were not published in English.

Included studies: A total of 13 studies were deemed suitable for narrative synthesis due to the heterogeneity in study designs and outcome measures. These studies provided the most comprehensive data on Long COVID-19 in pregnant and postpartum women, which was crucial for synthesizing meaningful conclusions.

Data extraction and synthesis. Data from each study was extracted independently by two reviewers using a standardized data extraction form. Key variables included study design, sample size, population characteristics, outcome measures and results related to Long COVID-19 symptoms and associated risk factors. Disagreements were resolved through discussion or consultation with a third reviewer.

The extracted information included: i) author, year and type of study; ii) population characteristics (for example, number of participants, demographics and inclusion criteria); iii) measurements (for example, diagnostic tools and questionnaires used to assess post-COVID-19 symptoms); and iv) key findings (for example, prevalence of specific symptoms and identified risk factors).

Quality assessment. The quality of included studies was assessed independently by two reviewers using validated tools. Cohort and case-control studies were evaluated using the Newcastle-Ottawa Scale (19), which assesses selection, comparability and outcome domains. Each study was assigned a score, and the quality was categorized as high (7-9 stars), moderate (4-6 stars), or low (<4 stars).

Data analysis. Due to the heterogeneity of study designs and reported outcomes, a narrative synthesis was used to describe key findings across studies. Where applicable, the prevalence of Long COVID symptoms was summarized, and risk factors were identified. Meta-analyses were not conducted due to significant variability in symptom assessment tools and follow-up durations across studies.

The present systematic review synthesizes evidence on the impact of Long COVID in pregnant women, highlighting prevalent symptoms, risk factors and the need for targeted management strategies.

Results

Study characteristics. The systematic review included 13 studies (6,7,13-15,17,20-26), encompassing a total of 13,729 participants. Studies varied in design, with most employing prospective or cross-sectional approaches. The sample sizes ranged from 33 to 5,397 participants, and studies were conducted across diverse geographical regions, including the United States, Brazil, China, Turkey, Ecuador and Russia. Study populations included pregnant women at various gestational stages and postpartum women. The characteristics of the

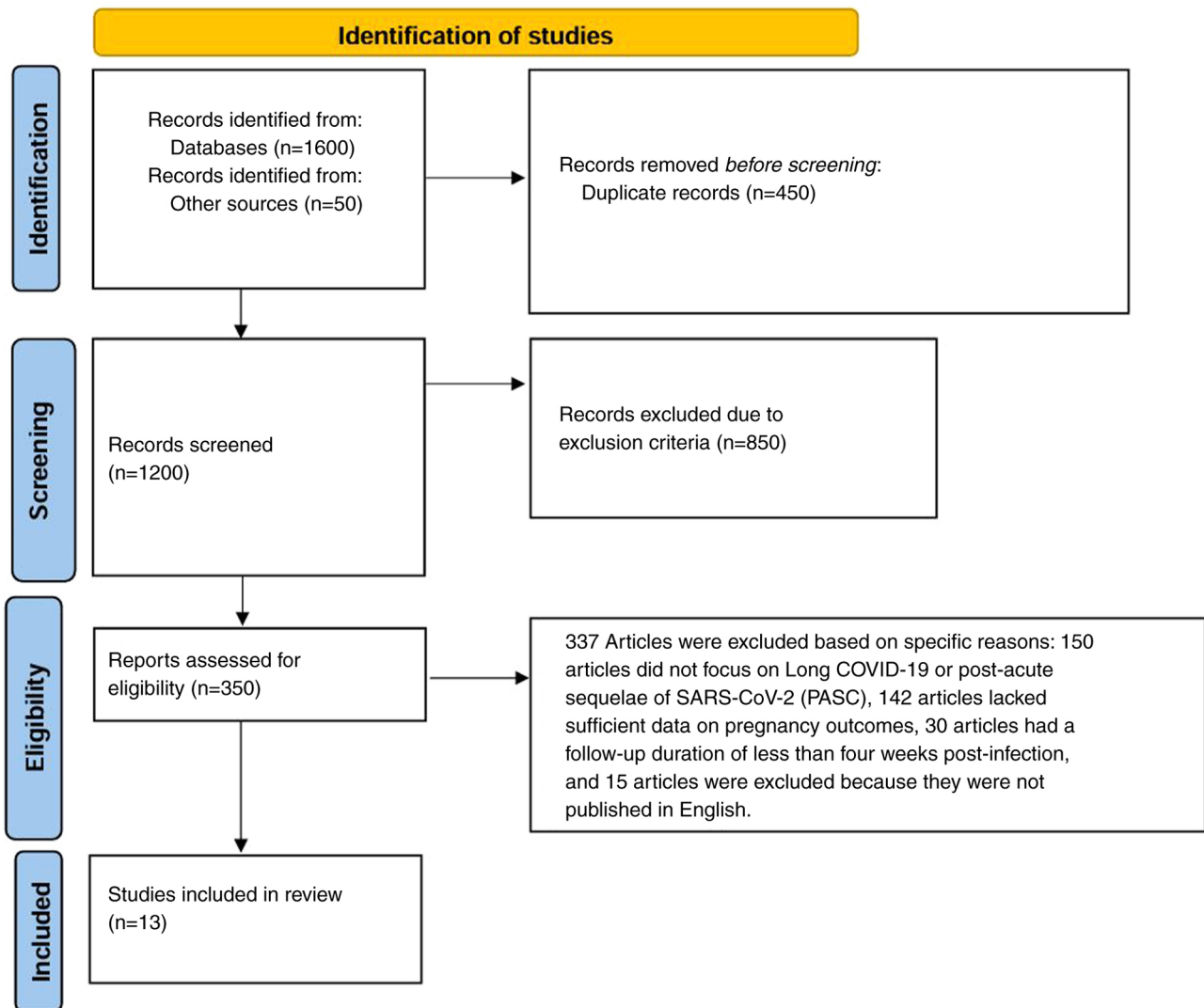


Figure 1. Flowchart for the study selection process.

included studies and the quality assessment are summarized in Table I.

Prevalence of Long COVID-19 in pregnant women. Across the included studies, the prevalence of Long COVID-19 in pregnant women varied widely, ranging from 9.3-93%. The variation in prevalence can be attributed to differences in study design, follow-up duration and the definition of Long COVID-19. Studies such as Metz *et al* (14), a large multicenter cohort study, reported a lower prevalence of Long COVID-19 at 9.3% when evaluating symptoms at a median follow-up of 10.3 months. By contrast, smaller single-center studies, such as Malgina *et al* (6), observed a significantly higher prevalence (93%) in pregnant women compared with non-COVID-19 controls (38.4%).

Persistent symptoms. The reported symptoms of Long COVID-19 in pregnant women encompassed a wide spectrum, with fatigue, cognitive dysfunction, respiratory symptoms and psychological disturbances being the most reported. Fatigue was the most frequently observed symptom across studies, with prevalence rates ranging from 54.5% (22) to 76% (7).

Cognitive impairment and memory loss were prominent in studies such as Malgina *et al* (6), affecting nearly 50% of the affected women. Psychological symptoms, including depression and anxiety, were highlighted by both Vetrugno *et al* (24) and Muñoz-Chápuli *et al* (15), indicating a significant impact on health-related quality of life (HRQoL).

Some studies also identified unique symptoms or sequelae associated with Long COVID-19 in pregnancy. Gu *et al* (21) found a high incidence of liver function abnormalities in 40.6% of pregnant women, suggesting a potential organ-specific impact of COVID-19 during pregnancy. Váscquez-González *et al* (23) noted difficulty concentrating and hair loss as distinctive symptoms among pregnant women, although no significant difference was observed compared with non-pregnant controls. These findings underscore the variability and complexity of Long COVID-19 symptomatology in the maternal population.

Impact of Long COVID-19 on maternal and perinatal outcomes. The severity of acute COVID-19 symptoms appears to be a significant predictor of Long COVID-19 development and its impact on pregnancy outcomes. Bruno *et al* (20)

Table I. Characteristics of the included studies.

First author/s, year	Type of study	Population	Measurements	Key findings	Quality assessment	(Refs.)
Backes <i>et al</i> , 2024	Pilot study	773 women enrolled in CRONOS registry; 110 completed follow-ups	Web-based questionnaire for follow-up data on Long-COVID-19 symptoms, including fatigue, and quality of life (EuroQoL EQ-5D-5L)	63.6% reported Long-COVID-19 symptoms, 55% experienced fatigue more than one-year post-infection, 76% rated their quality of life as 'good' or 'very good'	Moderate quality (NOS: 5/9 stars, based on low response rate and potential reporting bias)	(7)
Bruno <i>et al</i> , 2024	Retrospective cohort study	5397 pregnant women and 83,915 non-pregnant women with lab-confirmed SARS-CoV-2 infection	Electronic Health Records (EHR) data from 19 U.S. health systems; computable Long COVID-19 phenotype; adjusted hazard ratios using IPTW	SARS-CoV-2 infection acquired during pregnancy associated with lower Long COVID-19 risk (aHR 0.85, 95% CI 0.80-0.91); increased risk of thromboembolism, abdominal pain, and abnormal heartbeat; decreased risk for cognitive problems, malaise, and fatigue.	High quality (NOS: 9/9 stars; Validated computable phenotype, large sample size, adjustment for confounders using IPTW)	(20)
Ghizzoni <i>et al</i> , 2024	Retrospective cohort study	880 pregnant women (385 COVID-19 positive, 495 COVID-19 negative) admitted to the maternity ward of a tertiary care hospital in Brazil	Clinical characteristics and obstetric outcomes collected through hospital charts; persistent symptoms evaluated through follow-up calls at 3 and 6 months	COVID-19 positive pregnant women had higher risk of adverse outcomes (preterm birth, ICU admission, mechanical ventilation, maternal and neonatal death); 30% had persistent symptoms for 6+ months (fatigue, myalgia, olfactory disorders).	High quality (NOS: 8/9; The scoring considers strong representativeness and reliable follow-up, with a minor deduction due to potential biases)	(17)
Gu <i>et al</i> , 2023	Retrospective cohort study	155 pregnant women with prior COVID-19 infection and 76 COVID-19 negative controls, Affiliated Maternity and Child Health Care Hospital of Nantong University, China	Liver function tests (ALT, AST, ALP, GGT) assessed via routine biochemical tests; abnormal liver function defined based on hospital standards	40.6% of COVID-19 positive patients had elevated liver enzymes; gestational age and BMI were independent risk factors for liver injury. Liver function normalized within 4-26 days.	High quality (NOS: 7/9 stars; The scoring reflects a well-conducted study with limitations in follow-up and adjustment for confounders.)	(21)
Muñoz-Chápuli Gutiérrez <i>et al</i> , 2024	Prospective observational cohort study	409 pregnant women with confirmed COVID-19 infection during pregnancy or at delivery	Systematic clinical surveys via telephone using the Delphi consensus; long-term follow-up over a median of 100 weeks	34.2% had at least one post-COVID-19 symptom after 3 months; neurological (60%) and cutaneous (55%) symptoms were most common; risk factors include multiparity, non-vaccination, and severe acute infection.	High quality (NOS: 7/9 stars based on selection bias and follow-up limitations)	(15)

Table I. Continued.

First author/s, year	Type of study	Population	Measurements	Key findings	Quality assessment	(Refs.)
Kandemir <i>et al</i> , 2024	Cross-sectional, retrospective cohort study	99 COVID-19 positive pregnant women and 99 COVID-19 negative controls, Akdeniz University, Turkey	Clinical surveys via telephone interviews; acute and long-term symptoms recorded systematically	74.7% of COVID-19 positive women had long COVID-19 symptoms, primarily fatigue (54.5%), myalgia/arthralgia (49.5%), and anosmia/ageusia (31.3%). Severe acute disease increased the likelihood of long COVID-19 (aOR = 13.3).	High quality (NOS: 7/9 stars based on follow-up bias, lack of control for confounders)	(22)
Oliveira <i>et al</i> , 2022	Longitudinal comparative cohort study	588 pregnant women (259 COVID-19 symptomatic, 131 COVID-19 positive serology, 198 COVID-19 negative serology)	Custom-built fatigue questionnaires at multiple timepoints (6 weeks, 3 months, 6 months post-infection/delivery)	Higher fatigue prevalence in symptomatic women (G1) compared with G2 and G3 at all timepoints; increased risk with severe acute disease (HR = 2.43).	High quality (NOS: 7/9 stars based on follow-up loss and lack of confounder adjustment)	(13)
Metz <i>et al</i> , 2024	Multicenter prospective cohort study	1,502 pregnant individuals enrolled across multiple U.S. centers	NIH RECOVER-Pregnancy Cohort criteria; symptoms evaluated 6+ months post-infection using standardized questionnaires	9.3% had long COVID-19 at a median of 10.3 months post-infection; key risk factors included obesity (aOR 1.65), depression/anxiety (aOR 2.64), economic hardship (aOR 1.57), and severe acute infection requiring oxygen (aOR 1.86).	High quality (NOS: 8/9 stars, with minor bias due to enrollment timing and potential loss to follow-up)	(14)
Vásconez-González <i>et al</i> , 2023	Cross-sectional study	457 women (16 pregnant, 441 non-pregnant) in Ecuador	Online self-reported survey with 37 items covering demographics, lifestyle habits, and long COVID-19 symptoms	54.1% of respondents had long COVID-19 symptoms; common symptoms in pregnant women included fatigue (10.6%), hair loss (9.7%), and difficulty concentrating (6.2%). No statistically significant differences between pregnant and non-pregnant women.	Moderate quality (NOS: 4/9 stars; limitations include self-reporting bias, low representation of pregnant women, and limited confounder adjustment)	(23)
Vetrugno <i>et al</i> , 2023	Prospective observational study	33 unvaccinated pregnant women with COVID-19 at any gestational age admitted to University Hospital of Udine, Italy	SF-36 and IES-R to evaluate health-related quality of life (HRQoL) and PTSD at 1-year follow-up	30% tested positive for PTSD; physical impairment reported in HRQoL scores. Lower scores in bodily pain and physical function. Previous cardiac, pulmonary, or kidney disease significantly worsened HRQoL.	High quality (NOS: 7/9 stars; limitations include small sample size and self-report bias)	(24)

Table I. Continued.

First author/s, year	Type of study	Population	Measurements	Key findings	Quality assessment	(Refs.)
Belokrinitskaya <i>et al</i> , 2023	Cross-sectional observational study	111 pregnant women and 181 non-pregnant women with PCR-confirmed SARS-CoV-2 infection	Symptom assessment using a 10-point questionnaire; comparison of Long COVID-19 symptoms between groups	93.7% of pregnant and 97.2% of non-pregnant women had Long COVID-19. Pregnant women reported higher dyspnea rates (37.8% vs 26.5%, OR=1.69) and lower rates of hair loss (46.8% vs. 60.8%) and headache (30.6% vs. 43.1%).	High quality (NOS: 7/9 stars; limitations include self-reporting bias and potential selection bias due to lack of diverse population)	(25)
Malgina <i>et al</i> , 2023	Prospective observational cohort study	200 pregnant women with mild and moderate COVID-19 (I: n=22, II: n=76, III: n=102) and 99 non-COVID-19 controls	Symptom assessment using a 40-item questionnaire and Hamilton Depression Scale	93.0% of pregnant women in the study group had Long COVID-19 vs. 38.4% in the control group; significant symptoms: cognitive impairment, distortion of smell/taste, dry mouth, fatigue, and psychological disorders.	High quality (NOS: 7/9 stars; limitations include single-center design and potential selection bias)	(6)
Yao <i>et al</i> , 2024	Retrospective cohort	623 pregnant women: 209 acute COVID-19, 72 long-term COVID-19, 342 non-COVID-19	Epidemiological and clinical characteristics, maternal and fetal complications, blood coagulation indicators	Long-term COVID-19 associated with higher rates of gestational hypertension (OR 3.344), gestational diabetes (OR 2.301), and fetal intrauterine growth restriction (OR 2.817). No significant differences in premature rupture of membranes, preterm delivery, neonatal asphyxia, or NICU transfer. Slightly lower platelet count in long-term COVID-19 group.	High quality (NOS: 8/9 stars; ethically approved, robust statistical methods)	(26)

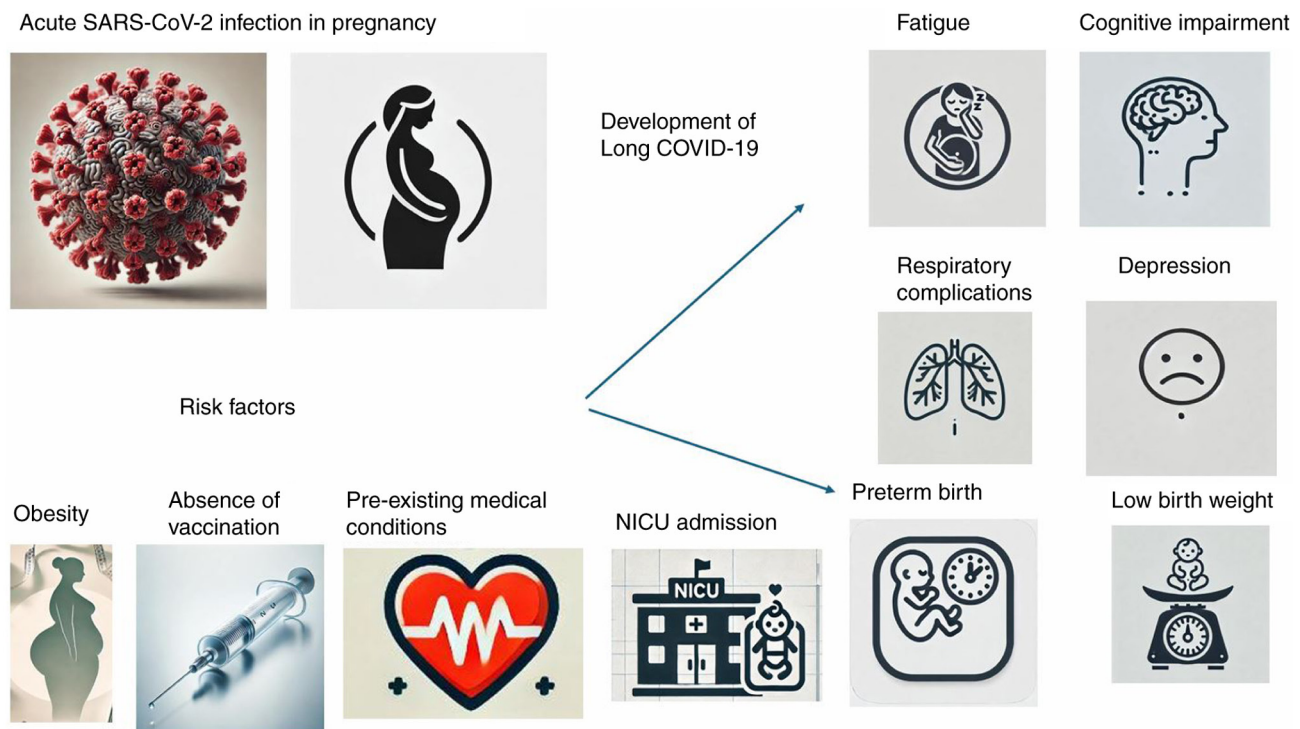


Figure 2. Risk factors and outcomes of Long COVID-19 in pregnant women.

demonstrated that women who contracted SARS-CoV-2 during pregnancy had a lower overall risk of Long COVID-19 (adjusted hazard ratio=0.85), but those who experienced severe symptoms were more likely to develop thromboembolic events and abnormal heart rhythms. Similarly, Yao *et al* (26) reported that pregnant women with long-term COVID-19 had a significantly higher risk of developing gestational hypertension [odd ratio (OR)=3.344], gestational diabetes (OR=2.301) and fetal intrauterine growth restriction (OR=2.817). No significant differences were observed in the rates of premature rupture of membranes, preterm delivery, or neonatal asphyxia between the long-term COVID-19 and non-COVID-19 groups.

Ghizzoni *et al* (17) similarly reported a higher rate of adverse pregnancy outcomes, including preterm birth and neonatal complications, in women with persistent symptoms.

In addition to obstetric outcomes, Long COVID-19 also influenced maternal HRQoL. Vetrugno *et al* (24) used the SF-36 and IES-R scales to assess HRQoL and post-traumatic stress disorder (PTSD) symptoms, revealing that 30% of participants tested positive for PTSD one-year post-infection. Women with underlying comorbidities such as cardiac or pulmonary disease had significantly poorer HRQoL scores, suggesting that pre-existing health conditions may exacerbate the long-term impact of COVID-19.

Risk factors for long COVID in pregnancy. Several studies identified risk factors associated with an increased likelihood of developing Long COVID-19 among pregnant women. Metz *et al* (14) highlighted that obesity, pre-existing mental health conditions, and severe acute infection were significantly associated with higher odds of Long COVID-19. Similarly, Muñoz-Chápuli *et al* (15) identified non-vaccination and multiparity as key risk factors. Oliveira *et al* (13) found that

women who experienced severe acute COVID-19 were at a 2.43-fold increased risk of persistent fatigue compared with those with milder symptoms, emphasizing the importance of acute symptom management to potentially mitigate long-term sequelae. Risk factors and outcomes of Long COVID-19 in pregnant women are illustrated in Fig. 2.

Discussion

The present systematic review highlights the significant prevalence and variability of Long COVID-19 in pregnant women, with rates ranging from 9.3-93%. The wide range in prevalence is due to differences in study designs, definitions and timing of symptom assessment. Common symptoms included fatigue, dyspnea, cognitive impairment and psychological issues such as anxiety and depression, emphasizing the need for mental health support. The severity of acute COVID-19 was found to be a key predictor of Long COVID-19, with severe cases linked to prolonged symptoms such as liver dysfunction and thromboembolic events. The clinical impact of Long COVID-19 on pregnancy extends beyond persistent symptoms. It is associated with adverse maternal and perinatal outcomes, such as preterm birth, low birth weight and an increased need for neonatal intensive care. The presence of long-term respiratory and neurological symptoms, such as thromboembolic events, may complicate daily activities and postpartum care, further stressing the need for targeted follow-up and support for pregnant women with Long COVID-19. This highlights the need for comprehensive care models that integrate physical, mental and perinatal health (27). Several studies within the review identified key risk factors for developing Long COVID-19 in pregnancy, such as severe acute infection, obesity and non-vaccination. Additionally, pre-existing mental health conditions were

significantly linked to prolonged psychological symptoms including anxiety and depression. The identified risk factors for Long COVID-19 in pregnancy (severe acute infection, obesity, non-vaccination and pre-existing mental health conditions) are not unique to pregnant women but are also well-established risk factors for Long COVID in the general population (28-31). Identifying key risk factors for Long COVID-19 in pregnancy, such as severe acute infection, obesity, non-vaccination and pre-existing mental health conditions, highlights the need for targeted clinical interventions. Pregnant women with these risk factors should receive closer monitoring during and after pregnancy to detect and manage prolonged symptoms early. Emphasizing COVID-19 vaccination is crucial to reducing severe infection and long-term complications, while addressing obesity through lifestyle interventions during pregnancy can help lower the risk of Long COVID-19 (32). Additionally, women with pre-existing mental health conditions require tailored postpartum mental health support, and understanding these risk factors enables more efficient resource allocation to prioritize care for high-risk individuals (33).

The management of pregnant women with Long COVID-19 should largely mirror that of non-pregnant individuals, with a focus on self-management and medical care. Self-management includes daily pulse oximetry, optimizing general health through adequate sleep, nutrition, smoking cessation and reducing alcohol and caffeine intake. A gradual increase in exercise should be encouraged, as tolerated, alongside setting realistic goals. Medical management involves treating symptoms, managing pre-existing conditions, prescribing antibiotics for secondary infections, and referring patients to specialists such as mental health professionals and pulmonary rehabilitation programs. Social and financial support should also be prioritized (34).

Pregnancy introduces additional complexities to the management of Long COVID-19. Women with severe symptoms should seek pre-conception counseling to optimize their health before pregnancy. The impact of pregnancy on Long COVID-19 remains uncertain, though symptoms such as fatigue and breathlessness may worsen, particularly in the third trimester. During pregnancy, symptom tracking via a diary can help identify new or worsening symptoms, which should not be automatically attributed to Long COVID-19 without thorough evaluation. Regular fetal growth monitoring is recommended for women with severe symptoms. The approach to labor and delivery should be individualized, especially for those with significant fatigue or cardiovascular and respiratory symptoms, reserving caesarean sections for obstetric indications (35).

The present systematic review is, to the best of our knowledge, the first to provide insights from Long COVID-19 syndrome in pregnant women. However, the present systematic review has several limitations that should be considered when interpreting the findings. First, there was significant heterogeneity in study designs, sample sizes, follow-up durations and definitions of Long COVID, which limited the ability to synthesize results quantitatively and may have contributed to the observed variability in prevalence estimates. Numerous included studies relied on self-reported data, which is subject to recall bias and may not accurately capture the true burden of symptoms, particularly for psychological and cognitive

outcomes. Additionally, the lack of standardized diagnostic criteria for Long COVID in pregnant populations further complicates the comparison of results across studies. Most studies were conducted in single centers or specific regions, limiting the generalizability of findings to broader, more diverse populations. Finally, the exclusion of non-English language studies and potential publication bias may have resulted in the omission of relevant data, particularly from regions with a high burden of COVID-19, such as Latin America and Asia, potentially skewing the overall D of Long COVID's impact on pregnancy.

Future studies should aim to address these limitations by adopting longitudinal study designs with larger sample sizes and standardized symptom assessment tools. Research should also focus on the long-term impact of Long COVID on both maternal and fetal health, with particular attention to the role of vaccination in mitigating the severity and duration of symptoms. Furthermore, exploring geographically diverse populations could provide a more comprehensive understanding of Long COVID's impact on global maternal health.

The present systematic review highlights the significant burden and complexity of Long COVID in pregnant women. The findings suggest that the prevalence and severity of Long COVID-19 are influenced by multiple factors, including the severity of the acute infection, pre-existing conditions and vaccination status. The wide range in prevalence estimates across studies reflects the need for standardized definitions and diagnostic criteria for Long COVID-19 in this population. Pregnant women with severe or moderate COVID-19 appear to be at the highest risk for persistent symptoms, which may impact not only maternal health but also perinatal outcomes such as preterm birth and neonatal complications. Psychological symptoms, such as anxiety and depression, were prominent in several studies, emphasizing the importance of comprehensive post-infection care that includes mental health support. Despite the valuable insights provided, the review's findings are limited by the heterogeneity of study designs and reliance on self-reported data. Future research should focus on longitudinal studies with larger sample sizes and diverse populations to provide a clearer understanding of the long-term impact of COVID-19 during pregnancy and inform evidence-based guidelines for managing Long COVID in this vulnerable population.

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Authors' contributions

AS and VEG conceptualized the study. AS, CT, VEG and DAS made a substantial contribution to data interpretation and analysis and wrote and prepared the draft of the manuscript. AS and VEG

analyzed the data and provided critical revisions. All authors contributed to manuscript revision, read and approved the final version of the manuscript. Data authentication is not applicable.

Ethics approval and consent to participate

Not applicable.

Patient consent for publication

Not applicable.

Competing interests

DAS is the Editor-in-Chief for the journal, but had no personal involvement in the reviewing process, or any influence in terms of adjudicating on the final decision, for this article. The other authors declare that they have no competing interests.

Use of artificial intelligence tools

During the preparation of this work, artificial intelligence tools were used to improve the readability and language of the manuscript, and subsequently, the authors revised and edited the content produced by the artificial intelligence tools as necessary, taking full responsibility for the ultimate content of the present manuscript.

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