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Survival analysis of COVID-19 outcomes in pregnant and non-pregnant women: A secondary data study

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ABSTRACT

Introduction: Pregnant women are a population vulnerable to health problems. The morbidity and mortality of pregnant women with COVID-19 are higher compared with the rest of the population. This study aims to determine the survival rate of pregnant versus non-pregnant women with COVID-19.

Methods: The study used a retrospective observational cohort design. Data were collected from Dr Soeradji Tirtonegoro and Penembahan Senopati hospitals on patients treated between March 2020 and June 2022. A total of 923 women diagnosed with COVID-19 were included in the study. Sociodemographic and clinical data on patient characteristics were extracted from medical records. Data analysis was conducted using Kaplan-Meier and Cox regression analyses to estimate survival probability and investigate predictors of death, with a 5% significance level.

Results: Among 932 women with COVID-19, 231 deaths occurred. The median survival time for all participants was 30.56 days, while for pregnant women, it was 11.21 days, and for pregnant women with comorbidities, it was 9.68 days. Years of treatment, age, comorbidities, number of comorbidities and pregnancy were associated with survival rate (P-value < 0.001). Consistent results were also obtained for pregnant women's age and number of comorbidities (P-value < 0.05). Significant differences between pregnant and non-pregnant patients remained after adjustment for year, sex, age and hospital type (P-value < 0.001).

Conclusion: Pregnant women with COVID-19 have a higher risk of death compared with non-pregnant women.

Keywords: comorbidity; COVID-19, female; pregnant women; survival analysis

INTRODUCTION

In 2019, the COVID-19 virus was identified as an acute respiratory syndrome that was spreading rapidly, and in 2020, the World Health Organization (WHO) declared this outbreak a pandemic (Cucinotta & Vanelli, 2020). Pregnant women were identified as a vulnerable group and were advised to take additional precautions. The WHO states that it is essential for healthcare providers to be aware that pregnant women with COVID-19 and their newborn babies are likely to require special care. This is especially true for pregnant women with COVID-19 who have comorbidities or other risk factors (Li et al., 2020; World Health Organization, 2020).

As a new viral infection, many aspects of the risks for pregnant women during the COVID-19 pandemic were unknown. Physiological changes during pregnancy can substantially impact the immune system, respiratory system, cardiovascular function and coagulation. These changes can have either a positive or negative impact on the progression of COVID-19 in pregnant women (Reynolds et al., 2022). Physiological, mechanical and immunological changes in pregnancy can increase susceptibility to infections in general, particularly if the cardiorespiratory system is affected, and may lead to the rapid progression of respiratory failure, increasing the risk of death (Dashraath et al., 2020). Immunological tolerance protects the fetus during pregnancy, potentially altering the mother's immune response to infectious processes such as COVID-19. This change in the immune response can increase vulnerability in fighting contagious diseases due to the weak response of the inflammatory system that can fight viruses. However, this protective system can also trigger a hyperinflammatory reaction, such as a cytokine storm, which leads to increasingly severe complications and a higher risk of death (Sessa et al., 2022; Yao et al., 2024).

Initial reports stated that COVID-19 infection had no effect on pregnancy (Muhidin et al., 2020; Turan et al., 2020; Wang et al., 2020). However, previous studies indicate that pregnant women infected with COVID-19 are at higher risk of experiencing severe conditions, abortion and death (Gajbhiye et al., 2021; La Verde et al., 2021; Lokken et al., 2021). The pandemic has led to an estimated 38.6% increase in maternal mortality per month across 118 low- and middle-income countries. This increase is attributed to both the direct effects of the virus and indirect effects, such as disruptions in healthcare services (Alabi et al., 2023). A systematic review found that COVID-19 increases the risk of maternal death,

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fetal death in the womb and neonatal death in 1% of pregnant women (Papapanou et al., 2021). A meta-analysis states that COVID-19 in pregnant women is associated with higher caesarean section rates and increased mortality (Karimi et al., 2021). Studies in the United States report that pregnant women are at greater risk of being admitted to the ICU and requiring invasive ventilation (Rasmussen & Jamieson, 2022). In Indonesia, maternal deaths due to COVID-19 increased from 3% to 9% with the emergence of the Delta variant (Azizah et al., 2023).

Pregnant women with comorbidities such as diabetes mellitus, hypertension and cardiovascular disease have an increased risk of experiencing severe impacts related to COVID-19, including higher maternal morbidity and adverse birth outcomes. In addition, other risk factors include HIV infection, being underweight before pregnancy and anaemia. Although pregnant women are already considered a high-risk population, special priority for prevention and treatment should be given to pregnant women with these additional risk factors (Smith et al., 2023). A woman who is diagnosed with COVID-19 before becoming pregnant also has a high risk of pregnancy. This suggests that past morbidity modifies the effects of COVID-19 exposure, especially in mothers with preeclampsia/eclampsia. In addition, pregnant women who are overweight at their first antenatal visit and diagnosed with COVID-19 also have the highest risk for maternal morbidity and mortality indices (Villar et al., 2021).

Several studies have examined the morbidity and mortality of pregnant women with COVID-19 (Akbar et al., 2022; Prasetyo et al., 2023; Setyowati et al., 2021; Wardhana et al., 2023), with most focusing on risk factors, related conditions and effects on pregnancy without assessing survival time. To the best of our knowledge, no studies have examined differences in survival rates between non-pregnant women, pregnant women and pregnant women with comorbidities. For this reason, this study aims to determine the survival rate of pregnant women with COVID-19. We assume that pregnant women have a lower survival rate compared with non-pregnant women.

METHODS

Study Design

The study used a retrospective observational cohort study research design. One of the variables analyzed is hospital type, so we determined two types, namely secondary and tertiary hospitals. It was conducted at the Dr. Soeradji Tirtonegoro Central General Hospital (tertiary hospital) and the Penembahan Senopati Regional General Hospital (secondary hospital). These two hospitals were selected based on the large number of available cases, the diversity of respondents' characteristics, and the availability of adequate facilities. Data collection was based on medical records of COVID-19 patients treated from March 2020 to June 2022.

Participant

The study used samples from women who were treated with a diagnosis of COVID-19 through real-time reverse transcriptase polymerase chain reaction (RT-PCR) SARS-CoV-2 examination using a nasopharyngeal swab. The number of samples was calculated using the survival formula to analyse the number of deaths and then determine the sample size. The formula is (Li et al., 2018),

$$E = (Z\alpha/2 + Z\beta)\ 2/\ (\log (HR))\ 2q0q1$$

With detail:
E= event, the number of deaths
Zα/2=1.96
Zβ=0.84
HR= hazard rate, used previous study 13.91 (Matsuo et al., 2023)
q1 = proportion of subjects in the exposed group
q0 = proportion of subjects in the unexposed group

The confidence level used was 95%, the power of the study was 80%, and the calculation results showed that the number of events was 14.24.

Next, the optimum sample size was calculated using the formula N=E/PE, where PE=cumulative mortality rate; previous studies found 7.2% (Guimarães et al., 2023), and the calculation results showed a minimum sample size of 201 people. This study involved 932 participants, selected through total sampling, with the inclusion criterion of having complete medical records.

Variables and Operational Definitions

The outcome of this study is the time to death of pregnant and non-pregnant women suffering from COVID-19, calculated from the onset of symptoms. Outcomes are categorised as death (event) with code 1 and censored with code 0. Participants are classified as censored if they are declared cured, discharged with improvement, discharged against medical advice or referred to another health facility. The event or censored verification process is carried out by the attending doctor and documented in the medical record. The doctor in charge will write down the patient's status in the medical record, such as death, discharge, or referral. The independent variables are years of treatment, reproductive age, presence or absence of comorbidities and pregnancy, while the dependent variable is survival rate. Age is categorised into <20 years, 20–35 years and >35 years, based on the classification of risk and non-risk age groups in pregnant women (Purborini & Rumaropen, 2023).

Data Collection

The patient medical record unit at the hospital provided detailed retrospective data on participants with variables according to the researcher's request in the form of soft files in Excel data form. We reviewed and extracted data into a form containing respondent characteristics (year of treatment and age), type of hospital, date of admission, date of discharge, length of stay, pregnancy status, outcome, presence or absence of comorbidities and type of comorbidity. We used participants with complete data, while participants with incomplete data were not included in the analysis.

Data Analysis and Ethical Consideration

This study used secondary data from medical records; therefore, informed consent was not obtained from each respondent. The data analysis process was conducted anonymously and did not involve direct patient interaction. Data collection was carried out after obtaining ethical clearance from the ethics commission of Respati Yogyakarta University number 110.3/FIKES/PL/VII/2022, July 26 2022 and research permission from the hospital with numbers LB.02.02/XIII/2243/2022 and LB.02.01/XXVI.3/1720/2022, August 08 2022. Univariate categorical data is presented using a frequency distribution, while numerical data uses the mean and standard deviation (SD). We used life table analysis to determine survival probability and the Kaplan-Meier method

and log-rank test to calculate survival time and compare groups. Cox regression analysis was used to examine factors associated with death in women with COVID-19. The factors analysed in Cox regression included year of treatment, age, presence of comorbidities and pregnancy. The entire data analysis process was conducted using SPSS V27 software, and variables with a p-value of less than 0.05 were considered statistically significant.

RESULTS

Demographic Characteristic of Respondents and Outcome Status of Women With COVID-19

Table 1 shows that the mean ± SD age and length of stay for 932 women with COVID-19 were 33.15 ± 8.29 and 8.52 ± 5.60. The death cases that occurred were 231 patients, with the highest number of deaths in patients treated in 2021 (179), aged 20-35 years (134), having comorbidities (148), having more than one comorbidity (92), being treated in a tertiary hospital (141), being pregnant (145). Variables related to the survival rate of women with COVID-19 included year of treatment, presence of comorbidities, number of comorbidities and pregnancy (all *P*-value < 0.001), as well as age (*P*-value < 0.002). Hospital type is not related to the survival rate of women with COVID-19 (*P*-value = 0.639). In pregnant women, comorbidities were related to the survival rate (0.049), whereas age did not show a significant relationship (*P*-value = 0.665). Table 1 presents data on respondent characteristics and the status of pregnant women with COVID-19.

Survival Time of Women with COVID-19 Based on Demographic Characteristic

Figure 1 illustrates the survival time of women with COVID-19. Patients with the longest survival time in 2020 were young (<20 years old), had no comorbidities and were treated in a secondary hospital. Meanwhile, women with comorbidities and those who were pregnant had a shorter

Table 1. Demographic characteristic and outcome status of women with COVID-19 (n=932)

Characteristics	Mean ± SD or n (%)	Death n (%)	Survived n (%)	95% CI	*P*-value
Age (years old)	33.15 ± 8.29				
Time (Days)	8.52 ± 5.60				
Status					
Censor	701 (65.8)				
Event (Death)	231 (24.8)				
Year					
2020	156 (16.7)	16 (10.3)	140 (89.7)	34.58-39.34	<0.001
2021	640 (68.7)	179 (28.0)	461 (72.0)	21.92-30.04	
2022	136 (14.6)	36 (26.5)	100 (73.5)	10.30-21.18	
Age					
<20	51 (5.5)	4 (7.8)	47 (92.2)	25.25-29.87	0.002
20-35	486 (52.1)	134 (27.6)	352 (72.4)	19.19-25.98	
>35	395 (42.4)	93 (23.5)	302 (76.5)	26.14-34.94	
Comorbid For All Women					
No	478 (51.3)	83 (17.3)	395 (82.6)	25.72-32.49	<0.001
Yes	454 (48.7)	148 (32.6)	306 (67.4)	19.45-28.93	
Number of Comorbid for All Women					
No	478 (51.3)	83 (17.3)	395 (82.6)	25.72-32.49	<0.001
One	207 (22.6)	56 (27.1)	151 (72.9)	16.30-22.62	
More than one	247 (26.3)	92 (37.2)	155 (62.8)	23.74-31.28	
Type of Hospital					
Secondary Hospital	402 (43.1)	90 (22.4)	312 (77.6)	20.32-31.90	0.639
Tertiary Hospital	530 (56.9)	141 (26.6)	389 (73.4)	23.30-28.96	
Pregnancy					
No	613 (65.8)	86 (14.0)	527 (86.0)	35.74-41.40	<0.001
Yes	319 (34.2)	145 (45.5)	174 (54.5)	10.48-13.74	
Risk of Age Pregnancy (n=319)					
Non-risk	246 (77.1)	113 (45.9)	133 (54.1)	10.47-14.58	0.665
Risk	73 (22.9)	32 (43.8)	41 (56.2)	9.20-13.82	
Comorbid of Age Pregnancy (n=319)					
No	193 (60.5)	65 (33.7)	128 (66.3)	11.18-16.61	0.049
Yes	126 (39.5)	80 (63.5)	46 (36.5)	8.95-12.54	

Table 2. Life table of women with COVID-19

Intervals (Days)	At Risk	Death (%)	Censored	Survival Probability	Cumulative Survival Probability
All participants[a]					
0-9	932	183	457	0.74	0.74
10-19	292	44	208	0.77	0.57
20-29	40	3	26	0.89	0.50
30-39	11	1	7	0.87	0.44
40-49	3	0	3	1.00	0.44
Pregnant women[b]					
0-9	319	112	149	0.54	0.54
10-19	58	30	22	0.36	0.20
20-29	6	2	1	0.64	0.12
30-39	3	1	2	0.50	0.06
Pregnant women with no comorbid[c]					
0-9	193	57	110	0.59	0.59
10-19	26	7	16	0.61	0.36
20-29	3	1	0	0.67	0.24
30-39	2	0	2	1.00	0.24
Pregnant women with comorbid[d]					
0-9	126	55	39	0.48	0.48
10-19	32	23	6	0.21	0.10
20-29	3	1	1	0.60	0.06
30-39	1	1	0	0.00	0.00

Note: The median survival time: a=30.56, b=11.21, c=13.81, d=9.68

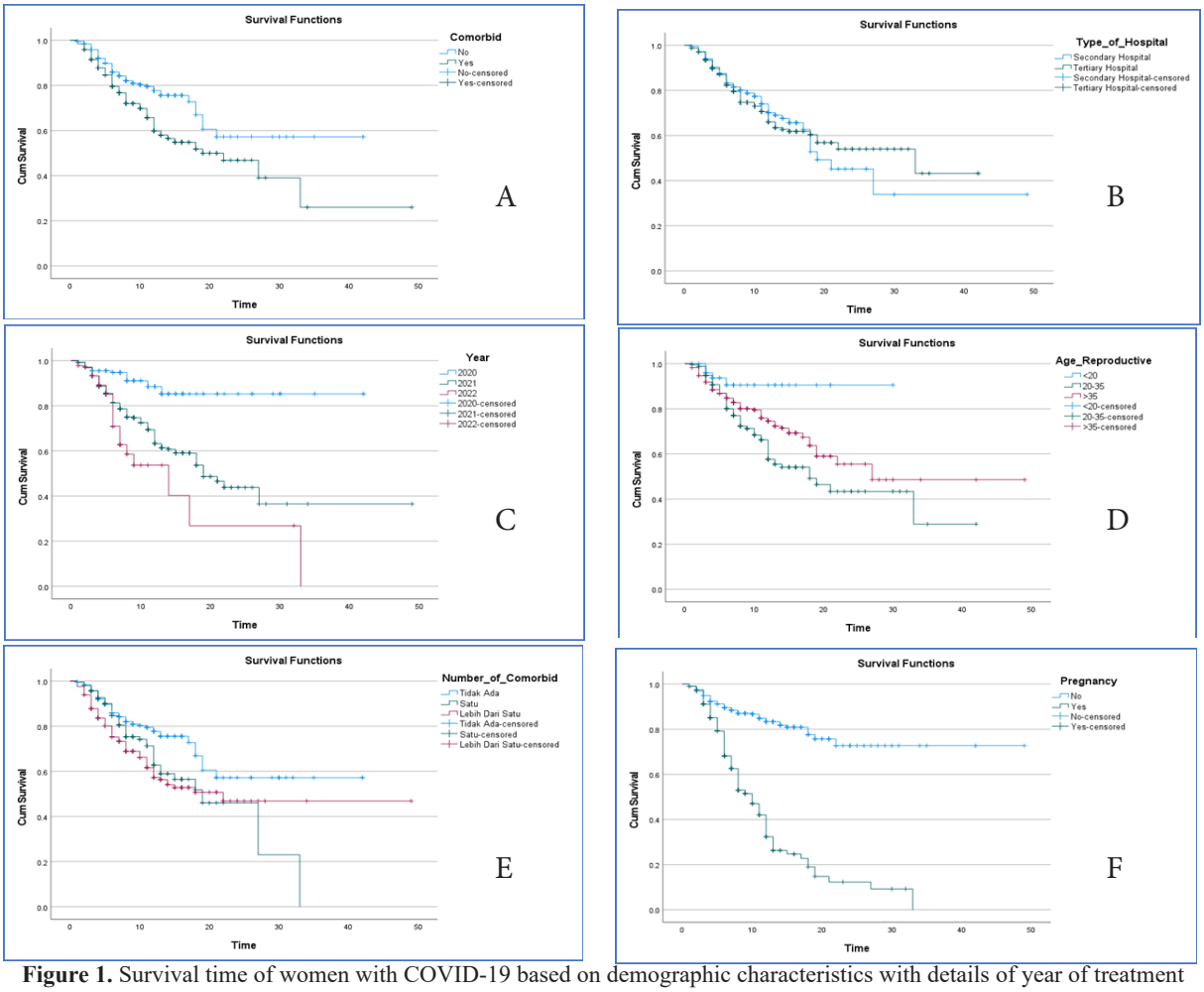

Figure 1. Survival time of women with COVID-19 based on demographic characteristics with details of year of treatment (A), reproductive age (B), comorbidities (C), type of hospital (D), number of comorbidities (E), and pregnancy (F)

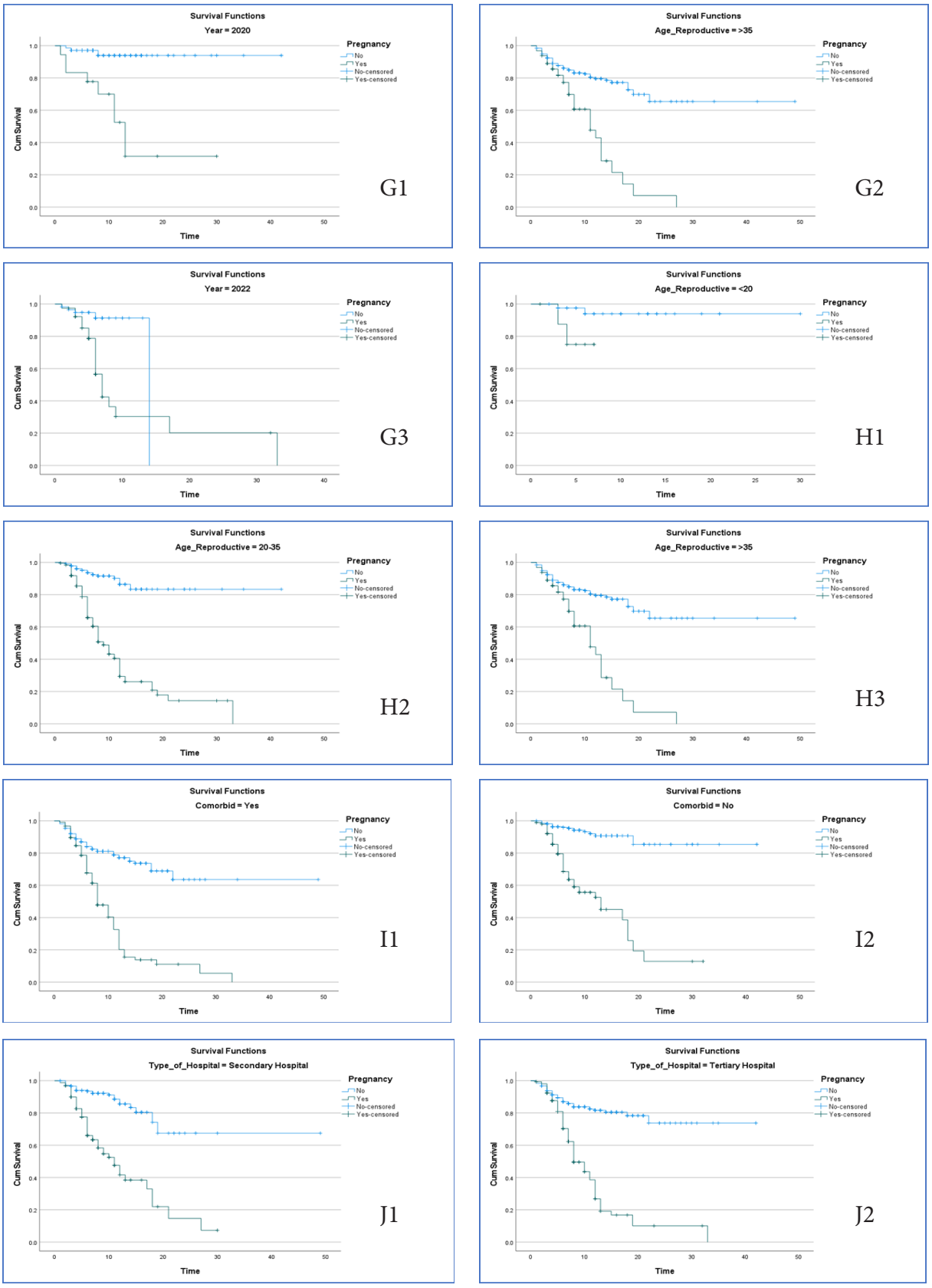

Figure 2. Survival time of women with COVID-19 adjusted by demographic characteristic
Part G shows the survival time adjusted for year of treatment, G1 for patients in 2020, G2 in 2021, and G3 in 2022. Part H shows the survival function adjusted for reproductive age, H1 for <20 years, H2 for 20-35, and H3 for >35 years old. Part I offers survival functions based on comorbidity, I1 for patients with comorbidity, and I2 for patients not comorbid. Part J shows survival time adjusted for hospital type, J1 for secondary and J2 for tertiary hospitals

Table 3. Adjusted outcomes of COVID-19 in pregnant and non-pregnant women (n=932)

Characteristics	Total n (%)	Non-pregnant (n=613)			Pregnant (n=319)			Log-rank *P*-value
		Death n (%)	Survived n (%)	95% CI	Death n (%)	Survived n (%)	95% CI	
Year								
2020	156 (16.7)	7 (5.1)	131 (94.9)	38.19-41.39	9 (50.0)	9 (50.0)	9.49-21.19	<0.001
2021	640 (68.7)	74 (16.7)	343 (83.3)	31.92-39.56	105 (47.1)	118 (52.9)	9.87-12.59	
2022	136 (14.6)	5 (8.6)	53 (91.4)	12.14-14.06	31 (39.7)	47 (60.3)	7.75-17.29	
Age								
<20	51 (5.5)	2 (4.8)	40 (95.2)	26.40-30.55	2 (21.2)	7 (77.8)	5.06-7.19	<0.001
20-35	486 (52.1)	21 (8.7)	219 (91.3)	33.75-39.18	113 (45.9)	133 (54.1)	10.47-14.58	
>35	395 (42.4)	63 (19.0)	268 (81.0)	31.94-39.68	30 (46.9)	34 (53.1)	9.18-13.87	
Comorbid								
No	193 (60.5)	18 (6.3)	267 (93.7)	34.75-40.34	65 (33.7)	128 (66.3)	11.18-16.61	<0.001
Yes	126 (39.5)	68 (20.7)	260 (79.3)	30.92-38.96	80 (63.5)	46 (36.5)	8.95-12.54	
Type of Hospital								
Secondary Hospital	402 (43.1)	26 (10.7)	216 (89.3)	31.41-43.12	64 (40.0)	96 (60.0)	10.57-15.27	<0.001
Tertiary Hospital	530 (56.9)	60 (16.2)	311 (83.8)	30.92-36.10	81 (50.9)	78 (49.1)	9.43-13.48	

Table 4. Cox regression of the risk factors to death in women with COVID-19 cases

Variables	CHR	*P*-value	95% CI
Year			
2020	0.185	<0.001	0.102-0.336
2021	0.065	0.028	0.462-0.958
Age			
<20	0.281	0.012	0.104-0.760
>35	0.707	0.011	0.542-0.923
Comorbid			
Yes	1.676	<0.001	1.280-2.194
Pregnancy			
Yes	4.586	<0.001	3.500-6.009
Pregnancy with comorbid	1.371	0.062	0.985-1.908

Note: CHR=Cox's Hazard Ratio

survival time than those without comorbidities or pregnancy.

Life Table of Women With COVID-19

Table 2 presents the life table for women with COVID-19, arranged in 10-day intervals. Data for the first ten days for all participants showed a cumulative survival probability of 74%, which decreased to 54% in the pregnant women group. Pregnant women with comorbidities had a lower cumulative survival probability than those without (48% vs. 59%). The median survival time for all participants was 30.56 days, with pregnant women with comorbidities having the lowest median survival time at 9.68 days.

Outcome Status of Women with COVID-19 Adjusted by Demographic Characteristic

Table 3 presents significant differences between pregnant and non-pregnant women with COVID-19, adjusted for year of treatment, age, presence or absence of comorbidities and hospital type (all *P*-value < 0.001). The non-pregnant women group had the highest survival rate, with characteristics including treatment in 2020 (94.9%), age <20 years (95.2%), absence of comorbidities (93.7%) and treatment in a secondary hospital (89.3%). The same thing was also seen in the group of pregnant women, with a slight difference in the highest survival rate in 2022 (60.3%), while other aspects were the same, namely age <20 years (77.8%), no comorbidities (66.3%), and being treated in a secondary hospital (60.0%). Survival time for pregnant and non-pregnant women is depicted in Figure 2.

The Risk Factors to Death in Women With COVID-19 Cases

The results of the Cox regression analysis are displayed in Table 4. The results show factors significantly related to the survival rate of women with COVID-19, namely the year of treatment (2020 with *P*-value < 0.001 and 2021 with *P*-value = 0.028), age (<20 with *P*-value = 0.012 and >35 with *P*-value = 0.011), presence of comorbidities (*P*-value < 0.001) and pregnancy (*P*-value < 0.001). Patients treated in 2020 (CHR = 0.185, CI = 0.102–0.336) and those aged <20 years (CHR = 0.281, CI = 0.104–0.760) had the lowest mortality. Patients with comorbidities (CHR = 1.676, CI = 1.280–2.194) and pregnant women (CHR = 4.586, CI = 3.500–6.009) had a higher risk of death compared with those without comorbidities or pregnancy.

DISCUSSION

The findings show that pregnancy is related to the survival rate of COVID-19 patients; pregnant women have a lower survival rate compared with women who are not pregnant. These results are consistent with previous studies indicating that compared with non-pregnant women, the severity and mortality of pregnant women with COVID-19 are higher (Gajbhiye et al., 2021; La Verde et al., 2021; Lokken et al., 2021; Matsuo et al., 2023; Qeadan et al., 2021; Scheler et al., 2021). Pregnancy is a natural process which causes anatomical and physiological changes in the mother. Changes occur in the immune system, heart, lungs and other systems during pregnancy. This condition causes pregnancy to be a vulnerable condition, so if a pregnant woman is exposed to an infection, it will increase morbidity and mortality (Abu-Raya et al., 2020). During the COVID-19 pandemic, pregnancy has been shown to worsen the clinical course of COVID-19 compared with non-pregnant women of the same age (Dawood et al., 2021), exacerbate acute respiratory disease (McClymont et al., 2022), and increase the risk of thromboembolism (Iba et al., 2021).

COVID-19 has a more severe impact on pregnant women due to immune suppression. Pregnancy naturally suppresses the immune system to prevent fetal rejection, making pregnant women more susceptible to infections, including COVID-19 (Alberca et al., 2020). Pregnancy also affects respiratory and cardiovascular functions; the respiratory and cardiovascular systems undergo substantial changes during pregnancy, which can be exacerbated by COVID-19, leading to severe respiratory complications. The growing fetus and placenta increase the maternal body's oxygen demand. If this demand is not met, it can lead to hypoxia (Twanow et al., 2022). Pregnancy notably increases the risk of thromboembolism due to hypercoagulability. Pregnancy induces a hypercoagulable state to protect against the bleeding challenges of miscarriage and childbirth. This state is characterised by increased levels of procoagulant factors and decreased levels of physiological anticoagulants, leading to a higher risk of thrombosis (Varlas et al., 2023).

Pregnant women experience haemostatic changes, making them more susceptible to thromboembolism, which can obstruct micro and macrovasculature (Egloff et al., 2023). Meta-analysis studies show that pregnant women with COVID-19 are substantially more likely to be hospitalised, with an increased risk of ICU admission and impaired ventilation (Wang et al., 2022). This study found that pregnant women with COVID-19 are at risk of dying more than four times compared to non-pregnant women. The results differ from previous studies that reported a 14-fold increase in the risk of death, with a substantially higher risk of severe maternal morbidity and mortality, including complications such as tracheostomy, respiratory distress syndrome, ventilation, acute myocardial infarction, sepsis, shock, cardiac arrest and coagulopathy (Matsuo et al., 2023). Furthermore, pregnancy also increases hospitalisation rates, length of stay and poorer ventilation outcomes (Qeadan et al., 2021).

This study also found a significant relationship between the presence of comorbidities and deaths caused by COVID-19 in pregnant and non-pregnant women. These findings support previous studies indicating that comorbidities increase the severity and mortality of COVID-19 patients (Atkins et al., 2020; Ge et al., 2021). Various comorbidities that have been proven to be significant predictors include respiratory conditions, cardiovascular diseases (including hypertension), diabetes mellitus, obesity and other chronic illnesses (Atkins et al., 2020; Ge et al., 2021; Khedr et al., 2022; Russell et al., 2023). COVID-19 can cause systemic inflammation, affecting multiple organs and systems in the body, thereby increasing mortality in COVID-19 patients (Zhu et al., 2020).

Findings also show that the survival time of pregnant women with comorbidities is lower compared with non-pregnant women and pregnant women without comorbidities. These findings align with previous studies indicating that pregnant women infected with COVID-19 who have excess weight, diabetes, hypertension, heart disease or chronic respiratory disease are at a high risk of developing preeclampsia (Qeadan et al., 2021; Villar et al., 2021). Underlying mechanisms include endothelial dysfunction, an exacerbated inflammatory response and physiological changes unique to pregnancy, which collectively contribute to adverse outcomes (Celewicz et al., 2023; Childs et al., 2024). The presence of comorbidities can intensify the pathological mechanisms of COVID-19 in pregnant women, potentially leading to more severe complications and worse outcomes. Understanding the role of comorbidities in COVID-19 is critical for determining intervention and treatment priorities, as certain health conditions may influence disease progression and severity in pregnant individuals (Russell et al., 2023).

Other findings show that years of treatment are related to the survival rate of women with COVID-19. The increase in mortality is closely related to the type of variant found, with the Delta variant (B.1.617.2) frequently detected in 2021. This variant caused an increase in cases and severity compared with the previous variant, especially in patients who had not received vaccination (Adhikari et al., 2022). Meanwhile, in 2022, a new variant, Omicron (B.1.1.529), emerged. Although this variant spread more quickly, its severity was lower than that of the Delta variant. Additionally, vaccination coverage improved in 2022 compared with previous years, leading to relatively lower morbidity and mortality rates (Villar et al., 2021).

Pregnancy accompanied by comorbidities presents a higher risk, making prevention, such as complete vaccination, essential. COVID-19 vaccination is crucial as it generates robust immunity in pregnant women, reducing the severity of the disease (Abbas-Hanif et al., 2022). Vaccination during pregnancy leads to the transfer of protective antibodies to the fetus, providing neonatal immunity (Sculli et al., 2021). Vaccination during pregnancy is crucial in mitigating the severity of COVID-19 symptoms and improving maternal and neonatal outcomes, especially when dealing with more severe variants like Delta. The protective effects of vaccination are evident across different variants, with vaccinated pregnant women showing substantially better health outcomes compared with those who are unvaccinated (de Freitas Paganoti et al., 2022). Pregnant women are advised to complete their vaccination schedule, including booster doses, to ensure maximum protection against severe COVID-19 outcomes and to enhance neonatal immunity (Guedalia et al., 2022).

The findings show that pregnant women have a lower survival rate compared with non-pregnant women, with the risk increasing further if the pregnant woman has comorbidities. These findings highlight the need for healthcare workers to be more vigilant when treating pregnant women with COVID-19. Apart from that, the comorbid conditions of pregnant women cannot be ignored; handling COVID-19 along with treating comorbid diseases is also carried out. For the wider community, there is a need for education and health promotion programmes for pregnant women to increase

awareness and encourage preventive measures to avoid contracting COVID-19. The general public must also be more vigilant in not transmitting COVID-19 to other people, especially pregnant women. Pregnant women should adhere to preventive health behaviours such as wearing masks, practising hand hygiene and maintaining social distancing to reduce the risk of contracting COVID-19 (Wang et al., 2021). At the same time, multidisciplinary care and advanced medical interventions are essential for managing severe cases. Hospitals should prioritise pregnant women with comorbidities for intensive care due to their increased risk of severe COVID-19 complications (Nana & Nelson-Piercy, 2021).

This study's use of secondary data can be a limitation as it has weaknesses, including information bias. Another limitation is that there are samples that have incomplete information in the medical record, thereby reducing the number of participants who can be analyzed. The following limitation is that the data does not show detailed PCR results, only indicating positive or negative; however, these results can still be accounted for. Despite these limitations, the number of respondents obtained is quite large, and the study results are consistent with world literature, contributing to the epidemiological analysis of COVID-19.

CONCLUSION

Factors related to the survival rate of women with COVID-19 are years of treatment, age, presence of comorbidities, number of comorbidities, pregnancy, and pregnancies with comorbidities. Pregnant women have a lower survival percentage compared to non-pregnant women, and the percentage will further decrease with the presence of comorbidities. Pregnant women with COVID-19 have more than four times the risk of death compared to those who are not pregnant. For this reason, pregnant women with COVID-19 need special attention and supervision to reduce the risk of death.

Declaration of Interest

The authors declare there are no conflicts of interest in this research.

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Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

REFERENCES

Abbas-Hanif, A., Rezai, H., Ahmed, S. F., & Ahmed, A. (2022). The impact of COVID-19 on pregnancy and therapeutic drug development. *British Journal of Pharmacology, 179*(10), 2108-2120. https://doi.org/10.1111/bph.15582

Abu-Raya, B., Michalski, C., Sadarangani, M., & Lavoie, P. M. (2020). Maternal immunological adaptation during normal pregnancy. *Frontiers in Immunology, 11*, Article 575197. https://doi.org/10.3389/fimmu.2020.575197

Adhikari, E. H., SoRelle, J. A., McIntire, D. D., & Spong, C. Y. (2022). Increasing severity of COVID-19 in pregnancy with Delta (B.1.617.2) variant surge. *American Journal of Obstetrics & Gynecology, 226*(1), 149-151. https://doi.org/10.1016/j.ajog.2021.09.008

Akbar, M. I. A., Gumilar, K. E., Andriya, R., Wardhana, M. P., Mulawardhana, P., Anas, J. Y., Ernawati, Laksana, M. A. C., & Dekker, G. (2022). Clinical manifestations and pregnancy outcomes of COVID-19 in Indonesian referral hospital in central pandemic area. *Obstetrics & Gynecology Science, 65*(1), 29-36. https://doi.org/10.5468/ogs.21135

Alabi, Q. K., Oyedeji, A. S., Kayode, O. O., & Kajewole-Alabi, D. I. (2023). Impact of COVID-19 pandemic on mother and child health in Sub-Saharan Africa – a review. *Pediatric Research, 94*(4), 1278-1283. https://doi.org/10.1038/s41390-023-02651-w

Alberca, R. W., Pereira, N. Z., Oliveira, L. M. D. S., Gozzi-Silva, S. C., & Sato, M. N. (2020). Pregnancy, viral infection, and COVID-19. *Frontiers in Immunology, 11*, Article 1672. https://doi.org/10.3389/fimmu.2020.01672

Atkins, J. L., Masoli, J. A. H., Delgado, J., Pilling, L. C., Kuo, C.-L., Kuchel, G. A., & Melzer, D. (2020). Preexisting comorbidities predicting COVID-19 and mortality in the UK Biobank community cohort. *The Journals of Gerontology: Series A, 75*(11), 2224-2230. https://doi.org/10.1093/gerona/glaa183

Azizah, S., Mustika, A. P., Widjaya, N., Irwinda, R., Harzif, A. K., Priyatini, T., Maidarti, M., Dilmy, M. A. F., Silvana, V., Teguh, C., Rivai, A. T., Djuliannisaa, Z., Nasution, V. A. F., Darmestari, D. L., Sukmadewanti, R., Cahyaningrum, Z. T., Amalia, S. N., & Jamilah, M. (2023). Factors related to maternal mortality rate in COVID-19 patients - a cross-sectional study from an Indonesian COVID-19 referral hospital. *Ceska Gynekologie, 88*(5), 334-346. https://doi.org/10.48095/cccg2023334

Celewicz, A., Celewicz, M., Michalczyk, M., Woźniakowska-Gondek, P., Krejczy, K., Misiek, M., & Rzepka, R. (2023). SARS CoV-2 infection as a risk factor of preeclampsia and pre-term birth. An interplay between viral infection, pregnancy-specific immune shift and endothelial dysfunction may lead to negative pregnancy outcomes. *Annals of Medicine, 55*(1), Article 2197289. https://doi.org/10.1080/07853890.2023.2197289

Childs, H., Bickerstaff, C., Stoikov, T., Xu, H., Marino, K., Li, C., Nguyen, L., Rodgers, B., & Allen, J. T. (2024). COVID-19 as a risk factor for hypertensive disorders of pregnancy: A retrospective cohort study. *Reproductive, Female and Child Health, 3*(2), Article e95. https://doi.org/10.1002/rfc2.95

Cucinotta, D., & Vanelli, M. (2020). WHO declares COVID-19 a pandemic. *Acta Bio Medica: Atenei Parmensis, 91*(1), 157-160. https://doi.org/10.23750/abm.v91i1.9397

Dashraath, P., Wong, J. L. J., Lim, M. X. K., Lim, L. M., Li, S., Biswas, A., Choolani, M., Mattar, C., & Su, L. L. (2020). Coronavirus disease 2019 (COVID-19) pandemic and pregnancy. *American Journal of Obstetrics and Gynecology, 222*(6), 521-531. https://doi.org/10.1016/j.ajog.2020.03.021

Dawood, F. S., Varner, M., Tita, A., Newes-Adeyi, G., Gyamfi-Bannerman, C., Battarbee, A., Bruno, A., Daugherty, M., Reichle, L., & Vorwaller, K. (2021). Incidence, clinical characteristics, and risk factors of SARS-CoV-2 infection among pregnant individuals in the United States. *Clinical Infectious Diseases, 75*(1), e627-e635. https://doi.org/10.1093/cid/ciab713

de Freitas Paganoti, C., Alkmin da Costa, R., Papageorghiou, A. T., da Silva Costa, F., Quintana, S. M., Graziela de Godoi, L., Adriana Jiménez Monroy, N., Sacramento Rodrigues, A., & Pulcineli Vieira Francisco, R. (2022). COVID-19 vaccines confer protection in hospitalized pregnant and postpartum women with severe COVID-19: A retrospective cohort study. *Vaccines, 10*(5), Article 749. https://doi.org/10.3390/vaccines10050749

Egloff, C., Roques, P., & Picone, O. (2023). Impact of COVID-19 on pregnant women's health: Consequences in obstetrics two years after the pandemic. J*ournal of Reproductive Immunology, 157*, Article 103981. https://doi.org/10.1016/j.jri.2023.103981

Gajbhiye, R. K., Sawant, M. S., Kuppusamy, P., Surve, S., Pasi, A., Prusty, R. K., Mahale, S. D., & Modi, D. N. (2021). Differential impact of COVID-19 in pregnant women from high-income countries and low-to middle-income countries: A systematic review and meta-analysis. *International Journal of Gynecology & Obstetrics, 155*(1), 48-56. https://doi.org/10.1002/ijgo.13793

Ge, E., Li, Y., Wu, S., Candido, E., & Wei, X. (2021). Association of pre-existing comorbidities with mortality and disease severity among 167,500 individuals with COVID-19 in Canada: A population-based cohort study. *PLOS ONE, 16*(10), Article e0258154. https://doi.org/10.1371/journal.pone.0258154

Guedalia, J., Lipschuetz, M., Calderon-Margalit, R., Cohen, S. M., Goldman-Wohl, D., Kaminer, T., Melul, E., Shefer, G., Sompolinsky, Y., Walfisch, A., Yagel, S., & Beharier, O. (2022). Effectiveness of a third BNT162b2 mRNA COVID-19 vaccination during pregnancy: A national observational study in Israel. *Nature Communications, 13*(1), Article 6961. https://doi.org/10.1038/s41467-022-34605-x

Guimarães, R. M., Reis, L. G. C., de Souza Mendes Gomes, M. A., Magluta, C., de Freitas, C. M., & Portela, M. C. (2023). Tracking excess of maternal deaths associated with COVID-19 in Brazil: A nationwide analysis. *BMC Pregnancy and Childbirth, 23*(1), Article 22. https://doi.org/10.1186/s12884-022-05338-y

Iba, T., Warkentin, T. E., Thachil, J., Levi, M., & Levy, J. H. (2021). Proposal of the definition for COVID-19-associated coagulopathy. *Journal of Clinical Medicine, 10*(2), Article 191. https://doi.org/10.3390/jcm10020191

Karimi, L., Makvandi, S., Vahedian-Azimi, A., Sathyapalan, T., & Sahebkar, A. (2021). Effect of COVID-19 on mortality of pregnant and postpartum women: A systematic review and meta-analysis. *Journal of Pregnancy,* 2021, Article 8870129. https://doi.org/10.1155/2021/8870129

Khedr, E. M., Daef, E., Mohamed-Hussein, A., Mostafa, E. F., Zein, M., Hassany, S. M., Galal, H., Hassan, S. A., Galal, I., & Zarzour, A. A. (2022). Comorbidities and outcomes among patients hospitalized with COVID-19 in Upper Egypt. *The Egyptian Journal of Neurology, Psychiatry and Neurosurgery, 58*(1), Article 92. https://doi.org/10.1186/s41983-022-00530-5

La Verde, M., Riemma, G., Torella, M., Cianci, S., Savoia, F., Licciardi, F., Scida, S., Morlando, M., Colacurci, N., & De Franciscis, P. (2021). Maternal death related to COVID-19: A systematic review and meta-analysis focused on maternal co-morbidities and clinical characteristics. *International Journal of Gynecology & Obstetrics, 154*(2), 212-219. https://doi.org/10.1002/ijgo.13726

Li, Q., Guan, X., Wu, P., Wang, X., Zhou, L., Tong, Y., Ren, R., Leung, K. S., Lau, E. H., & Wong, J. Y. (2020). Early transmission dynamics in Wuhan, China, of novel coronavirus–infected pneumonia. *New England Journal of Medicine, 382*(13), 1199-1207. https://doi.org/10.1056/NEJMoa2001316

Li, Z., Wang, X., Wu, Y., & Owzar, K. (2018). Sample size calculation for studies with grouped survival data. *Statistics in Medicine, 37*(27), 3904-3917. https://doi.org/10.1002/sim.7847

Lokken, E. M., Taylor, G. G., Huebner, E. M., Vanderhoeven, J., Hendrickson, S., Coler, B., Sheng, J. S., Walker, C. L., McCartney, S. A., & Kretzer, N. M. (2021). Higher severe acute respiratory syndrome coronavirus 2 infection rate in pregnant patients. *American Journal of Obstetrics and Gynecology, 225*(1), 75.e1-75.e16. https://doi.org/10.1016/j.ajog.2021.02.011

Matsuo, K., Green, J. M., Herrman, S. A., Mandelbaum, R. S., & Ouzounian, J. G. (2023). Severe maternal morbidity and mortality of pregnant patients with COVID-19 infection during the early pandemic period in the US. *JAMA Network Open, 6*(4), Article e237149. https://doi.org/10.1001/jamanetworkopen.2023.7149

McClymont, E., Albert, A. Y., Alton, G. D., Boucoiran, I., Castillo, E., Fell, D. B., Kuret, V., Poliquin, V., Reeve, T., & Scott, H. (2022). Association of SARS-CoV-2 infection during pregnancy with maternal and perinatal outcomes. *JAMA, 327*(20), 1983-1991. https://doi.org/10.1001/jama.2022.5906

Muhidin, S., Moghadam, Z. B., & Vizheh, M. (2020). Analysis of maternal coronavirus infections and neonates born to mothers with 2019-nCoV; a systematic review. *Archives of Academic Emergency Medicine, 8*(1), Article e49.

Nana, M., & Nelson-Piercy, C. (2021). COVID-19 in pregnancy. *Clinical Medicine, 21*(5), e446-e450. https://doi.org/10.7861/clinmed.2021-0503

Papapanou, M., Papaioannou, M., Petta, A., Routsi, E., Farmaki, M., Vlahos, N., & Siristatidis, C. (2021). Maternal and neonatal characteristics and outcomes of COVID-19 in pregnancy: An overview of systematic reviews. *International Journal of Environmental Research and Public Health, 18*(2), Article 596. https://doi.org/10.3390/ijerph18020596

Prasetyo, B., Laksana, M. A. C., Tjokroprawiro, B. A., Dewi, E. R., Izza, A., Prasetyo, M. R., Prastika, A. B., & Sukarjiyah, W. (2023). The relationship between maternal death due to COVID-19 and the human development index in East Java, Indonesia. J*ournal of Public Health Research, 12*(1), Article 22799036221147369. https://doi.org/10.1177/22799036221147369

Purborini, S., & Rumaropen, N. (2023). Relationship of age, parity, and education level with unwanted pregnancy in fertile age couples in Surabaya. *Media Gizi Kesmas, 12*(1), 207-211. https://doi.org/10.20473/mgk.v12i1.2023.207-211

Qeadan, F., Mensah, N. A., Tingey, B., & Stanford, J. B. (2021). The risk of clinical complications and death among pregnant women with COVID-19 in the Cerner COVID-19 cohort: A retrospective analysis. *BMC Pregnancy and Childbirth, 21*(1), Article 305. https://doi.org/10.1186/s12884-021-03772-y

Rasmussen, S. A., & Jamieson, D. J. (2022). COVID-19 and pregnancy. *Infectious Disease Clinics of North America, 36*(2), 423-433. https://doi.org/10.1016/j.idc.2022.01.002

Reynolds, R. M., Stock, S. J., Denison, F. C., Maybin, J. A., & Critchley, H. O. (2022). Pregnancy and the SARS-CoV-2 pandemic. *Physiological Reviews, 102(*3), 1385-1391. https://doi.org/10.1152/physrev.00003.2022

Russell, C. D., Lone, N. I., & Baillie, J. K. (2023). Comorbidities, multimorbidity and COVID-19. *Nature Medicine, 29*(2), 334-343. https://doi.org/10.1038/s41591-022-02156-9

Scheler, C. A., Discacciati, M. G., Vale, D. B., Lajos, G. J., Surita, F., & Teixeira, J. C. (2021). Mortality in pregnancy and the postpartum period in women with severe acute respiratory distress syndrome related to COVID-19 in Brazil, 2020. *International Journal of Gynaecology & Obstetrics, 155*(3), 475-482. https://doi.org/10.1002/ijgo.13804

Sculli, M. A., Formoso, G., & Sciacca, L. (2021). COVID-19 vaccination in pregnant and lactating diabetic women. *Nutrition, metabolism, and cardiovascular diseases: NMCD, 31*(7), 2151-2155. https://doi.org/10.1016/j.numecd.2021.04.012

Sessa, R., Anastasi, E., Brandolino, G., Brunelli, R., Di Pietro, M., Filardo, S., Masciullo, L., Terrin, G., Viscardi, M. F., & Porpora, M. G. (2022). What is the hidden biological mechanism underlying the possible SARS-CoV-2 vertical transmission? A mini review. *Frontiers in Physiology, 13*, Article 875806. https://doi.org/10.3389/fphys.2022.875806

Setyowati, M., Wardoyo, A., & Prasetya, J. (2021). *High-risk pregnancy and obstetric complication during the COVID-19 pandemic in Semarang, Central Java*. The International Conference on Public Health Proceeding

Smith, E. R., Oakley, E., Grandner, G. W., Rukundo, G., Farooq, F., Ferguson, K., Baumann, S., Waldorf, K. M. A., Afshar, Y., & Ahlberg, M. (2023). Clinical risk factors of adverse outcomes among women with COVID-19 in the pregnancy and postpartum period: A sequential, prospective meta-analysis. *American Journal of Obstetrics and Gynecology, 228*(2), 161-177. https://doi.org/10.1016/j.ajog.2022.08.038

Turan, O., Hakim, A., Dashraath, P., Jeslyn, W. J. L., Wright, A., & Abdul-Kadir, R. (2020). Clinical characteristics, prognostic factors, and maternal and neonatal outcomes of SARS-CoV-2 infection among hospitalized pregnant women: A systematic review. *International Journal of Gynecology & Obstetrics, 151*(1), 7-16. https://doi.org/10.1002/ijgo.13329

Twanow, J. E., McCabe, C., & Ream, M. A. (2022). The COVID-19 pandemic and pregnancy: Impact on mothers and newborns. *Seminars in Pediatric Neurology,* 42, Article 100977. https://doi.org/10.1016/j.spen.2022.100977

Varlas, V. N., Borș, R. G., Plotogea, M., Iordache, M., Mehedințu, C., & Cîrstoiu, M. M. (2023). Thromboprophylaxis in pregnant women with COVID-19: An unsolved issue. *International Journal of Environmental Research and Public Health, 20*(3), Article 1949. https://doi.org/10.3390/ijerph20031949

Villar, J., Ariff, S., Gunier, R. B., Thiruvengadam, R., Rauch, S., Kholin, A., Roggero, P., Prefumo, F., Do Vale, M. S., & Cardona-Perez, J. A. (2021). Maternal and neonatal morbidity and mortality among pregnant women with and without COVID-19 infection: The INTERCOVID multinational cohort study. *JAMA Pediatrics, 175*(8), 817-826. https://doi.org/10.1001/jamapediatrics.2021.1050

Wang, H., Li, N., Sun, C., Guo, X., Su, W., Song, Q., Liang, Q., Liang, M., Ding, X., Lowe, S., Bentley, R., & Sun, Y. (2022). The association between pregnancy and COVID-19: A systematic review and meta-analysis. *The American Journal of Emergency Medicine*, 56, 188-195. https://doi.org/10.1016/j.ajem.2022.03.060

Wang, Q., Mo, P. K. H., Song, B., Di, J.-L., Zhou, F.-R., Zhao, J., Wu, Y.-L., Tian, H., Qiu, L.-Q., Xia, J., Wang, L., Li, F., & Wang, L.-H. (2021). Mental health and preventive behaviour of pregnant women in China during the early phase of the COVID-19 period. *Infectious Diseases of Poverty, 10*(1), Article 37. https://doi.org/10.1186/s40249-021-00825-4

Wang, Z., Wang, Z., & Xiong, G. (2020). Clinical characteristics and laboratory results of pregnant women with COVID-19 in Wuhan, China. *International Journal of Gynecology & Obstetrics, 150*(3), 312-317. https://doi.org/10.1002/ijgo.13265

Wardhana, M. P., Wijaya, M. C., Rifdah, S. N., Wafa, I. A., Ningrum, D., & Dachlan, E. G. (2023). Devastating pregnancy outcomes in the second wave of the COVID-19 pandemic. *Journal of Education and Health Promotion, 12*, Article 377. https://doi.org/10.4103/jehp.jehp_24_23

World Health Organization. (2020). *Generic protocol: A prospective cohort study investigating maternal, pregnancy and neonatal outcomes for women and neonates infected with SARS-CoV-2*, 2 December 2020. https://www.who.int/publications/i/item/WHO-2019-nCoV-pregnancy-and-neonates-2022.1

Yao, Y., Sun, L., Luo, J., Qi, W., Zuo, X., & Yang, Z. (2024). The effect of long-term COVID-19 infection on maternal and fetal complications: A retrospective cohort study conducted at a single center in China. *Scientific Reports, 14*(1), Article 17273. https://doi.org/10.1038/s41598-024-68184-2

Zhu, H., Rhee, J.-W., Cheng, P., Waliany, S., Chang, A., Witteles, R. M., Maecker, H., Davis, M. M., Nguyen, P. K., & Wu, S. M. (2020). Cardiovascular complications in patients with COVID-19: Consequences of viral toxicities and host immune response. *Current Cardiology Reports, 22*, Article 32. https://doi.org/10.1007/s11886-020-01292-31