Comorbidity, poverty and social vulnerability as risk factors for mortality in pregnant women with confirmed SARS-CoV-2 infection: analysis of 13 062 positive pregnancies including 176 maternal deaths in Mexico

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CONTRIBUTION

What are the novel findings of this work?
This is one of the largest cohorts to date on coronavirus disease 2019 (COVID-19) in pregnancy. The findings demonstrate that advanced maternal age, pre-existing diabetes, chronic hypertension, obesity, high social vulnerability and low socioeconomic status are risk factors for COVID-19-related maternal mortality.

What are the clinical implications of this work?
The findings of this study should help identify high-risk pregnant women who should observe mask-wearing, social distancing and good hand hygiene and ideally get vaccinated in order to reduce the risk of acquiring severe acute respiratory syndrome coronavirus 2 infection, as well as raise awareness of the possibility of selective vaccination in developing countries in which vaccines and resources are scarce.

ABSTRACT

Objective Mortality in pregnancy due to coronavirus disease 2019 (COVID-19) is a current health priority in developing countries. Identification of clinical and sociodemographic risk factors related to mortality in pregnant women with COVID-19 could guide public policy and encourage such women to accept vaccination.

We aimed to evaluate the association of comorbidities and socioeconomic determinants with COVID-19-related mortality and severe disease in pregnant women in Mexico.

Methods This is an ongoing nationwide prospective cohort study that includes all pregnant women with a positive reverse-transcription quantitative polymerase chain reaction result for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) from the Mexican National Registry of Coronavirus. The primary outcome was maternal death due to COVID-19. The association of comorbidities and socioeconomic characteristics with maternal death was explored using a log-binomial regression model adjusted for possible confounders.

Results There were 176 (1.35%) maternal deaths due to COVID-19 among 13 062 consecutive SARS-CoV-2-positive pregnant women. Maternal age, as a continuous (adjusted relative risk (aRR), 1.08 (95% CI, 1.05–1.10)) or categorical variable, was associated with maternal death due to COVID-19: women aged 35–39 years (aRR, 3.16 (95% CI, 2.34–4.26)) or 40 years or older (aRR, 4.07 (95% CI, 2.65–6.25)) had a higher risk for mortality, as compared with those aged <35 years. Other clinical risk factors associated with maternal mortality were pre-existing diabetes (aRR, 2.66 (95% CI, 1.65–4.27)), chronic hypertension (aRR, 1.75 (95% CI, 1.02–3.00)) and obesity (aRR, 2.15 (95% CI,
The objective of this study was to evaluate the association of clinical characteristics and socioeconomic determinants with COVID-19-related mortality and severe morbidity among pregnant women.

METHODS

Study design and participants

This study analyzed data from the Mexican National Registry of Coronavirus, which is an ongoing prospective cohort based on information from the Mexican government and is updated weekly with data from 475 monitoring hospitals located across the 32 states of Mexico. Inclusion criteria were all pregnant women with a positive reverse-transcription quantitative polymerase chain reaction (RT-qPCR) test for SARS-CoV-2 in the Mexican National Registry of Coronavirus between 1 April 2020 and 31 July 2021. Maternal deaths due to other causes were excluded from the study population. The study protocol was approved by the General Hospital of Mexico (Dr Eduardo Liceaga), Mexico City, Mexico, under the ethics committee number CE/23020.

Data collection

Data on patients’ medical history were collected and transferred from the Mexican National Registry of Coronavirus. Access to the Mexican National Registry is available at each hospital only by institutional approval. The following data were collected for each patient: age; pregestational diabetes mellitus; chronic obstructive pulmonary disease; asthma; immunosuppression; chronic hypertension; cardiovascular disease; obesity (defined as body mass index \( \geq 30 \text{kg/m}^2 \)); chronic renal disease or other non-specified morbidity; smoking; pneumonia; ICU admission; and maternal death. To avoid bias due to missing data, we retrieved and analyzed data from the last update of the Mexican National Registry of Coronavirus, which contains complete information on the outcomes at each update. Socioeconomic determinants included ethnicity (including the proportion of women who were indigenous), access to private health services, social security for public health services, social lag indices or social vulnerability indices and the poverty index for Mexican states. Socioeconomic determinants were calculated based on postal code for every participant; information on postal code, town, state and country is part of the COVID-19 National Database.

Outcomes

The primary outcome was maternal death as a direct result of COVID-19, as labeled by the monitoring hospital. Maternal deaths due to other causes were excluded from the study population. A woman with COVID-19 was defined as any symptomatic patient with a positive RT-qPCR result for SARS-CoV-2. Secondary outcomes were severe pneumonia, ICU admission and intubation. Severe pneumonia due to
COVID-19 was defined according to the definition of the American Thoracic Society criteria⁸, which includes either one major criterion (septic shock with need for vasopressors or respiratory failure requiring mechanical ventilation) or three or more minor criteria (respiratory rate ≥ 30 breaths/min, \(\text{PaO}_2/\text{FiO}_2\) ratio ≤ 250, multilobar infiltrates, confusion/disorientation, uremia (blood urea nitrogen level ≥ 20 mg/dL), leukopenia (white blood cell count < 4000 cells/µL), thrombocytopenia (platelet count < 100 000/µL), hypothermia (core temperature < 36°C) or hypotension requiring aggressive fluid resuscitation. Need for ICU admission was determined using the quick Sequential Organ Failure Assessment (qSOFA) score, with a score of ≥ 2 points indicating need for ICU admission⁹. Viral sepsis was defined according to the Sepsis-3 International Consensus associated with SARS-CoV-2 infection¹⁰,¹¹. Data for severe pneumonia and ICU admission were missing in some cases; therefore, we included only cases with complete data in the calculation of these outcomes.

Social vulnerability index

The social vulnerability index, also known as the social delay index, allows ranking of the states of Mexico from the highest to the lowest degree of social vulnerability at a given moment in time. Using the Dalenius–Hodges stratification method, the social vulnerability index in Mexico may be divided into five categories: very high vulnerability, high vulnerability, medium vulnerability, low vulnerability and very low vulnerability¹². It provides a summary of four social deficiencies monitored by the National Council for Evaluation of Social Development Policy¹³: educational lag, access to health services, access to essential services in housing and quality of and space in housing.

Poverty in Mexican states

The poverty index is based on the CONEVAL methodology¹⁴. It considers the current per-capita income, average educational lag in a household, access to healthcare services, access to social security services, quality of and space in housing, access to quality and nutritious food, degree of social cohesion and degree of accessibility to a paved road. The poverty index in Mexico is divided into three categories: not poor, poor and extremely poor. The 2018 poverty report and its methodology were published on 31 July 2019 (MCS-ENIGH 2018 report)¹⁵.

Statistical analysis

Descriptive and inferential statistics were used. Quantitative variables were reported as mean ± SD; categorical variables were summarized as \(n\) (%). Univariate and multivariate log-binomial regression analyses were performed to establish the association of several clinical, demographic and social risk factors with the primary and secondary outcomes. The treatment effect used for this analysis was relative risk (RR) based on univariate analysis, as well as adjusted RR (aRR) based on multivariate analysis when statistically significant variables were identified on univariate analysis, including maternal age, pre-existing diabetes, obesity, hypertension, renal chronic disease, asthma and ethnicity.

Statistical analyses were performed using Stata version 16 (Stata Corp., College Station, TX, USA). A \(P\)-value < 0.05 was considered statistically significant.

RESULTS

Description of cohort and characteristics of study population

A total of 13 062 consecutive SARS-CoV-2-positive pregnant women were included in the analysis. Mean age at diagnosis was 28.3 ± 6.0 years. Of those women, 176 (1.35%) died as a direct result of COVID-19, 1191 (9.12%) were diagnosed with severe pneumonia, 322 (2.47%) were admitted to the ICU and 185 (1.42%) were intubated.

On univariate analysis, pregnant women who died due to COVID-19, compared with those who did not die, were older and had higher rates of comorbidities, such as pre-existing diabetes, chronic hypertension, obesity, chronic renal disease and asthma (Table 1). In addition, pre-existing diabetes, obesity, hypertension, renal chronic disease, asthma and ethnicity.

| Characteristic                  | Maternal survival (\(n = 12 886\)) | Maternal death (\(n = 176\)) | \(P\)   |
|--------------------------------|-----------------------------------|-----------------------------|--------|
| Maternal age (years)           | 28.3 ± 6.00                       | 31.7 ± 6.63                 | < 0.001|
| Maternal age < 35 years        | 10 699 (83.03)                    | 106 (60.23)                 | < 0.001|
| 35–39 years                   | 1745 (13.54)                      | 47 (26.70)                  |        |
| ≥ 40 years                     | 442 (3.43)                        | 23 (13.07)                  |        |
| Pre-existing diabetes          | 391 (3.03)                        | 24 (13.64)                  | < 0.001|
| Chronic hypertension           | 345 (2.68)                        | 19 (10.80)                  | < 0.001|
| Obesity                        | 986 (7.65)                        | 30 (17.05)                  | < 0.001|
| Chronic renal disease          | 32 (0.25)                         | 4 (2.27)                    | < 0.001|
| Asthma                         | 268 (2.08)                        | 8 (4.55)                    | 0.022  |
| COPD                           | 18 (0.14)                         | 0 (0)                       | 0.623  |
| Immunosuppression              | 93 (0.72)                         | 2 (1.14)                    | 0.511  |
| Cardiovascular disease         | 50 (0.39)                         | 1 (0.57)                    | 0.696  |
| Smoker                         | 225 (1.75)                        | 3 (1.70)                    | 0.74   |
| Indigenous ethnicity           | 330 (2.56)                        | 5 (2.84)                    | 0.815  |
| Type of HS used                |                                   |                             | 0.450  |
| Private                        | 295 (2.29)                        | 4 (2.27)                    |        |
| Public (SW)                    | 5247 (40.72)                      | 65 (36.93)                  |        |
| Public (not SW)                | 7344 (56.99)                      | 107 (60.80)                 |        |
| Social vulnerability           |                                   |                             |        |
| Very high                      | 1073 (8.33)                       | 27 (15.34)                  | 0.001  |
| High                           | 2021 (15.68)                      | 37 (21.02)                  | 0.043  |
| Medium                         | 2026 (15.72)                      | 20 (11.36)                  | 0.114  |
| Low                            | 4699 (36.47)                      | 69 (39.20)                  | 0.454  |
| Very low                       | 3067 (23.80)                      | 23 (13.07)                  | 0.001  |
| Poverty                        |                                   |                             |        |
| Not poor                       | 5431 (42.15)                      | 45 (25.57)                  | 0.001  |
| Poor                           | 5226 (40.56)                      | 82 (46.39)                  | 0.042  |
| Extremely poor                 | 2229 (17.30)                      | 49 (27.84)                  | 0.001  |

Data are given as mean ± SD or \(n\) (%). COPD, chronic obstructive pulmonary disease; HS, health service; SW, state worker.
women who died, compared with those who did not die, had a significantly higher rate of very high and high social vulnerability and of poverty and extreme poverty, while the rate of very low social vulnerability was lower in those who died.

Risk factors for maternal death

Risk factors associated with maternal death due to COVID-19 are shown in Table 2. Maternal age, as either a continuous (aRR, 1.08 (95% CI, 1.05–1.10)) or categorical variable, was associated with maternal death; women aged 35–39 years (aRR, 3.16 (95% CI, 2.34–4.26)) or 40 years or older (aRR, 4.07 (95% CI, 2.65–6.25)) had a higher risk for mortality, as compared with those aged < 35 years. Other risk factors associated with maternal mortality were pre-existing diabetes, chronic hypertension and obesity. Chronic renal disease and asthma were not significant on multivariate analysis.

Women with very high social vulnerability had an 88% increased risk of death due to COVID-19 (aRR, 1.88 (95% CI, 1.26–2.80)). Women with high social vulnerability had a 35% increased risk of death due to COVID-19 (aRR, 1.21 (95% CI, 1.05–1.39)). Poorer maternal health outcomes were noted in those who died, compared with those who did not die.

Table 2 Risk factors for COVID-19-related maternal death and severe disease among 13 062 SARS-CoV-2-positive pregnant women

| Risk factor | Maternal death (n = 176) | Severe pneumonia (n = 1191) | ICU admission (n = 322) | Intubation (n = 185) |
|-------------|--------------------------|----------------------------|------------------------|----------------------|
|             | aRR (95% CI) | P     | aRR (95% CI) | P     | aRR (95% CI) | P     | aRR (95% CI) | P     |
| MA (in years) |                        |       |             |       |             |       |             |       |
| < 35 years   | 1.08 (1.05–1.10)    | < 0.001 | 1.03 (1.02–1.05) | < 0.001 | 1.02 (1.01–1.04) | < 0.001 | 1.06 (1.04–1.09) | < 0.0001 |
| ≥ 40 years   | 3.16 (2.34–4.26)    | < 0.001 | 1.57 (1.39–1.77) | < 0.001 | 1.35 (1.07–1.69) | 0.012 | 1.98 (1.49–2.65) | < 0.0001 |
| Pre-existing diabetes | 2.66 (1.44–2.23) | < 0.001 | 1.08 (1.07–1.69) | 0.011 | 0.97 (0.74–1.34) | 0.297 | 0.37 (0.37–1.35) | < 0.0001 |
| Chronic renal disease | 1.75 (1.39–2.17) | 0.042 | 1.74 (1.07–1.69) | < 0.001 | 0.99 (0.71–1.34) | 0.973 | 1.05 (0.58–1.91) | 0.880 |
| Asthma       | 1.62 (0.82–1.62)    | 0.228 | 1.16 (0.82–1.62) | 0.400 | 1.00 (0.52–1.94) | 0.988 | 1.23 (0.56–2.71) | 0.600 |
| COPD         | 1.56 (1.15–2.84)    | 0.522 | 1.81 (0.62–1.44) | 0.011 | 2.01 (0.51–2.29) | 0.312 | 2.57 (0.92–2.04) | 0.122 |
| Immunosuppression | 1.42 (0.91–1.62) | 0.721 | 0.86 (0.62–1.44) | 0.744 | 1.73 (0.51–2.29) | 0.396 | 1.62 (0.92–2.04) | 0.599 |
| Cardiovascular disease | 0.93 (0.33–2.19) | 0.905 | 0.94 (0.62–1.44) | 0.791 | 1.08 (0.51–2.29) | 0.842 | 1.21 (0.47–3.12) | 0.684 |
| Smoker       | 0.86 (0.91–1.62)    | 0.380 | 1.21 (0.62–1.44) | 0.192 | 0.55 (0.52–1.22) | 0.396 | 1.25 (0.59–2.63) | 0.559 |
| Indigenous ethnicity | 0.82 (0.78–1.52) | 0.695 | 1.09 (0.91–1.62) | 0.608 | 1.06 (0.62–1.83) | 0.825 | 0.71 (0.30–1.69) | 0.447 |
| Using private health services | 0.82 (0.78–1.52) | 0.218 | 1.04 (0.94–1.17) | 0.431 | 0.78 (0.63–0.96) | 0.021 | 0.91 (0.69–1.21) | 0.525 |
| Using public health services (state worker) | 0.61 (0.51–2.13) | 1.12  | | | | | |
| Social vulnerability* |       |       |             |       |             |       |             |       |
| Very high    | 1.88 (2.43–3.69)    | 0.002 | 3.00 (2.65–3.21) | < 0.001 | 1.69 (0.92–1.47) | 0.017 | 1.16 (0.70–1.95) | 0.342 |
| High         | 1.49 (2.17–3.18)    | 0.028 | 2.62 (2.17–3.18) | < 0.001 | 0.85 (0.58–1.26) | 0.440 | 1.11 (0.68–1.80) | 0.673 |
| Medium       | 0.76 (0.81–1.32)    | 0.237 | 1.03 (0.81–1.32) | 0.753 | 0.92 (0.59–1.42) | 0.729 | 0.98 (0.55–1.76) | 0.188 |
| Low          | 1.07 (1.79–2.54)    | 0.653 | 2.13 (1.79–2.54) | < 0.001 | 1.40 (1.05–1.86) | 0.021 | 1.40 (0.95–2.07) | 0.085 |
| Very low     | 0.47 (0.71–1.19)    | 0.001 | 1.00 (0.71–1.19) | 1.00 | 1.00 (0.0001) | 1.00 |
| Poverty      |                        |       |             |       |             |       |             |       |
| Not poor     | 1.53 (0.93–1.47)    | 0.014 | 1.66 (0.93–1.47) | < 0.0001 | 1.17 (0.93–1.47) | 0.185 | 1.08 (0.79–1.47) | 0.618 |
| Poor         | 1.83 (0.72–1.42)    | < 0.0001 | 1.63 (1.32–2.33) | < 0.0001 | 0.92 (0.71–1.19) | 0.511 | 1.01 (0.72–1.42) | 0.939 |

Adjusted relative risk (aRR) values were calculated using log-binomial regression adjusted for the following confounders: maternal age (MA), pre-existing diabetes, obesity, hypertension, chronic renal disease, asthma and ethnicity. *Each social vulnerability category was treated as a dichotomous variable. COPD, chronic obstructive pulmonary disease; ICU, intensive care unit.

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vulnerability also had a higher risk of death (aRR, 1.49 (95% CI, 1.04–2.13)), while women with very low social vulnerability had a 53% decreased risk (aRR, 0.47 (95% CI, 0.30–0.73)). Being poor (aRR, 1.53 (95% CI, 1.09–2.15)) or extremely poor (aRR, 1.83 (95% CI, 1.32–2.53)) were also significant risk factors for maternal death due to COVID-19.

Risk factors for severe pneumonia, intensive care unit admission and intubation

Risk factors associated with severe pneumonia, ICU admission and intubation are shown in Table 2. Maternal age, as either a continuous or categorical variable, pre-existing diabetes, chronic hypertension, immunosuppression and obesity were risk factors for severe pneumonia. Maternal age and immunosuppression were risk factors for ICU admission and intubation.

Women with very high, high or low social vulnerability had a higher risk of severe pneumonia (aRR, 3.00 (95% CI, 2.43–3.69), 2.62 (95% CI, 2.17–3.18) and 2.13 (95% CI, 1.79–2.54), respectively), which reflects that, overall, the risk of severe pneumonia remained stable across social vulnerability groups. Poor and extremely poor pregnant women had a higher risk for severe pneumonia (aRR, 1.66 (95% CI, 1.46–1.88) and 1.63 (95% CI, 1.44–1.84)). Women with low social vulnerability had a higher risk of ICU admission, while women using public health services had a lower risk of being admitted to the ICU. The relationship between socioeconomic determinants and comorbidities is shown in Table S1.

DISCUSSION

Main findings

The findings of this study in SARS-CoV-2-positive pregnant women demonstrated that: (i) advanced maternal age, pre-existing diabetes, chronic hypertension and obesity were associated with COVID-19-related maternal mortality; (ii) similar to maternal death, risk factors associated with severe pneumonia were advanced maternal age, pre-existing diabetes, chronic hypertension, immunosuppression and obesity; advanced maternal age and immunosuppression were also risk factors for ICU admission and intubation, while women using public health services had a lower risk of being admitted to the ICU; and (iii) women with high social vulnerability had an increased risk of maternal death and severe pneumonia, while very low social vulnerability was associated with a reduced risk of maternal death, but low social vulnerability was associated with higher risks of severe pneumonia and ICU admission. Similarly, being poor and extremely poor were significant risk factors for maternal death and severe pneumonia.

Comparison with existing literature

It has been demonstrated recently that pregnancy per se constitutes a risk factor for complications in women with SARS-CoV-2 infection during the reproductive period16. Our findings are in agreement with those of previous studies involving non-pregnant and pregnant individuals, in which advanced age, diabetes, chronic hypertension and obesity were found to be risk factors for severe COVID-19 and mortality2,3,16. Zambrano et al.3 showed that Latin-American pregnant women living in the USA, who belong to a vulnerable minority group, are at a higher risk of COVID-19-related mortality; therefore, in this study, we explored the interplay between comorbidities and socioeconomic determinants contributing to severe COVID-19 and maternal mortality. Although the possible mechanisms leading to higher maternal mortality related to COVID-19 in developing countries are not clear, some investigators have demonstrated that low socioeconomic status is associated with a higher risk of severe maternal morbidity17,18. Previous studies have shown that minority women receive disproportionately delayed or inadequate prenatal care19, and a systematic review identified strong evidence for the impact of race, ethnicity, insurance and education on maternal mortality and severe morbidity20.

Measures of socioeconomic disadvantage, such as social vulnerability and poverty indices, are also associated with an increased risk of complications related to SARS-CoV-2 infection21,22. The significant association of low social vulnerability with a higher risk of ICU admission may be related to socioeconomic status and access to healthcare, since highly vulnerable women may not have access to adequate healthcare and, therefore, their probability of being admitted to the ICU is lower. On the other hand, women with low social vulnerability, who, by definition, have better access to healthcare, have a higher risk of ICU admission, accompanied by a lower risk of death. During the pandemic, this was observed in the health services; public hospitals were overcrowded, while ICU beds were readily available to people who were able to pay for care at a private hospital. Another explanation for the higher risk of intubation and ICU admission in women with low social vulnerability could be the higher incidence of chronic hypertension in this subgroup; on the other hand, despite the higher incidence of obesity in the very high vulnerability group, multivariate logistic regression analysis showed that high social vulnerability as well as obesity are independent predictors of maternal mortality. Our finding that lower socioeconomic status is associated with a higher incidence of SARS-CoV-2-related severe pneumonia and maternal death supports existing evidence that densely populated communities living in poverty have an increased risk of sustained community transmission of various infectious diseases, including SARS-CoV-2.23,24. On the other hand, pregnant women with very low social vulnerability had a reduced risk of mortality due to COVID-19. Overall, our findings suggest a possible causal relationship of education, access to health services, basic infrastructure, quality of and space in housing and household assets with mortality in pregnant women with SARS-CoV-2 infection, which could explain why the rate of maternal mortality is higher in developing countries.
and in minority groups in developed countries who have limited access to health services.

In symptomatic pregnant women with COVID-19 in Mexico, the rate of maternal mortality is 1.5%2. A recent small cohort of 793 patients from Greece, Turkey, the UK and Austria showed a similar 1.3% incidence of death25. However, Zambrano et al.3 described a 0.14% mortality rate in symptomatic pregnant women with SARS-CoV-2 infection in the USA, and Mullins et al.26 found a 0.5% mortality rate in a UK registry and a 0.2% mortality rate in a USA registry, which differ substantially from the rate observed in this study. We speculate that the excess mortality is due to the factors explored in the current study, which are related to lower socioeconomic status, access to healthcare services, housing, education and household assets.

Strengths and limitations

This study reports results based on one of the largest consecutive cohorts of pregnant women with SARS-CoV-2 infection and is the first to demonstrate that comorbidities, including pre-existing diabetes, chronic hypertension, obesity and social determinants, such as poverty and social vulnerability indices, are significant risk factors for COVID-19-related mortality and morbidity during pregnancy. The advantage of a population-based cohort is that it minimizes bias by allowing calculation of real-population estimates in an unselected population. Cohort studies with low numbers or an overselected population tend to overestimate effect size. Our large dataset, including 176 maternal deaths, allowed us to estimate the effect size of each risk factor with a robust CI, thus reducing bias. No other single consecutive cohort of pregnant women with COVID-19 has included such a large number of maternal deaths with sufficient data to calculate robust effect sizes. Another strength of this study is the prospective acquisition of data across the whole country, allowing representative data from a desired population, which is often a limitation of hospital-based cohorts.

A limitation of this study is the amount of missing data on severe pneumonia and ICU admission, which is compensated for by the large number of included participants, allowing us to calculate robust effect sizes for these outcomes. Another limitation is the lack of data on perinatal outcome, such as fetal growth restriction, pre- eclampsia, preterm birth, stillbirth and neonatal death, due to the population-based origin of the information used for the analysis. However, the data included in this study provide sufficient information to allow us to understand the most important risk factors and social determinants associated with the main outcomes related to COVID-19, which are death, severe pneumonia, intubation and ICU admission.

Clinical implications

COVID-19 is now the leading cause of maternal mortality in Mexico1, and, in most countries, the groups of pregnant women at highest risk of severe complications related to COVID-19 have not been characterized. Furthermore, vaccination against SARS-CoV-2 infection has not been prioritized for pregnant women in most countries, particularly in developing countries, in which the increasing maternal mortality rate related to COVID-19 is alarming. To worsen the situation, there is unequal distribution of the available vaccines, which makes it even more difficult for pregnant women to get vaccinated in a timely manner. The results from this study could help guide decision-making regarding who should be prioritized for vaccination based on their high-risk status, especially in countries in which vaccines are not readily available and resources are scarce. For example, considering the maternal mortality rate of 1.35% in our population and taking into account 90–100% efficacy of the vaccine against severe COVID-19 for normal SARS-CoV-2 variants and 96% efficacy for the Delta variant, we would need to vaccinate 74 pregnant women to avoid one death in a 100% effectiveness scenario for normal variants, 81 in a 90% effectiveness scenario for normal variants and 77 in a scenario of 96% effectiveness against the Delta variant. There is a critical need to identify high-risk pregnant women who should observe mask-wearing, social distancing and good hand hygiene and ideally get vaccinated in order to reduce the risk of acquiring SARS-CoV-2 infection, as well as raise awareness of the possibility of severe COVID-19 so that asymptomatic SARS-CoV-2-infected women or those with mild disease are monitored for clinical deterioration; if they are symptomatic, there should be more proactive management to reduce the risk of deterioration.

Conclusions

The findings of this study, which is one of the largest prospective consecutive cohorts of SARS-CoV-2-positive pregnant women to date, have confirmed that advanced maternal age, pre-existing diabetes, chronic hypertension, obesity, high social vulnerability and low socioeconomic status are risk factors for COVID-19-related maternal mortality. Pregnant women at risk of serious complications of COVID-19 should be identified and prioritized for vaccination and early healthcare, especially in low-resource settings.

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SUPPORTING INFORMATION ON THE INTERNET

The following supporting information may be found in the online version of this article:

Table S1 Relationship between socioeconomic determinants and comorbidities in 13 062 SARS-CoV-2-positive pregnant women.
Enfermedades concomitantes, pobreza y vulnerabilidad social como factores de riesgo de mortalidad en mujeres embarazadas con infección confirmada por SRAS-CoV-2: un análisis de 13.062 embarazos de madres positivas en México, de las cuales 176 murieron

RESUMEN

Objetivo. La mortalidad en el embarazo debida a la enfermedad por coronavirus 2019 (COVID-19) es una prioridad sanitaria actual en los países en desarrollo. La identificación de los factores de riesgo clínicos y sociodemográficos relacionados con la mortalidad en mujeres embarazadas con COVID-19 podría informar las políticas públicas y animar a estas mujeres a aceptar la vacunación. El objetivo fue evaluar la asociación de enfermedades concomitantes y de determinantes socioeconómicos con la mortalidad relacionada con COVID-19 y las enfermedades graves en mujeres embarazadas en México.

Métodos. Se trata de un estudio de cohorte prospectivo a nivel nacional que incluyó a todas las mujeres embarazadas con un resultado positivo de la reacción en cadena de la polimerasa con transcriptasa inversa para el coronavirus 2 del síndrome respiratorio agudo severo (SRAS-CoV-2) del Registro Nacional de Coronavirus de México. El resultado primario fue la muerte materna por COVID-19. Se estudió la asociación de las enfermedades concomitantes y las características socioeconómicas con la muerte materna mediante un modelo de regresión log-binomial ajustado para posibles factores de confusión.

Resultados. Se produjeron 176 (1,35%) muertes maternas por COVID-19 en una cohorte consecutiva de 13.062 mujeres embarazadas con SRAS-CoV-2. La edad materna, como variable continua (riesgo relativo ajustado [RRa], 1,08 [IC 95%, 1,05–1,10]) o categórica, se asoció con la muerte materna debida a COVID-19; las mujeres de 35–39 años (RRa, 3,16 [IC 95%, 2,34–4,26]) o de 40 años o más (RRa, 4,07 [IC 95%, 2,63–6,25]) tuvieron un mayor riesgo de mortalidad, en comparación con las de edad <35 años. Otros factores de riesgo clínicos asociados a la mortalidad materna fueron la diabetes preexistente (RRa, 2,66 [IC 95%, 1,65–4,27]), la hipertensión crónica (RRa, 1,75 [IC 95%, 1,02–3,00]) y la obesidad (RRa, 2,15 [IC 95%, 1,46–3,17]). La vulnerabilidad social muy alta (RRa, 1,88 [IC 95%, 1,26–2,80]) y la vulnerabilidad social alta (RRa, 1,49 [IC 95%, 1,04–2,13]) se asociaron con un mayor riesgo de mortalidad materna, mientras que la vulnerabilidad social muy baja se asoció con un riesgo reducido (RRa, 0,47 [IC 95%, 0,30–0,73]). Ser pobre o extremadamente pobre fueron también factores de riesgo de mortalidad materna (RRa, 1,53 [IC 95%, 1,09–2,15] y RRa, 1,83 [IC 95%, 1,32–2,53], respectivamente).

Conclusion. Este estudio, que abarca la mayor cohorte prospectiva consecutiva de mujeres embarazadas con COVID-19 hasta la fecha, ha confirmado que la edad materna avanzada, la diabetes preexistente, la hipertensión crónica, la obesidad, la alta vulnerabilidad social y el bajo nivel socioeconómico son factores de riesgo de mortalidad materna relacionada con COVID-19.

并存病、贫雇和社会脆弱性作为确诊感染 SARS-CoV-2 的孕妇死亡率的风险因素：对墨西哥 13062 名阳性妊娠（含 176 名产妇死亡）的分析

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