

Impact of the COVID-19 pandemic on the Maternal Mortality Ratio: a time series study in Bahia, Brazil.

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Abstract

Background

Little is known about the effects of the COVID-19 pandemic on maternal mortality in Brazil. Therefore the objective of this study is to assess the impact of the COVID-19 pandemic on the maternal mortality in the State of Bahia, Brazil.

Methods

This study used state databases for data on maternal deaths and live births in Bahia, Brazil, from January 1, 2011 to September 30, 2020. The time trend of MMR was analyzed through polynomial regression analysis, of order 6. Predict monthly (Jan-Sep) and annual values, for 2020, were estimated by the additive Holt-Winters exponential smoothing algorithm, with 95% confidence interval, and the accuracy MMR forecasts for 2020 was assessed by checking the smoothing coefficients and the mean errors.

Results

Between January 1 and September 30, 2020, the MMR in Bahia, Brazil, was 79.51/100,000 live births, 60.7% higher than the expected ratio (49.48 [95% CI 60.27-38.70]). The increase on maternal mortality ratio relative to expected values was observed throughout the 2020 months. However, only from May, when the COVID-19 epidemic rose sharply, it exceeded the upper limit of the 95% CI of the monthly prediction. In August, we can observe a dramatical decrease in the maternal mortality ratio, followed by an increase in September. Of the 109 registered maternal deaths in 2020, 16 (14.7%) had COVID-19 related to the causes of death.

Conclusions

The COVID-19 pandemic is causing devastating consequences for maternal mortality, in Bahia, Brazil. An urgent public health action is needed to prevent and reduce maternal deaths during this pandemic, in Brazil.

Introduction

The COVID 19 pandemic hit Brazil in February 2020 and, until October 26 of that same year, 5,414,069 cases and 157,509 deaths already had been reported, corresponding to 2,9% case fatality rate and mortality of 74.2 deaths per 100,000 inhabitants,¹ and until that date, it is the third country with the greatest number of cases in the world.²

At earlier stages of the epidemic, pregnant women without comorbidities were not considered at greater risk for COVID-19 and its related complications. However, with the further spread of the disease, data reporting a higher risk of severe forms in this population group, even among those without

comorbidities, as well as near-miss and maternal deaths from US, UK, France, Mexico and Brazil started to emerge.³⁻⁷ These findings subsidized PAHO, to issue an Alert in August 2020, encouraging member countries to redouble efforts to ensure access and continuity of prenatal care, with special attention to the early detection of signs and symptoms of COVID-19.⁸ Therefore, in light of the uncertainty that remains about the impact of the pandemic on maternal health, we assessed the effect of COVID-19 pandemic and its related disruptions on maternal deaths in a state of a middle-income country with a high incidence of SARS-CoV-2 infections.

Methods

Maternal deaths, live births, COVID-19 cases and number of inhabitants of State of Bahia information were obtained from the website of the local State Health Secretariat, from January 2011 to September of 2020. We estimated maternal mortality ratio (MMR), according to a year of death, by dividing the number of maternal deaths by the number of live births, multiplied by 100,000 in each month and year.⁹ Annual and monthly MMR were plotted on a time curve. The incidence of COVID-19 in the State of Bahia, per month in 2020, was calculated by the ratio between the number of new cases by its population estimate, multiplied by 100,000.

The time trend of MMR in the period from 2011 to 2020 was verified through polynomial regression analysis, of order 6. To predict monthly (Jan-Sep) and yearly values for 2020 we used the additive Holt-Winters exponential smoothing algorithm (ETS A, A, A), which takes into account the additive parameters error, trend and seasonality, with a 95% confidence interval. The accuracy of the monthly and annual MMR forecasts for 2020 was assessed by checking the Alpha, Beta and Gamma smoothing coefficients and the values of Scaled Mean Absolute Error (MASE), Symmetric Mean Percentage Absolute Error (sMAPE), Mean Absolute Error (MAE) and Root of the Mean Quadratic Simulation Error (RMSE).

As this study was carried out using public domain data, it was not necessary to submit it to the Research Ethics Committee.

Results

Between January 1 and September 30, 2020, the maternal mortality ratio (MMR) in Bahia, Brazil, was 79.51/100,000 live births, this amount corresponds to an excess of 60.4% from the expected ratio for this same period (49.48 [95% CI 60.27-38.70]). Since 2013, the MMR time trend was decreasing over the years ($R^2 = 0.9702$) (Figure 1). From January to April 2020, the observed values of maternal mortality were within the range of expected monthly values. From May to September the COVID-19 pandemic rose sharply in Bahia and its incidence per month reached 99.23, 374.37, 624.26, 608.97 and 361.72 / 100,000 inhabitants, respectively. Following a similar pattern of increase, in May the MMR reached 92.1/100,000 live births and surpassed the upper limit of the 95% CI of the monthly prediction. The MMR remained above the expected monthly ratio in June (123.1/100,000 live births) and July (93.0/100,000 live births), in August there was a decrease of the MMR (46.7/ 100.000 live births), followed by another increase in

September (106.7/100.000 live births) (Figure 2). Of the 109 registered maternal death in 2020 (until September), 16 (14.7%) were related to COVID-19 and occurred in the months April (01), May (02), June (05), July (06) and September (02) (Table 1).

Discussion

This study evidences the rise in maternal mortality ratio in Bahia in 2020. The officially recorded ratio of maternal deaths, 79.5/100,000 livebirths, is far higher than the expected number for the year (49.5/100,000 live births) and shows a strong temporal association with COVID-19 incidence. It is important to highlight that 14.7% (16 deaths) of the 109 maternal deaths had COVID-19 registered as one of the causes of death, 13 with ICD-10 U071 (COVID-19, identified virus), which means a diagnosis with laboratory examination, and 03 with ICD-10 U072 (COVID-19, unidentified virus), which represents diagnosis by clinical-epidemiological and/or imaging exams.

Maternal deaths could be a result of maternal illness direct related to COVID-19 infection or an indirect effect of health service disruptions, and other indirect effects caused by the pandemic. First, maternal deaths directed related to COVID-19 in Brazil has been alarmed high.³ However, it is also important to consider the possible indirect contributions of the pandemic in the occurrence of maternal deaths, as many pregnant women have stopped to attend antenatal appointments because they did not feel protected against SARS-CoV-2 infection. There may have been delay or resistance from some maternities with a lower level of complexity, to provide care to pregnant women with flu-like symptoms, or difficulty in the transportation of pregnant women to health units of a higher level of complexity located in other municipalities.

In addition, the change in the organization of prenatal services during the pandemic, with a limited number of medical care provided to avoid crowding in the waiting rooms, may have caused delays on care, contributing to maternal deaths that could otherwise be avoided. As the pandemic continues, it is expected that the private health sector will be able to adapt to the provision of care to wealthier women. On the other hand, public health sector may face more challenges in this adaptation, and the impact of the COVID-19 pandemic would fall disproportionately on the poorest women, which would exacerbate the social injustices that already exist in Brazil.

These maternal deaths are still being under epidemiological investigation and analysis by the Epidemiological Surveillance Services and the State Maternal Mortality Studies Committee, so, the final cause of death can still be changed, and some deaths which COVID -19 has not been mentioned could emerge after evaluation. Despite inherent limitations in the use of preliminary data, and of the relatively small number of events, the results of our study suggest devastating consequences for maternal mortality during the COVID-19 pandemic in the state of Bahia, Brazil. Further national wide research throughout the pandemic is required to confirm these estimates and for understanding the longer-term impacts of this disease on maternal health. This study also provides evidence that urgent public health action is needed to reduce maternal deaths during the COVID-19 epidemic in Brazil.

Declarations

Availability of data and material

The data that support the findings of this study are available on request from the first author (email contact: rita.sauer@outlook.com). The data are publicly available.

Ethics approval and consent to participate

The data is publicly available; therefore, does not need ethics approval.

Consent to publish

Not applicable

Competing interests

The authors declare that they have no competing interests.

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Not applicable

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Author's contributions

RCOCS, MCNC and MGT conceived and designed the study, RCOCS, MLAB, GRS, TPS collected the data, RCOCS, ESP, EMRN carried out the data analysis and interpretation. RCOCS, MCNC, EMRN, ESP and MGT wrote the first draft of the article. All authors critically revised the manuscript and approved the final version.

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Table

Table 1. Number of maternal deaths according to the classification of basic cause group, by ICD-10 and year of occurrence, Bahia, Brazil, 2011-2020.

Figures

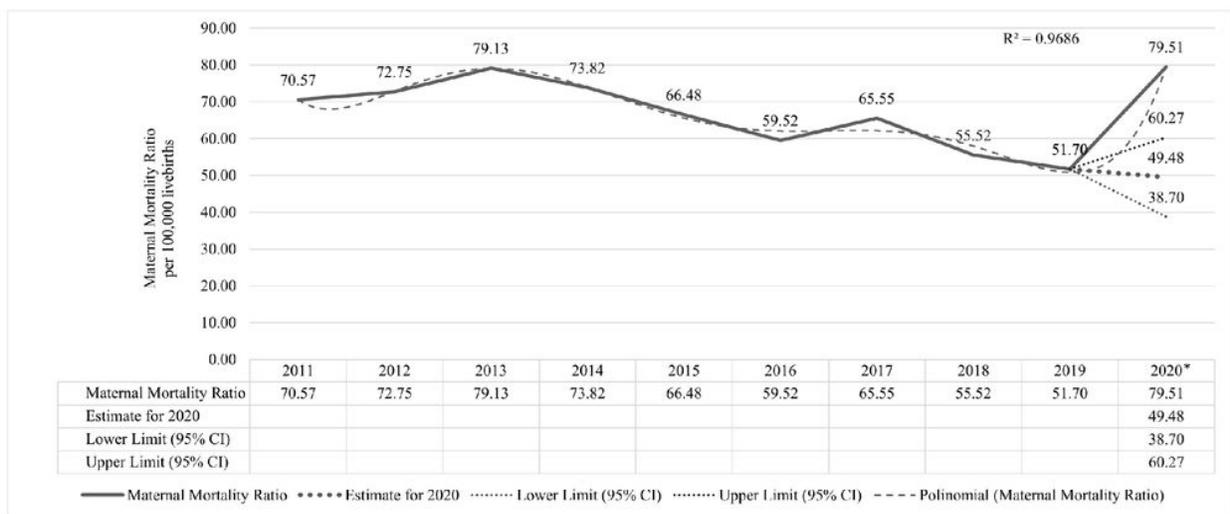
ICD-10	Causes Group Year of occurrence	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	
											*Total	**With mention of COVID-19
A30- A49	Other bacterial diseases	-	-	1	-	-	-	-	-	-	-	-
B24	Human immunodeficiency virus [HIV] disease	3	-	1	2	1	2	4	1	-	1	-
D37- D48	Neoplasm of uncertain or unknown behavior	-	-	-	-	-	-	-	-	-	1	-
F50- F59	Behavioral syndromes associated with physiological disorders and physical factors	-	-	1	1	-	-	-	-	-	-	-
O00- O08	Pregnancy ending in abortion	12	12	4	11	11	10	16	10	4	9	-
O10- O16	Edema, proteinuria, and hypertensive disorders in pregnancy, delivery and the puerperium	25	30	33	38	35	23	25	25	28	25	2
O20- O29	Other maternal disorders predominantly related to pregnancy	2	4	4	1	4	3	7	1	1	9	-
O30- O48	Assistance provided to the mother for reasons related to the fetus and amniotic cavity and for possible problems related to delivery.	12	9	9	9	6	13	7	9	8	9	-
O60- O75	Complications of labor and delivery	24	29	30	23	27	17	24	19	21	11	1
O85- O92	Complications related predominantly to the puerperium	14	18	23	26	14	12	14	12	10	11	1
O94- O99	Other obstetric conditions, not elsewhere classified	60	51	55	40	40	39	37	37	30	33	12
Total		152	153	161	151	138	119	134	114	102	109	16

Source: Brazilian's Mortality Information System (SIM/DATASUS).

*2020 only from January to September, preliminary data, updated on 10/15/2020.

**Number of maternal deaths, according to the basic cause group of the ICD-10, with mention of COVID-19 among the causes attested in the death certificate.

Figure 1. Maternal Mortality Ratio time series (per 100,000 livebirths) 2011-2019 in Bahia, polynomial trend, and real versus predicted values[¥] for 2020*, with 95% confidence interval. Bahia, Brazil.



Source: Brazilian's Mortality Information System (SIM/DATASUS) and Live Birth Information System (SINASC/DATASUS).

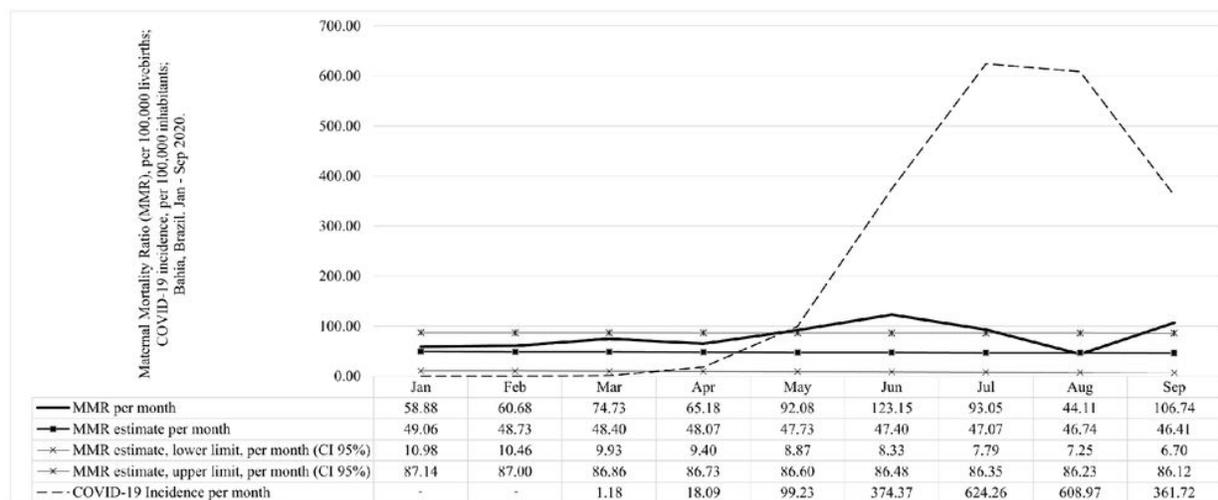
* Partial value, only from January to September 2020. Preliminary data, updated on 10/15/2020.

¥ Values estimated by additive Holt-Winters exponential smoothing algorithm. Smoothing coefficients: Alpha = 0.75; Beta = 0.00; Gamma = 0.00. Forecast Accuracy: MASE = 0.75; SMAPE = 0.07; MAE = 4.51; RMSE = 5.50.

Figure 1

Maternal Mortality Ratio time series (per 100,000 livebirths) 2011-2019 in Bahia, polynomial trend, and real versus predicted values[¥] for 2020*, with 95% confidence interval. Bahia, Brazil.

Figure 2. Maternal Mortality Ratio (MMR) per 100,000 live births, and the incidence of COVID-19 per 100,000 inhabitants, per month, from January to September 2020, and predicted MMR values (¥) with 95% confidence interval, for the same period. Bahia, Brazil.



Source: Brazilian's Mortality Information System (SIM/DATASUS) and Live Birth Information System (SINASC/DATASUS), preliminary data, updated on 10/15/2020; COVID-19 Bahia / Epidemiological Bulletins No. 01, 04, 35, 67, 98, 129, 160 and 190/2020.

¥ Values estimated by additive Holt-Winters exponential smoothing algorithm. Smoothing coefficients: Alpha = 0.10; Beta = 0.00; Gamma = 0.00. Forecast Accuracy: MASE = 0.56; SMAPE = 0.28; MAE = 14.01; RMSE = 16.00.

Figure 2

Maternal Mortality Ratio (MMR) per 100,000 live births, and the incidence of COVID-19 per 100,000 inhabitants, per month, from January to September 2020, and predicted MMR values (¥) with 95% confidence interval, for the same period. Bahia, Brazil.