

Epidemiological analysis of maternal mortality in the state of Parana: the impact of the COVID-19 pandemic*

Análise epidemiológica da mortalidade materna no estado do Paraná: repercussão da pandemia da COVID-19

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ABSTRACT: *Introduction:* Maternal mortality is a significant indicator in Brazilian public policies concerning women's health care. The Rede Mãe Paranaense program works to decrease these indicators, but the impacts of the pandemic on maternal-fetal mortality are not yet understood. *Objectives:* To analyze Maternal Mortality in the years 2015-2019 and compare it to the year 2020 in Paraná. *Methods:* Retrospective documentary study, through data collection from the DATASUS/SIM program. *Results:* An increase in indirect maternal deaths was observed, specifically in the ICD-10 category O98 (Maternal infectious and parasitic diseases [...]), which included deaths caused by COVID-19 ($p < 0.0001$). Puerperal deaths predominated, especially in the white population, with infectious and parasitic diseases being the main indirect causes. A relative comparison of the periods demonstrated that indirect deaths in 2020 exceeded the average of the previous 5 years, indicating the impact of COVID-19 on maternal mortality. *Discussion:* In both studied periods, deaths occurred predominantly in a hospital setting. However, in 2020, the proportion of deaths in hospitals increased from 76% to 91%, reflecting a consequence of the elevated maternal mortality due to the COVID-19 pandemic and higher rates of complications in the pregnancies of these patients. *Conclusion:* The pattern disruption of indirect maternal mortality demonstrated the significant impact of the COVID-19 pandemic on maternal health. Further studies should analyze and compare additional variables, due to the nature of the study and the sample taken from a specific state in Brazil limit the generalization of findings to other locations and populations. Additionally, epidemiological data collection research can serve as a planning tool to formulate intervention and prevention strategies for comorbidities that directly and indirectly influence pregnancies.

RESUMO: *Introdução:* A mortalidade materna é relevante indicador nas políticas públicas Brasileiras de assistência à saúde da mulher. A Rede Mãe Paranaense trabalha para reduzir esses indicadores, mas ainda são desconhecidos os impactos da pandemia no óbito materno-fetal. *Objetivo:* Analisar a Mortalidade Materna nos anos de 2015-2019 e comparar ao ano de 2020 no Paraná. *Métodos:* Estudo documental retrospectivo, através de coleta de dados do programa DATASUS/SIM. *Resultados:* Foi observado aumento das mortes maternas indiretas, especificamente na categoria CID10-O98 (Doenças infecciosas e parasitárias maternas [...]), onde foram incluídos os óbitos causados pela COVID-19 ($p < 0,0001$). Predominaram as mortes puerperais e na população de cor/raça branca, sendo as doenças infecciosas e parasitárias as principais causas indiretas. Uma comparação relativa dos períodos demonstrou que os óbitos indiretos em 2020 superaram a média dos 5 anos anteriores, indicando o impacto da COVID-19 na mortalidade materna. *Discussão:* Em ambos os períodos estudados, as mortes ocorreram, predominantemente, em ambiente hospitalar. Contudo, em 2020, a proporção de mortes em hospitais aumentou de 76% para 91%, expressando um reflexo do aumento da mortalidade materna devido à pandemia da COVID-19 e de maiores taxas de complicações nas gestações dessas pacientes. *Conclusão:* A quebra de padrão de mortalidade materna indireta demonstrou o impacto significativo da pandemia de COVID-19 na saúde materna. Novos estudos devem analisar e comparar outras variáveis, pois a natureza do estudo e a amostra extraída de um estado específico do Brasil, limitam a generalização dos achados para outros locais e populações. Ademais, pesquisas de levantamento de dados epidemiológicos podem ser úteis como ferramenta de planejamento no âmbito de elaborar estratégias de intervenção e prevenção de comorbidades que influenciem direta e indiretamente as gestações.

KEYWORDS: Maternal Mortality; Pregnancy; COVID-19.

PALAVRAS-CHAVE: Mortalidade materna; Gestação; Covid -19.

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INTRODUCTION

With the sudden increase in the number of deaths and hospitalizations due to the COVID-19 pandemic, countries around the world have had to adopt emergency measures in an attempt to ensure the health of the population. Among the various panoramas affected is the impact on Maternal Death, defined as deaths during pregnancy and in the period up to 42 days after childbirth¹. To quantify it for epidemiological purposes, the Maternal Mortality Ratio (MMR) is used, calculated as the number of maternal deaths divided by the number of 100,000 live births^{2,3}.

In addition, other conditions contribute significantly to maternal death. These include cardiovascular complications, pre-eclampsia and eclampsia, severe bleeding, infections, unsafe abortions and complications during childbirth². Problems that had been on a downward trend since the social programs aimed at reducing MMR began. In Paraná, there is the Paranaense Mother Network, defined as a set of state welfare measures. These include prenatal care, outpatient support for high-risk pregnant women and guaranteed delivery according to their stratification^{3,4}. Through its actions, the program has reduced the maternal mortality rate by 25.4% in 7 years of implementation^{5,6}.

For the Ministry of Health, this rate is an important indicator of social inequality, women's health and the population's access to the public health system. Therefore, this study sought to understand the behavior of this indicator before (2015 to 2019) and during (2020) the covid-19 pandemic in the state of Parana⁴.

OBJECTIVES

General objective

To identify, analyze and compare the causes and risk factors of maternal mortality in the state of Paraná in the period 2015-2019 in relation to 2020.

Specific objectives

- Identify the main causes of maternal death in the period studied;
- Assess the impact of COVID-19 on maternal death indicators during 2020;
- To analyze the distribution of maternal death according to sociodemographic (maternal age, race, marital status, schooling), clinical-obstetric (gestational age and cause of death) and care (place of death - hospital/pre-hospital/home) indicators.

METHODS

This is a descriptive-analytical, retrospective, quantitative and documentary study, carried out by analyzing maternal mortality data from 2015-2020, made available by the Ministry of Health in the Mortality Information System (DATASUS-SIM). The project was submitted to and approved by the Research Ethics Committee of Positivo University (UP), protocol CAAE 46312921.4.0000.0093.

The study included women of childbearing age (10 to 49 years) who died during pregnancy, childbirth or up to 42 days after the puerperium in the state of Paraná between January 1, 2015 and December 31, 2020. Deaths in women not of childbearing age were excluded and not considered direct or indirect maternal deaths.

Data was collected from the DATASUS- SIM information database in order to obtain the following variables:

- Sociodemographic indicators: maternal age (15-19 years, 20-29 years, 30-39 years, 40-49 years), color/race (white, black, indigenous brown), marital status (single, married, legally separated, other) and schooling (none, 1 to 3 years, 4 to 7 years, 8 to 11 years, 12 years and over).

- Clinical and obstetric indicators: gestational age (during pregnancy, childbirth or miscarriage, during the puerperium - up to 42 days, outside pregnancy or the puerperium) and cause of death (direct and indirect).

For comparison purposes in this study, the standardization of the International Classification of Diseases and Related Health Problems (ICD-10) was used and the categories with the highest mortality rates were considered, as shown in Table 1.

Deaths from COVID-19 were included in the subcategory ICD10-O985 - Other viral diseases complicating pregnancy, childbirth and the puerperium.

- Care indicators: place of death - in a hospital environment, other health facility, home or public road; and health macro-regions (Figure 1).

For comparison purposes, maternal deaths were grouped into the "pre-pandemic period" (P1 corresponding to the years 2015-2019) and the "pandemic period" (P2 referring to the year 2020, marked by the start of the COVID-19 pandemic). Data for the year 2021 was not used in this study because, at the time of submission, it was not yet available in the public domain.

Statistical analyses were carried out using the SPSS V. 17.0 program. The chi-square test and Fisher's exact test were used to compare the data, with a p-value < 0.05.

Table 1 - Direct and indirect causes of maternal death in the state of Paraná according to the International Classification of Diseases and Related Health Problems.

Direct and indirect causes of maternal death in the State of Paraná	
Direct maternal death	
Pre eclampsia	
ICD10-O11 - Pre-existing hypertensive disorder with superimposed proteinuria	
ICD10-O14 - Gestational hypertension [pregnancy-induced] with significant proteinuria	
ICD10-O15 - Eclampsia	
Hemorrhages	
ICD10-O72 - Postpartum hemorrhage	
ICD10-O62 - Uterine contraction abnormalities	
ICD10-O45 - Placental abruption	
ICD10-O44 - Placenta previa	
Infections	
ICD10-O23 - Genitourinary tract infections in pregnancy	
Thromboembolism	
ICD10-O88 - Embolism of obstetric origin	
Indirect maternal death	
ICD10-O98 - Maternal infectious and parasitic diseases classifiable elsewhere, but which complicate pregnancy, childbirth and the postpartum period	
O980 - Tuberculosis complicating pregnancy, childbirth and the postpartum period	
O981 - Syphilis complicating pregnancy, childbirth and the postpartum period	
O982 - Gonorrhea complicating pregnancy, childbirth and the postpartum period	
O983 - Other infections in which the transmission route is predominantly sexual, complicating pregnancy, childbirth and the postpartum period	
O984 - Viral hepatitis complicating pregnancy, childbirth and the postpartum period	
O985 - Other viral diseases complicating pregnancy, childbirth and the postpartum period	
O986 - Diseases caused by protozoa complicating pregnancy, childbirth and the postpartum period	
O988 - Other maternal infectious and parasitic diseases complicating pregnancy, childbirth and the postpartum period	
O989 - Maternal infectious and parasitic diseases, unspecified, complicating pregnancy, childbirth and the postpartum period	

Source: Datasus - Ministry of Health



SECRETARIA DA SAÚDE DO PARANÁ

DIVISÃO POR REGIONAIS E MACROREGIONAIS

REGIONAIS DE SAÚDE	Nº DE MUNICÍPIOS	REGIONAIS DE SAÚDE	Nº DE MUNICÍPIOS	MACROREGIONAIS DE SAÚDE	Nº DE MUNICÍPIOS
1º PARANAGUÁ	7	13º CANTO NORTE	11	MACRO LESTE	86
2º CURITIBA	29	14º PARANANÍ	28	MACRO NORTE	104
3º PONTA GROSSA	12	15º MARINGÁ	30	MACRO OESTE	94
4º IRATI	9	16º APUÇARANA	17	MACRO NORDESTE	115
5º GUARAPUAVA	20	17º LONDRINA	21		
6º LUNDA DO VITÓRIA	9	18º CORNÉLIO PROPCOPRIO	21		
7º PATO BRANCO	15	19º JACAREZINHO	22		
8º FRANCISCO BELTRÃO	87	20º JULIÂNIA	18		
9º FOZ DO IGUAÇU	9	21º TELHADO BOIRÁ	7		
10º CASCAVEL	29	22º MARIPÓDI	18		
11º CAMPO MOURÃO	25	TOTAL DO PARANÁ	399		
12º URAUBAMA	31				

Source: SESA, 2020

Figure 1 - Distribution of the four health macro-regions, with their respective regional and municipal coverage, according to the Paraná State Health Department (SESA, 2020).

RESULTS

In the period analyzed, 411 deaths were recorded, distributed in the pre-pandemic and pandemic periods, with statistical significance in relation to the type of obstetric cause, more specifically within indirect causes ($p < 0.0001$). The other indicators showed no statistically significant association ($p > 0.05$).

There was a predominance of deaths among white women, with 223 (67%) cases in P1 and 50 (65%) in P2. The 20-29 age group was the most affected, with 134 (41%) deaths in P1 and 30 (39%) in P2. Single women accounted for 133 (40%) deaths in P1 and 33 (43%) in P2. Years of schooling ranged from 8 to 11 years, with 174 (52%) deaths in P1 and 44 (57%) in P2 (Table 2).

Table 2 - Sociodemographic indicators of maternal mortality in Parana.

Socio-demographic indicators of maternal mortality in Parana	Period	P1 (2015-19)		P2 (2020)	
		Count	Percentage	Count	Percentage
Color/Race	White	223	67%	50	65%
	Brown	75	22%	17	22%
	Black	23	7%	8	10%
	Indigenous	6	2%	2	3%
	Ignored	4	1%	0	0%
	Yellow	3	1%	0	0%
	Total	334	100%	77	100%
Age range	20-29 years	138	41%	30	39%
	30-39 years	132	40%	37	48%
	15-19 years	40	12%	5	6%
	40-49 years	21	6%	5	6%
	10-14 years	3	1%	0	0%
	Total	334	100%	77	100%
Marital status	Single	133	40%	33	43%
	Married	120	36%	30	39%
	Others	56	17%	10	13%
	Ignored	13	4%	2	3%
	Legally separated	10	3%	2	3%
	Widower	2	1%	0	0%
	Total	334	100%	77	100%
Education	8-11 years	174	52%	44	57%
	04-07 years	84	25%	11	14%
	12 and over	47	14%	10	13%
	01-03 years	13	4%	3	4%
	Ignored	12	4%	7	9%
	None	4	1%	2	3%
	Total	334	100%	77	100%
Total		334	100%	77	100%

Source: Research data.

The gestational age at which most deaths occurred was the puerperium, with 229 (69%) deaths in P1 and 58 (75%) in P2. The most prevalent type of cause of death was direct, with 214 (64%) deaths occurring in P1 and 37 (48%) in P2 (Table 3). The statistical significance observed in relation to Type of cause ($p = 0.025$) is due to the indirect

causes of maternal death (Table 5).

Maternal deaths were predominantly hospital-based, with 306 (92%) deaths in P1 and 70 (91%) in P2. The macro-region with the most maternal deaths was the east, with 125 (37%) in P1 and 32 (42%) in P2 (Table 4).

Table 3 - Obstetric indicators of maternal mortality in Paraná.

Obstetric indicators of maternal mortality in Parana	Period	P1 (2015-19)		P2 2020	
Patient's gestational age	During the postpartum period, up to 42 days	229	69%	58	75%
	During pregnancy, childbirth or miscarriage	93	28%	18	23%
	Not informed or ignored	7	2%	0	0%
	Not during pregnancy or the postpartum period	3	1%	1	1%
	During the postpartum period, from 43 days to less than a year	2	1%	0	0%
	Total	334	100%	77	100%
Type of cause	Direct	214	64%	37	48%
	Indirect	96	29%	34	44%
	Not specified	24	7%	6	8%
	Total	334	100%	77	100%
Total		334	100%	77	100%

Source: Research data.

Table 4 - Maternal mortality care indicators in Paraná.

Maternal mortality assistance indicators in Parana	Period	P1 (2015-19)		P2 2020	
Place of death	Hospital	306	92%	70	91%
	Residence	17	5%	3	4%
	Other healthcare facility	6	2%	2	3%
	Others	4	1%	1	1%
	Public highway	1	0%	1	1%
	Total	334	100%	77	100%
Health macroregions	East	125	37%	32	42%
	North	71	21%	18	23%
	Northwest	70	21%	12	16%
	West	68	20%	15	19%
	Total	334	100%	77	100%
Total		334	100%	77	100%

Source: Research data.

In P1, direct causes (136 deaths) and undefined causes (189 deaths) predominated. Indirect causes (96 deaths) included the ICD10-O98 category (Maternal infectious and parasitic diseases classifiable elsewhere but complicating pregnancy, childbirth and the puerperium), with 9 deaths. Of these, 1 death related to ICD10 - O980, 1 to ICD10 - O985 and 7 to ICD10 - O988. The sequence of data obtained shows an increase in the ICD10-O98 maternal mortality notification rate, with 17 deaths in P2 (Table 5). Of these, 15 deaths related to ICD10 - O985 (COVID-19)

and 2 deaths related to ICD10 - O986.

When investigating the significant association in table 3, we see in table 5 that the ICD10-O98 category ($p < 0.0001$) was responsible for the relationship previously found. There was no statistically significant difference in maternal deaths from direct causes ($p = 0.153$) and miscellaneous causes ("Other causes" $p < 0.128$).

Overall, there were around 67 deaths/year in P1 and 77 deaths/year in P2, which indicates a 15.3% increase in maternal mortality in the context of COVID-19.

Table 5 - Direct and indirect causes of maternal death in Paraná, 2015-2020.

Direct and indirect causes of maternal death in the State of Parana	Total		p-value*
	P1 (2015-2019)	P2 (2020)	
Direct maternal death	136	24	0.153
Pre eclampsia	57	15	0.619
ICD10-O11 - Pre-existing hypertensive disorder with superimposed proteinuria	12	0	
ICD10-O14 - Gestational hypertension [pregnancy-induced] with significant proteinuria	27	9	
ICD10-O15 - Eclampsia	18	6	
Hemorrhages	46	7	0.346
ICD10-O72 - Postpartum hemorrhage	29	5	
ICD10-O62 - Uterine contraction abnormalities	3	1	
ICD10-O45 - Placental abruption	10	0	
ICD10-O44 - Placenta previa	4	1	
Infections	10	0	0.219
ICD10-O23 - Genitourinary tract infections in pregnancy	10	0	
Thromboembolism	23	2	0.193
ICD10-O88 - Embolism of obstetric origin	23	2	
Indirect maternal death	96	34	
ICD10-O98 - Maternal infectious and parasitic diseases classifiable elsewhere, but that complicate pregnancy, childbirth and the postpartum period	9	17	<0.0001
Other causes	189	36	0.128
TOTAL	334	77	

*Fisher's exact test

Source: Research data.

DISCUSSION

The death of a woman of childbearing age has a major impact on the family and the community, and is an indicator of social inequality that reveals possible barriers to access or deficiencies in the provision of health services^{7,8,9}. In view of this and the pandemic, we sought to analyze the characteristics of maternal deaths resulting from the impacts of COVID-19 in Paraná, in 2020, compared to the period 2015-2019.

The higher number of white pregnant women can be attributed to the state's ethnic composition¹⁰. The Eastern macro-region also concentrated higher rates as it has a high demographic density and includes regions with an important concentration of medical and hospital resources, such as Paranaguá, the Metropolitan Region of Curitiba, Ponta Grossa, Irati, Guarapuava, União da Vitória and Telêmaco Borba³.

Obstetric clinical indicators reveal a predominance of deaths during the puerperium, which can be explained by the fact that this is the gestational phase with the highest number of complications involved, such as thromboembolism, pre-eclampsia, hemorrhages and infections¹¹. In both periods studied, deaths occurred predominantly in hospital settings. However, in 2020, the proportion of deaths in hospitals increased from 76% to 91%, expressing a reflection of the increase in maternal mortality due to the COVID-19 pandemic and higher rates of complications in the pregnancies of these patients¹².

The main causes of maternal death identified in the period studied were pre-eclampsia, hemorrhages, infections, thromboembolism - direct maternal deaths - and infectious and parasitic diseases related to pregnancy (indirect maternal deaths). It is therefore possible to draw a parallel between the main risk factors related to these causes and the main causes of death in Brazil: coronary artery disease, diabetes mellitus, hypertension and infections¹³. Most of the factors reflect preventable underlying causes related to cardiovascular events and, in the context of the pandemic, pregnant women with this risk profile may have suffered from possible difficulties in accessing health facilities, which could have a negative impact on prenatal care and consequent vaccination.

When comparing the five-year period (2015-2019) with a single year (2020), it is expected that the absolute values of deaths from five years together will be higher than a single year, and this can be seen in the analysis of the data collected on direct maternal deaths, with a total of 136 deaths in the first five years prior to the pandemic compared to 24 deaths in 2020. The same comparative pattern of absolute values occurs in the total of indirect maternal deaths: a total of 96 deaths from 2015 to 2019 compared to 34 deaths in 2020. However, when these figures are compared relatively, there is a break in the pattern of indirect maternal deaths: while the annual average of direct maternal deaths between 2015 and 2019 (27.2 deaths) results in a figure very close to the number of direct maternal deaths in 2020 (24 deaths), indirect deaths in

2020 (34 deaths) exceed the average of the previous 5 years (19.2 deaths) by almost twice. This is most evident when analyzing the specific category of indirect maternal death in which COVID-19 deaths were allocated (“ICD10-O98 - Maternal infectious and parasitic diseases classifiable elsewhere but complicating pregnancy, childbirth and the puerperium”), since there were only 17 deaths in 2020, against an annual average of 1.8 deaths per year in the years 2015 to 2019, supporting the hypothesis that COVID-19 has contributed to the increase in maternal mortality, since pregnant women infected with SARS-CoV-2 are more likely to be hospitalized, admitted to intensive care units and mechanically ventilated^{12,14}.

Changes in the immune system during pregnancy make pregnant women more prone to illnesses such as viral pneumonia, and cause this group to be affected by these and other complications arising from COVID-19¹⁵. And because it includes pre-gestational comorbidities as potential triggers for complications^{12,16}, indirect maternal deaths are a very sensitive target for variations related to external agents, as in the case of the pandemic. Thus, observing the influence of COVID-19 on maternal mortality rates shows the impact that the pandemic has had on the population studied. In this way, specific actions for this population can be useful in similar situations that may occur in the future.

The limitations of this study are possible underreporting or inadequate recording of data and population density bias between state macro-regions. In addition, the indicators available on death certificates are limited in terms of understanding the care provided to this population.

Studies suggest that the involvement of pregnant women by COVID-19 could mimic a case of pre-eclampsia, due to enzymatic alterations of the infection superimposed with physiological alterations of pregnancy, which could mask the true diagnosis and consequent registration of death¹⁷. Underreporting, on the other hand, is sensitive to situations such as low access to screening tests, tests carried out outside the appropriate detection window and the absence of an efficient coping plan, situations faced

with greater importance in areas with a lower density of technological and medical-hospital resources¹⁸. In addition, the lack of uniform guidelines on prevention and self-care also influenced this underreporting, as patients who may have been infected may have failed to seek medical attention and comply with isolation periods based on information that was convenient to their contexts^{18,19}. However, this study adds value by analyzing the subject and considering the lessons learned from this pandemic in pregnancy and childbirth care.

CONCLUSION

The COVID-19 pandemic has had a considerable impact on maternal health. The close relationship between the risk factors of the main causes of maternal death identified in the period studied (direct - pre-eclampsia, hemorrhages, infections, thromboembolism - and indirect - infectious and parasitic diseases related to pregnancy) and the main causes of death in Brazil, associated with the break in the pattern of indirect maternal mortality observed between 2020 and the period 2015-2019 - explained by deaths from COVID-19, draw attention to the importance of guaranteeing pregnant women access to primary health care, especially during health crises.

Considering the limitations of this study, further research comparing other variables (socioeconomic status, race, length of pregnancy, maternal perception and beliefs about vaccination) is relevant for expanding public policies. This analysis points to a relevant result as an epidemiological planning tool for developing intervention and prevention strategies for comorbidities that directly and indirectly influence pregnancies. In this sense, it is a challenge to include these factors in the development of strategies for health regions - projects to encourage access for pregnant women in any future pandemics or similar situations, promotion of primary health care, encouragement to vaccinate against dTPa, influenza and, above all, COVID-19 - in order to have a positive impact on the evolution of these population health indicators.

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REFERENCES

1. Organização Mundial da Saúde. CID-10: Classificação Estatística Internacional de Doenças e Problemas Relacionados à Saúde. São Paulo: Centro Colaborador da Organização Mundial da Saúde para classificação de Doenças em Português; 1997.
2. OPAS/OMS. Saúde Materna. Saúde materna - OPAS/OMS. [citado 18 de outubro de 2022]. <https://www.paho.org/pt/node/63100>
3. Secretaria de Estado da Saúde do Paraná. Linha Guia Mãe Paranaense. 2014. https://crianca.mppr.mp.br/arquivos/File/publi/sesa_pr/mae_paranaense_linha_guiia.pdf
4. Rodrigues ARM, Cavalcante AES, Viana AB. Mortalidade materna no Brasil entre 2006-2017: análise temporal. *ReTEP* 2019;11(1):3-9. <http://www.coren-ce.org.br/wp-content/uploads/2020/01/Mortalidade-materna-no-Brasil-entre-2006-2017-an%C3%AAlise-temporal-final.pdf>
5. Organização das Nações Unidas. UNFPA: mortalidade materna no Brasil aumentou 94,4% durante a pandemia [Internet]. UNFPA: mortalidade materna no Brasil aumentou 94,4% durante a pandemia. 2022 [citado 26 de outubro de 2022]. <https://brasil.un.org/pt-br/203964-unfpa-mortalidade-materna-no-brasil-aumentou-944-durante-pandemia>
6. Secretaria de Vigilância em Saúde. Painel de Monitoramento da Mortalidade Materna. [citado 18 de outubro de 2022]. <https://svs.aids.gov.br/daent/centrais-de-conteudos/paineis-de-monitoramento/mortalidade/materna/>
7. Albert SBZ, Martinelli KG, Zandonade E, Santos Neto ET do. Mortalidade de mulheres em idade fértil no Brasil de 2006 a 2019: causas e tendências. *Rev Bras Estud Popul* [Internet]. 2023;40:e0233. DOI: <https://doi.org/10.20947/S0102-3098a0233>.
8. Aguiar JEAT de, Severo J, Carvalho MAL, Silva TSL de B, Bohland AK. Perfil da mortalidade de mulheres em idade fértil por causas naturais no estado de Sergipe: um estudo retrospectivo. *Rev. Med. (São Paulo)*. 2023;100(4):343-50. <https://www.revistas.usp.br/revistadc/article/view/164708>.
9. Castañeda-Orjuela C, Hilarion Gaitan L, Diaz-Jimenez D, Cotes-Cantillo K, Garfield R. Maternal mortality in Colombia during the COVID-19 pandemic: time series and social inequities. *BMJ open*. 2023;13(4):e064960. <https://pubmed.ncbi.nlm.nih.gov/37015796/> DOI: 10.1136/bmjopen-2022-064960.
10. IBGE. Pesquisa Nacional por Amostra de Domicílios - PNAD 2005. <http://produtos.seade.gov.br/produtos/idr/download/populacao.pdf>.
11. Viana RC, Novaes MRCG, Calderon IMP. Mortalidade Materna: uma abordagem atualizada. *Comun Ciênc Saúde*. 2011;33(sup. esp.1):141-52. <https://pesquisa.bvsalud.org/portal/resource/pt/lil-619064>
12. Alves RP, Souza VR de, Costa AJ da, Cardoso TC dos SF, Freitas VL, Nascimento DRM do. Mortalidade materna em tempos de pandemia de COVID-19: Uma revisão integrativa. *Res Soc Dev*. 2022;11(4):e2871142694. DOI: <http://dx.doi.org/10.33448/rsd-v11i4.26942>
13. World Health Organization. World health statistics 2022: monitoring health for the SDGs, sustainable development goals [Internet]. World health statistics 2022: monitoring health for the SDGs, sustainable development goals. 2022 [citado 18 de novembro de 2022]. <https://www.who.int/publications/i/item/9789240051157>
14. Brasil. Ministério da Saúde. Manual de Recomendações para a Assistência à Gestante e Puerpera frente à Pandemia de Covid-19. 2021. https://portaldeboaspraticas.iff.fiocruz.br/wp-content/uploads/2021/09/manual_assistencia_gestante.pdf
15. Souza ASR, Amorim MMR. Maternal mortality by COVID-19 in Brazil. *Rev Bras Saúde Materno Infant*. 2021;21(supl 1):253-6. DOI: <http://dx.doi.org/10.1590/1806-9304202100s100014>
16. Martínez-Perez O, Vouga M, Cruz Melguizo S, Forcen Acebal L, Panchaud A, Muñoz-Chápoli M, et al. Association between mode of delivery among pregnant women with COVID-19 and maternal and neonatal outcomes in Spain. *JAMA*. 2020;324(3):296-9. DOI: <http://dx.doi.org/10.1001/jama.2020.10125>
17. Nascimento MI do, Cunha A de A, Falcão Rangel Netto N, Santos RA dos, Barroso RR, Alves TR de C, et al.. COVID-19 and Preeclampsia: a systematic review of pathophysiological interactions. *Rev Bras Ginecol Obstet*. 2023;45(6):347-55. DOI: <https://doi.org/10.1055/s-0043-1770091>
18. Alves AR, Silva AF, Franco DE, Selzler HS, Madeira JP, Yamaoka JG, et al. Povos originários do Paraná e Covid-19: panorama de 2020. Seção especial - O desmonte socioambiental e as resistências emergentes. *Desenvolv Meio Ambiente*. 2022;60:4-25. DOI: <http://dx.doi.org/10.5380/dma.v60i0.79999>
19. Prado MF do, Antunes BB de P, Bastos L dos SL, Peres IT, Silva A de AB da, Dantas LF, et al. Análise da subnotificação de COVID-19 no Brasil. *Rev Bras Ter Intensiva*. 2020;32(2):224-8. DOI: <https://doi.org/10.5935/0103-507X.20200030>

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