

# Nationwide study of in-hospital maternal mortality in Ecuador, 2015–2022

German Josuet Lapo-Talledo<sup>1</sup>

**Suggested citation** Lapo-Talledo GJ. Nationwide study of in-hospital maternal mortality in Ecuador, 2015–2022. *Rev Panam Salud Publica*. 2024;48:e5. <https://doi.org/10.26633/RPSP.2024.5>

## ABSTRACT

**Objective.** This study aimed to analyze estimates of in-hospital delivery-related maternal mortality and socio-demographic factors influencing this mortality in Ecuador during 2015 to 2022.

**Methods.** Data from publicly accessible registries from the Ecuadorian National Institute of Statistics and Censuses were analyzed. Maternal mortality ratios (MMRs) were calculated, and bivariate and multivariate logistic regression models were used to obtain unadjusted and adjusted odds ratios.

**Results.** There was an increase in in-hospital delivery-related maternal deaths in Ecuador from 2015 to 2022: MMRs increased from 3.70 maternal deaths/100 000 live births in 2015 to 32.22 in 2020 and 18.94 in 2022. Manabí province had the highest rate, at 84.85 maternal deaths/100 000 live births between 2015 and 2022. Women from ethnic minorities had a higher probability of in-hospital delivery-related mortality, with an adjusted odds ratio (AOR) of 9.59 (95% confidence interval [95% CI]: 6.98 to 13.18). More maternal deaths were also observed in private health care facilities (AOR: 1.99, 95% CI: 1.4 to 2.84).

**Conclusions.** Efforts to reduce maternal mortality have stagnated in recent years. During the COVID-19 pandemic in 2020, an increase in maternal deaths in hospital settings was observed in Ecuador. Although the pandemic might have contributed to the stagnation of maternal mortality estimates, socioeconomic, demographic and clinical factors play key roles in the complexity of trends in maternal mortality. The results from this study emphasize the importance of addressing not only the medical aspects of care but also the social determinants of health and disparities in the health care system.

## Keywords

Maternal mortality; maternal death; hospital mortality; socioeconomic disparities in health; COVID-19; Ecuador.

Recent global estimates of maternal mortality have been unacceptably high (1). In 2020, about 287 000 women died during and following pregnancy and childbirth, and almost 95% of these maternal deaths occurred in low- and lower middle-income countries (1). Maternal mortality varies greatly by area, with developed areas such as Europe and North America having maternal mortality ratios (MMRs) of approximately 13 deaths/100 000 live births in 2020; however, in developing countries, MMRs in 2020 ranged from 206 to 368 maternal deaths/100 000 live births, and in the least developed countries in 2020 MMRs were about 377 maternal deaths/100 000 live births (2). These higher MMRs in developing countries reflect

inequalities in access to high-quality health services and highlight the gap between rich and poor. This gap seems to have been accentuated during the COVID-19 pandemic. Global studies comparing maternal mortality trends before and during the pandemic in 2020, observed an increase in maternal deaths (3, 4). Two hypothetical pathways describe how the COVID-19 pandemic might have affected maternal mortality rates: either through to the effects of infection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) during pregnancy or through disruptions in maternal health care services (4).

In the Millennium Development Goals era, between 2000 and 2015, the observed global average annual rate of reduction of

<sup>1</sup> School of Medicine, Faculty of Health Sciences, Technical University of Manabí, Portoviejo, Ecuador; ORCID: 0000-0002-4525-7534; ✉ German Josuet Lapo-Talledo, [gerjolata@gmail.com](mailto:gerjolata@gmail.com)

MMRs was 2.7%, while during the first 5 years of the Sustainable Development Goals era, from 2016 to 2020, the annual rate of reduction fell to -0.04% (2). In Ecuador, MMRs fell from 120 maternal deaths/100 000 live births in 2000 to 66/100 000 live births in 2015; however, 2020 represented a period of stagnation, during which the MMR estimate remained the same as it was in 2015 (2). These reports highlight the stagnation of recent efforts to reduce maternal mortality.

Maternal mortality is an important indicator for a health care system and the overall health status of a country or region, and globally (2). The World Health Organization (WHO) recognizes maternal mortality as a global health priority, and it is addressed by Target 3.1 of the Sustainable Development Goals (2). Concerns have been raised about whether the COVID-19 pandemic in 2020 has contributed to the stagnation of MMRs, particularly in hospital settings (2). However, it is essential to recognize that this pandemic is but one piece of a complex puzzle. While the COVID-19 pandemic may have played a role, multiple interrelated factors – including demographic disparities, socioeconomic inequalities, comorbidities, clinical complications and other determinants of health – may have contributed to the complexity of trends in maternal mortality (5–8). In light of the lack of evidence about the current state of in-hospital maternal mortality in Ecuador, this study aimed to analyze in-hospital delivery-related maternal mortality and the sociodemographic factors influencing maternal mortality.

## METHODS

### Study design

This retrospective longitudinal study was performed using registries of patients hospitalized in Ecuador between 2015 and 2022 whose diagnosis was coded as O80 to O84 (Delivery), according to the *International statistical classification of diseases and related health problems*, tenth revision (ICD-10). Data were obtained for each year of the study from the Statistical Registry of Hospital Beds and Discharges of the Ecuadorian National Institute of Statistics and Censuses (known as INEC for its Spanish-language acronym); these data are publicly available (<https://www.ecuadorencifras.gob.ec/camas-y-egresos-hospitalarios/>).

### Study population

This study included patients with a diagnosis of delivery who were hospitalized in all public and private health centers in Ecuador between 2015 and 2022; patients were included if their ICD-10 diagnosis was coded as O80 to O84.

### Variables

The independent variables were age, ethnicity, area where the health center was located (urban or rural), health sector (private or public), area of residence (urban or rural), length of hospital stay ( $\leq 24$  hours,  $\leq 48$  hours,  $> 48$  hours), year of hospital discharge and type of delivery; the dependent variable was the patient's condition at the time of hospital discharge (alive or dead). The variable for type of delivery was divided into six categories based on ICD-10 codes: single vaginal delivery

(O80.0–O81.5), multiple vaginal delivery (O84.0–O84.1), single delivery by elective caesarean section (O82.0), single delivery by emergency caesarean section (O82.1), multiple delivery by caesarean section (O84.2) and other deliveries by caesarean section (O82.2, O82.8, O82.9).

## Statistical analyses

Continuous variable descriptive analyses were expressed as mean and standard deviation (SD), and categorical variables as frequency (*n*) and percentage (%). MMRs for in-hospital delivery-related maternal deaths were calculated using the following formula, as recommended by WHO (9):

$$\text{Maternal mortality ratio} = \left( \frac{\text{Number of maternal deaths}}{\text{Number of live births}} \right) \times 100\,000.$$

Bivariate and multivariate logistic regression models were used to obtain unadjusted odds ratios (ORs) and adjusted odds ratios (AORs) and 95% confidence intervals (95% CIs) for in-hospital delivery-related maternal deaths. Significant variables in the bivariate logistic regression with a *P* value  $< 0.20$  were maintained in the multivariate model. Variables with a *P* value  $< 0.05$  were considered significant. The logistic regression model used the variance inflation factor (VIF) to detect multicollinearity, and found no evidence of collinearity among the independent variables (mean VIF = 1.28, maximum VIF = 1.70). Data were analyzed using the SPSS statistical program version 25.0 for Windows (IBM, Chicago, United States).

## Ethical considerations

According to local and international ethics regulations, this study did not require ethical approval. All data came from secondary registries that are available in the public domain; these registries do not contain any sensitive or confidential information that might violate the rights to the protection of personal data.

## RESULTS

This study included 1 118 842 individuals hospitalized between 2015 and 2022 who were discharged with a diagnosis of delivery (ICD-10 codes: O80–O84), of whom 307 died. The mean age of the study population who survived was 26.07 (SD = 6.70) years; those who died had a mean age of 27.35 (SD = 6.96) years (Table 1). The four most common types of deliveries were single vaginal delivery (656 211 individuals, 58.65%), followed by other deliveries by caesarean section (286 395 individuals, 25.60%), elective caesarean section (92 849 individuals, 8.30%) and emergency caesarean section (80 185 individuals, 7.17%) (Table 1).

Data collected during the study period show that the percentage of deliveries that occurred in a hospital setting decreased from 14.42% in 2015 to 10.19% in 2022. However, between 2015 and 2022 the percentage of in-hospital delivery-related maternal deaths increased from 4.23% in 2015 to 30.94% in 2021, but it then dropped to 15.64% in 2022 (Table 1). These results were also consistent with the in-hospital MMRs, which increased from 3.7 maternal deaths/100 000 live births in 2015 to 37.32 in 2021 and then dropped slightly to 18.94 in 2022 (Table 2).

**TABLE 1. Characteristics of individuals who delivered in hospital, by condition at discharge, Ecuador, 2015–2022**

Variable	Maternal condition at time of hospital discharge					
	Alive (n = 1 118 535)		Deceased (n = 307)		Total (N = 1 118 842)	
	n	%	n	%	n	%
Mean (SD) age (years)	26.07 (6.70)		27.35 (6.96)		26.07 (6.70)	
Age group (years)						
10–14	9 020	0.81	1	0.33	9 021	0.81
15–19	203 246	18.17	41	13.36	203 287	18.17
20–29	562 346	50.28	152	49.51	562 498	50.28
30–39	312 181	27.91	103	33.55	312 284	27.91
40–49	31 594	2.82	10	3.26	31 604	2.82
50–59	148	0.01	0	0.00	148	0.01
Ethnicity						
Mestizo	965 216	86.29	224	72.96	965 440	86.29
Indigenous	51 246	4.58	3	0.98	51 249	4.58
Afrodescendant	11 903	1.06	1	0.33	11 904	1.06
Montubio	3 188	0.29	1	0.33	3 189	0.29
White	3 943	0.35	1	0.33	3 944	0.35
Other	30 456	2.72	73	23.78	30 529	2.73
Unknown	52 583	4.70	4	1.30	52 587	4.70
Area where health center located						
Urban	1 083 817	96.90	304	99.02	1 084 121	96.90
Rural	34 718	3.10	3	0.98	34 721	3.10
Health sector						
Public	792 371	70.80	137	44.60	792 508	70.83
Private	326 164	29.20	170	55.40	326 334	29.17
Area of residence						
Urban	909 395	81.30	278	90.55	909 673	81.30
Rural	209 140	18.70	29	9.45	209 169	18.70
Type of delivery						
Single vaginal delivery	656 150	58.66	61	19.87	656 211	58.65
Multiple vaginal delivery	429	0.04	0	0.00	429	0.04
Elective C-section	92 839	8.30	10	3.26	92 849	8.30
Emergency C-section	80 097	7.16	88	28.66	80 185	7.17
Multiple delivery by C-section	2 773	0.25	0	0.00	2 773	0.25
Other delivery by C-section	286 247	25.59	148	48.21	286 395	25.60
Hospital stay						
≤24 hours	529 040	47.30	197	64.20	529 237	47.30
≤48 hours	397 550	35.50	71	23.10	397 621	35.50
>48 hours	191 945	17.20	39	12.70	191 984	17.20
Year of discharge						
2015	161 271	14.42	13	4.23	161 284	14.42
2016	151 120	13.51	4	1.30	151 124	13.51
2017	157 490	14.08	9	2.93	157 499	14.08
2018	154 078	13.77	27	8.79	154 105	13.77
2019	141 318	12.63	25	8.14	141 343	12.63
2020	127 281	11.38	86	28.01	127 367	11.38
2021	112 056	10.02	95	30.94	112 151	10.02
2022	113 921	10.18	48	15.64	113 969	10.19

C-section: caesarean section; SD: standard deviation.

Source: Table prepared by the author based on analyses of data sets from the Statistical Registry of Hospital Beds and Discharges of the Ecuadorian National Institute of Statistics and Censuses (known as INEC).

Between 2015 and 2022 the five provinces with the most in-hospital maternal deaths were Manabí, with an MMR of 84.85 deaths/100 000 live births; followed by Galápagos, with 34.72; Azuay, with 16.22; Los Ríos, with 14.59; and Napo, with

13.26 (Table 2). During the study period, the province of Manabí had an enormous increase in the in-hospital MMR, from 7.60 maternal deaths/100 000 live births in 2015 to 233.08 in 2020, 298.66 in 2021 and then dropping slightly to 134.91 in 2022

**TABLE 2. In-hospital delivery-related maternal mortality ratios (MMRs) per 100 000 live births, by province and year of discharge, Ecuador, 2015–2022**

Province	Year								Total <sup>b</sup>
	2015	2016	2017	2018	2019	2020	2021	2022	
Azuay	0	0	41.51	0	7.66	0	49.07	49.71	16.22
Bolívar	0	0	0	0	0	0	0	0	0
Cañar	0	0	0	0	0	0	0	0	0
Carchi	0	0	0	0	0	0	0	0	0
Cotopaxi	0	0	0	0	0	28.47	31.20	30.43	10.17
Chimborazo	0	0	0	0	13.76	0	0	0	1.69
El Oro	0	0	0	0	0	0	0	0	0
Esmeraldas	6.65	0	0	0	0	0	0	0	1
Galápagos	0	0	0	0	0	259.07	0	0	34.72
Guayas	1.08	1.29	0	20.53	5.28	17.17	4.41	6.12	6.75
Imbabura	0	0	0	12.03	62.77	0	31.59	0	12.53
Loja	0	0	12.34	0	0	0	0	0	1.57
Los Ríos	5.21	0	5.42	5.41	42.96	28.87	22.34	5.70	14.59
Manabí	7.60	9.08	0	15.11	0	233.08	298.66	134.91	84.85
Morona Santiago	14.42	0	0	0	18.92	0	0	0	4.73
Napo	0	0	0	0	36.39	82.75	0	0	13.26
Orellana	0	0	0	0	0	0	0	0	0
Pastaza	0	0	0	0	0	0	0	0	0
Pichincha	0	2.04	0	6.24	8.55	2.47	17.37	5.62	4.74
Santa Elena	0	0	0	0	0	91.74	0	0	11.04
Santo Domingo de los Tsáchilas	6.97	0	7.91	7.94	0	9.04	0	9.18	5.15
Sucumbios	0	0	0	19.64	0	0	0	0	2.78
Tungurahua	54.90	0	0	0	0	0	13.57	13.74	11.26
Zamora Chinchipe	0	0	0	0	0	0	0	0	0
<b>Total<sup>a</sup></b>	<b>3.70</b>	<b>1.35</b>	<b>2.92</b>	<b>8.80</b>	<b>8.42</b>	<b>32.22</b>	<b>37.32</b>	<b>18.94</b>	<b>13.15</b>

<sup>a</sup> These rates represent the total number of all in-hospital maternal deaths during each year divided by the total number of live births in Ecuador in that year multiplied by 100 000.

**Source:** Table prepared by the author based on analyses of data sets from the Statistical Registry of Hospital Beds and Discharges of the Ecuadorian National Institute of Statistics and Censuses (known as INEC).

(Table 2). Although Galápagos province had the second highest MMRs, it should be noted that there was only one in-hospital maternal death between 2015 and 2022. The MMRs in Galápagos appear to be higher because of the very low number of live births in the province. The province of Azuay had an increase from zero in-hospital maternal deaths in 2015 and 2016 to 49.07 in 2021 and 49.71 in 2022 (Table 2).

Regarding sociodemographic factors associated with in-hospital maternal mortality, this study found that ethnic minority individuals categorized as “other” were more likely to die during delivery (AOR: 9.59, 95% CI: 6.98 to 13.18) when compared with those in the category mestizo. Additionally, individuals in private health facilities were also more likely to die during delivery (AOR: 1.99, 95% CI: 1.40 to 2.84) when compared with individuals in public health facilities (Table 3).

Moreover, individuals undergoing emergency caesarean section were more likely to die during delivery (AOR: 7.49, 95% CI: 5.20 to 10.79). Higher odds were also observed for individuals undergoing other types of caesarean section (AOR: 3.39, 95% CI: 2.31 to 4.99), of whom 96% of cases were coded as “O82.9 Delivery by caesarean section, unspecified”. Additionally, in concordance with the finding of higher MMRs during 2020, 2021 and 2022, it was also observed that there was a higher probability of maternal death during these years after

adjusting for confounding factors in multivariate analyses (Table 3).

## DISCUSSION

In this study, a decrease in the number of in-hospital deliveries was observed in Ecuador in 2022; although there was a general decrease in in-hospital deliveries during 2020–2022, there was a large increase in in-hospital deliveries that ended in death compared with 2015. In Ecuador, the overall MMR in 2015 was 66 maternal deaths/100 000 live births, and this MMR was the same in 2020 (2). Despite the overall MMR in Ecuador remaining the same, this study observed a large increase in in-hospital delivery-related maternal deaths, from 3.70 maternal deaths/100 000 live births in 2015 to 32.22 maternal deaths in 2020. The increase in maternal deaths remained in the multivariate analysis, and there were higher odds of delivery-related maternal death in 2020, 2021 and 2022 when compared with 2015.

The results from this study might suggest that the COVID-19 pandemic played a role in maternal deaths during 2015–2022, which is in line with results observed in recent studies. Both infection with SARS-CoV-2 and the pandemic’s effects on health care services could have contributed to the increase in maternal mortality (10). A study conducted between March 1,

**TABLE 3. Unadjusted and adjusted odds ratios for in-hospital delivery-related maternal deaths, Ecuador, 2015–2022**

Variable	Odds ratio (95% CI); P value	Adjusted odds ratio (95% CI); P value
Age group (years)		
10–14	0.41 (0.06 to 2.93); 0.374	0.59 (0.08 to 4.21); 0.598
15–19	0.75 (0.53 to 1.05); 0.096	1.10 (0.78 to 1.56); 0.578
20–29	Reference	Reference
30–39	1.22 (0.95 to 1.57); 0.118	0.98 (0.76 to 1.27); 0.892
40–49	1.17 (0.62 to 2.22); 0.629	0.92 (0.48 to 1.74); 0.790
50–59	NA	NA
Ethnicity		
Mestizo	Reference	Reference
Indigenous	0.25 (0.08 to 0.79); 0.018 <sup>a</sup>	0.61 (0.19 to 1.93); 0.401
Afrodescendant	0.36 (0.05 to 2.58); 0.311	1.00 (0.14 to 7.22); 0.996
Montubio	1.35 (0.19 to 9.64); 0.764	1.20 (0.17 to 8.58); 0.855
White	1.09 (0.15 to 7.79); 0.929	0.91 (0.13 to 6.52); 0.928
Other	10.33 (7.93 to 13.45); ≤0.001 <sup>a</sup>	9.59 (6.98 to 13.18); ≤0.001 <sup>a</sup>
Unknown	0.33 (0.12 to 0.88); 0.027 <sup>a</sup>	0.35 (0.13 to 0.95); 0.039
Area where health center located		
Urban	Reference	Reference
Rural	0.31 (0.10 to 0.96); 0.042 <sup>a</sup>	0.46 (0.15 to 1.46); 0.188
Health sector		
Public	Reference	Reference
Private	3.01 (2.41 to 3.78); ≤0.001 <sup>a</sup>	1.99 (1.40 to 2.84); ≤0.001 <sup>a</sup>
Area of residence		
Urban	Reference	Reference
Rural	0.45 (0.31 to 0.66); ≤0.001 <sup>a</sup>	0.88 (0.59 to 1.3); 0.522
Type of delivery		
Single vaginal delivery	Reference	Reference
Multiple vaginal delivery	NA	NA
Elective C-section	1.16 (0.59 to 2.26); 0.666	1.20 (0.6 to 2.39); 0.612
Emergency C-section	11.82 (8.52 to 16.38); ≤0.001 <sup>a</sup>	7.49 (5.2 to 10.79); ≤0.001 <sup>a</sup>
Multiple delivery by C-section	NA	NA
Other delivery by C-section	5.56 (4.13 to 7.49); ≤0.001 <sup>a</sup>	3.39 (2.31 to 4.99); ≤0.001 <sup>a</sup>
Hospital stay		
≤24 hours	Reference	Reference
≤48 hours	0.48 (0.37 to 0.63); ≤0.001 <sup>a</sup>	0.47 (0.35 to 0.64); ≤0.001 <sup>a</sup>
>48 hours	0.55 (0.39 to 0.77); ≤0.001 <sup>a</sup>	0.54 (0.37 to 0.8); 0.002 <sup>a</sup>
Year of discharge		
2015	Reference	Reference
2016	0.33 (0.11 to 1.01); 0.051	0.32 (0.11 to 1); 0.049
2017	0.71 (0.3 to 1.66); 0.428	0.67 (0.29 to 1.56); 0.352
2018	2.17 (1.12 to 4.21); 0.021 <sup>a</sup>	1.96 (1.01 to 3.8); 0.047
2019	2.19 (1.12 to 4.29); 0.022 <sup>a</sup>	1.81 (0.92 to 3.55); 0.084
2020	8.38 (4.68 to 15.02); ≤0.001 <sup>a</sup>	5.74 (3.19 to 10.32); ≤0.001 <sup>a</sup>
2021	10.52 (5.89 to 18.78); ≤0.001 <sup>a</sup>	5.87 (3.26 to 10.56); ≤0.001 <sup>a</sup>
2022	5.23 (2.83 to 9.65); ≤0.001 <sup>a</sup>	4.08 (2.2 to 7.57); ≤0.001 <sup>a</sup>

C-section: caesarean section; CI: confidence interval; NA: not applicable.

<sup>a</sup> Statistically significant.

Source: Table prepared by the author based on analyses of data sets from the Statistical Registry of Hospital Beds and Discharges of the Ecuadorian National Institute of Statistics and Censuses (known as INEC).

2020, and November 29, 2021, in eight Latin American countries observed that around 90% of all maternal deaths were related to acute respiratory failure after severe COVID-19, and 35% of these cases were not admitted to critical care (4). In the United States of America, there was an increase of 57% in maternal deaths in 2021 compared with 2019 (11).

During the COVID-19 pandemic in 2020, there was a decline in the use of maternal health care services in low- and middle-income countries, which experienced significant decreases in the number of first antenatal care visits (12). Also, a 13% reduction in ambulatory consultations was reported during the COVID-19 pandemic, with the first quarter of the pandemic

being the period with the most severe disruptions to health care services (13). Restrictions on mobility and social gatherings during the pandemic were associated with the magnitude of service disruption, and these could have decreased the utilization of life-saving essential health services (13). High birth rates and the limited resources for health care observed in low- and middle-income countries contribute to increasing the risks of maternal death due to COVID-19 (14). As population immunity to SARS-CoV-2 increases and adaptations are made by governments and health facilities to address the detrimental effects of the pandemic on health care services, maternal mortality is expected to decrease (10, 13). This is in accordance with the findings of this study, which documented a decrease in in-hospital delivery-related maternal mortality from 32.22 maternal deaths/100 000 live births in 2020 to 18.94 maternal deaths/100 000 live births in 2022.

Furthermore, this study found that ethnic minorities in the category “other” had higher rates of in-hospital delivery-related maternal mortality, which is in line with other studies that had reported higher risks among ethnic and social minorities (7, 8, 14). The results from this study revealed a bivariate association between rural areas and a higher probability of maternal death, but unlike other studies (6, 15), this study did not find a significant association in the multivariate analysis. Preconception care seems to play an important role in addressing disparities in maternal health care since this helps to screen vulnerable and high-risk groups (16). Ethnic minorities often have higher rates of comorbidities, which are mainly linked with poorer living conditions and disparities in access to high-quality health care; thus, focusing on preconception care is crucial (16). Prioritizing preconception care by increasing accessibility to culturally sensitive counseling services in deprived communities and implementing community-based educational programs and support groups based on the needs of the target ethnic minorities might help to effectively address disparities (17). These community-based interventions that are implemented through the use of health workers are crucial determinants of awareness of maternal health among women (17). Awareness of maternal health might lead to more women from ethnic minority groups seeking preconception counseling and appropriate care plans.

Interestingly, it was observed that mortality from delivery-related causes was two times higher in private health facilities in Ecuador, which is in accordance with previous research in the country (18). Many low- and middle-income countries have wide variations in quality within the private health care sector; some providers may offer high-quality care while other private health care facilities may lack trained staff, appropriate equipment and adherence to best practices in maternal health care (5, 18, 19). Private health care facilities may be more inclined to perform unnecessary medical interventions to increase revenue and, in some cases, the private sector may not be as rigorously regulated as the public sector, resulting in substandard care and increased maternal deaths (5, 18, 19). It has been reported that 1 in 5 births in low- and middle-income countries occurred in private health care facilities, thus making them key players in delivering maternal and newborn health services and potential contributors to help tackle maternal mortality (5, 20).

The main strength of this study is that it is based on data from a nationwide, multicenter population obtained from

official reports of the Ecuadorian National Institute of Statistics and Censuses. However, although the data set covers all in-hospital delivery-related maternal deaths, some cases may have been unreported. The main limitation of this study was the use of secondary data sets, which limits the analysis to the data already registered. Therefore, specific information regarding clinical characteristics could not be obtained, such as information about comorbidities, the onset of complications during pregnancy or delivery, or the specific cause of death (e.g. postabortion; sepsis; prepartum, intrapartum or postpartum hemorrhage; or other direct causes, such as COVID 19). Moreover, it was not possible to obtain information about whether hospitals had complied with guidelines on essential obstetric and neonatal care.

Also, this study considered only in-hospital deliveries and did not include data from deliveries outside the hospital setting; the causes of maternal mortality outside the hospital setting could be different from those found in this study. The lack of information about these key characteristics may affect the results; thus, more research is needed, especially to take into consideration both key clinical aspects and sociodemographic factors that may influence maternal mortality.

## Conclusions

Maternal deaths in Ecuador increased during the COVID-19 pandemic, and this could be due to multiple factors, from the SARS-CoV-2 infection itself to the detrimental effects of the pandemic on health care services. Social inequalities seem to play a role in Ecuador’s MMR, as individuals who are members of ethnic minority groups were among those who were most affected. Notably, this research uncovered a surprising finding of higher in-hospital delivery-related maternal deaths occurring in private health care facilities in Ecuador. This observation aligns with broader concerns about the quality of care and practices within the private health care sector, which may vary widely in low- and middle-income countries. The potential contribution of the private health care sector to tackling maternal mortality should not be ignored, especially in countries such as Ecuador, in which more maternal deaths are observed in private facilities. This study highlights the need for enhanced regulation and quality assurance within the private health care sector, particularly in the context of maternal and newborn care. Overall, the findings underscore the complexity of trends in maternal mortality and emphasize the importance of addressing not only the medical aspects of care but also the social determinants of health and disparities in the health care system.

**Author’s contribution.** GJLT conceived the original study, collected the data, analyzed the data, interpreted the results, wrote and revised the manuscript, and approved the final version.

**Conflicts of interest.** None declared.

**Funding.** No funding was received for this study.

**Disclaimer.** Authors hold sole responsibility for the views expressed in the manuscript, which may not necessarily reflect the opinion or policy of the *Revista Panamericana de Salud Pública/Pan American Journal of Public Health* or the Pan American Health Organization.

## REFERENCES

1. World Health Organization. Maternal mortality [Internet]. Geneva: World Health Organization; 2023 [cited 2023 Nov 26]. Available from: <https://www.who.int/news-room/fact-sheets/detail/maternal-mortality#:~:text=The%20high%20number%20of%20maternal,births%20in%20high%20income%20countries>
2. World Health Organization. Trends in maternal mortality 2000 to 2020: estimates by WHO, UNICEF, UNFPA, World Bank Group and UNDESA/Population Division. Geneva: World Health Organization; 2023. <https://www.who.int/publications/i/item/9789240068759>
3. Chmielewska B, Barratt I, Townsend R, Kalafat E, van der Meulen J, Gurol-Urganci I, et al. Effects of the COVID-19 pandemic on maternal and perinatal outcomes: a systematic review and meta-analysis. *Lancet Glob Health*. 2021;9(6):e759–72.
4. Maza-Arnedo F, Paternina-Cacedo A, Sosa CG, de Mucio B, Rojas-Suarez J, Say L, et al. Maternal mortality linked to COVID-19 in Latin America: Results from a multi-country collaborative database of 447 deaths. *Lancet Reg Health Am*. 2022;12:100269.
5. Agrawal P, Campbell OMR, Prata N. The role of private providers in maternal health. *Lancet Glob Health*. 2014;2(3):e133–4.
6. Harrington KA, Cameron NA, Culler K, Grobman WA, Khan SS. Rural–urban disparities in adverse maternal outcomes in the United States, 2016–2019. *Am J Public Health*. 2023;113(2):224–7.
7. Singh GK, Lee H. Trends and racial/ethnic, socioeconomic, and geographic disparities in maternal mortality from indirect obstetric causes in the United States, 1999–2017. *Int J MCH AIDS*. 2020;10(1):43–54.
8. Tran P, Jreij B, Sistani F, Shaya FT. Disparities in maternal mortality. *J Clin Transl Sci*. 2023;7(1):e192.
9. World Health Organization. The Global Health Observatory: Maternal mortality ratio (per 100 000 live births) [Internet]. Geneva: World Health Organization; 2023 [cited 2023 Oct 2]. Available from: [https://www.who.int/data/gho/indicator-metadata-registry/imr-details/26#:~:text=Maternal%20mortality%20ratio%20%3D%20\(Number%20of,household%20surveys%20or%20other%20sources](https://www.who.int/data/gho/indicator-metadata-registry/imr-details/26#:~:text=Maternal%20mortality%20ratio%20%3D%20(Number%20of,household%20surveys%20or%20other%20sources)
10. Khalil A, Samara A, O'Brien P, Coutinho CM, Quintana SM, Ladhani SN. A call to action: the global failure to effectively tackle maternal mortality rates. *Lancet Glob Health*. 2023;11(8):e1165–7.
11. Simpson KR. Effect of the COVID-19 pandemic on maternal health in the United States. *MCN Am J Matern Child Nurs*. 2023;48(2):61.
12. Aranda Z, Binde T, Tashman K, Tadikonda A, Mawindo B, Maweu D, et al. Disruptions in maternal health service use during the COVID-19 pandemic in 2020: experiences from 37 health facilities in low-income and middle-income countries. *BMJ Glob Health*. 2022;7(1):e007247.
13. Ahmed T, Robertson T, Vergeer P, Hansen PM, Peters MA, Ofosu AA, et al. Healthcare utilization and maternal and child mortality during the COVID-19 pandemic in 18 low- and middle-income countries: An interrupted time-series analysis with mathematical modeling of administrative data. *PLoS Med*. 2022 30;19(8):e1004070.
14. Guimarães RM, Reis LGC, de Souza Mendes Gomes MA, Magluta C, de Freitas CM, Portela MC. Tracking excess of maternal deaths associated with COVID-19 in Brazil: a nationwide analysis. *BMC Pregnancy Childbirth*. 2023 12;23(1):22.
15. Rossen LM, Ahrens KA, Womack LS, Uddin SFG, Branum AM. Rural–urban differences in maternal mortality trends in the United States, 1999–2017: Accounting for the impact of the pregnancy status checkbox. *Am J Epidemiol*. 2022;191(6):1030–9.
16. Howell EA. Reducing disparities in severe maternal morbidity and mortality. *Clin Obstet Gynecol*. 2018;61(2):387–99.
17. Emond A, Pollock J, da Costa N, Maranhão T, Macedo A. The effectiveness of community-based interventions to improve maternal and infant health in the Northeast of Brazil. *Rev Panam Salud Publica*. 2002;12(2):101–10.
18. Baca Guerrero ML. Análisis de la caracterización de las causas de la mortalidad materna en Ecuador, periodo 2015-2017 [Analysis of the characterization of maternal mortality causes in Ecuador during 2015-2017; thesis] [Internet]. Quito: Pontificia Universidad Católica del Ecuador; 2020 [cited 2023 Oct 6]. Available from: <http://repositorio.puce.edu.ec/handle/22000/17968>
19. Tripathi S, Srivastava A, Memon P, Nair TS, Bhamare P, Singh D, et al. Quality of maternity care provided by private sector healthcare facilities in three states of India: a situational analysis. *BMC Health Serv Res*. 2019;19(1):971.
20. World Health Organization. Maternal, newborn, child and adolescent health and ageing: private sector engagement for quality of care [Internet]. Geneva: World Health Organization; 2023 [cited 2023 Oct 6]. Available from: <https://www.who.int/teams/maternal-newborn-child-adolescent-health-and-ageing/quality-of-care/private-sector-engagement-for-quality-of-care>

---

Manuscript submitted 15 October 2023. Revised version accepted for publication on 28 November 2023.

## Estudio a nivel nacional de la mortalidad materna intrahospitalaria en Ecuador, 2015-2022

### RESUMEN

**Objetivo.** El objetivo de este estudio fue analizar las cifras estimadas de mortalidad materna intrahospitalaria asociada al parto y los factores sociodemográficos que influyen en ella en Ecuador en el período 2015-2022.

**Métodos.** Se analizaron datos de los registros de acceso público del Instituto Nacional de Estadística y Censos de Ecuador. Se calcularon las razones de mortalidad materna (RMM) y se utilizaron modelos de regresión logística bivariados y multivariados para obtener los cocientes de posibilidades sin ajustar y ajustados.

**Resultados.** Entre el 2015 y el 2022, se observó un aumento de las muertes maternas intrahospitalarias asociadas al parto en Ecuador: la RMM aumentó de 3,70 muertes maternas por 100 000 nacidos vivos en el 2015 a 32,22 en el 2020 y 18,94 en el 2022. En la provincia de Manabí se registró la cifra más alta, con 84,85 muertes maternas por 100 000 nacidos vivos entre el 2015 y el 2022. Las mujeres pertenecientes a minorías étnicas tuvieron una mayor probabilidad de muerte intrahospitalaria por causas relacionadas con el parto, con un cociente de posibilidades ajustado (aOR, por su sigla en inglés) de 9,59 (intervalo de confianza del 95% [IC del 95%]: 6,98 a 13,18). También se observó una mayor mortalidad materna en los establecimientos de salud privados (aOR: 1,99, IC del 95%: 1,4 a 2,84).

**Conclusiones.** Los esfuerzos para reducir la mortalidad materna se han estancado en los últimos años. Durante la pandemia de COVID-19, se observó un aumento de las muertes maternas en el 2020 en entornos hospitalarios en Ecuador. Si bien la pandemia podría haber contribuido a que las cifras estimadas de mortalidad materna se estancaran, los factores socioeconómicos, demográficos y clínicos desempeñan un papel clave en la complejidad de las tendencias de la mortalidad materna. Los resultados de este estudio destacan la importancia de abordar no solo los aspectos médicos de la atención, sino también los determinantes sociales de la salud y las disparidades en el sistema de atención de salud.

### Palabras clave

Mortalidad materna; muerte materna; mortalidad hospitalaria; disparidades socioeconómicas en salud; COVID-19; Ecuador.

## Estudo nacional sobre mortalidade materna intra-hospitalar no Equador, 2015-2022

### RESUMO

**Objetivo.** O objetivo deste estudo foi analisar estimativas de mortalidade materna relacionada ao parto intra-hospitalar e os fatores sociodemográficos que influenciaram esse tipo de mortalidade no período de 2015 a 2022 no Equador.

**Métodos.** Foram analisados dados de registros de acesso público do Instituto Nacional de Estatísticas e Censos do Equador. Foram calculadas razões de mortalidade materna (RMM), com o uso de regressão logística bivariada e multivariada para obter razões de chance não ajustadas e ajustadas.

**Resultados.** Houve um aumento nas mortes maternas relacionadas ao parto intra-hospitalar no Equador entre 2015 e 2022: as RMM aumentaram de 3,70 mortes maternas/100 mil nascidos vivos em 2015 para 32,22 em 2020 e 18,94 em 2022. A província de Manabí teve a taxa mais alta, com 84,85 mortes maternas/100 mil nascidos vivos entre 2015 e 2022. Mulheres de minorias étnicas tiveram maior probabilidade de mortalidade relacionada ao parto intra-hospitalar, com uma razão de chances ajustada (RCa) de 9,59 (intervalo de confiança de 95% [IC95%]: 6,98 a 13,18). Também foram observadas mais mortes maternas em estabelecimentos de saúde privados (RCa: 1,99, IC95%: 1,4 a 2,84).

**Conclusões.** As iniciativas para reduzir a mortalidade materna estagnaram nos últimos anos. Durante a pandemia de COVID-19 em 2020, foi observado um aumento nas mortes maternas em hospitais do Equador. Embora a pandemia possa ter contribuído para a estagnação das estimativas de mortalidade materna, fatores socioeconômicos, demográficos e clínicos desempenharam papéis fundamentais na complexidade das tendências de mortalidade materna. Os resultados deste estudo destacam a importância de abordar não apenas os aspectos clínicos da atenção, mas também os determinantes sociais da saúde e as disparidades do sistema de saúde.

### Palavras-chave

Mortalidade materna; morte materna; mortalidade hospitalar; disparidades socioeconômicas em saúde; COVID-19; Equador.