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MATERNAL DEATHS ASSOCIATED WITH ANESTHESIA-RELATED COMPLICATIONS IN BRAZIL: A DESCRIPTIVE ANALYSIS OF DATASUS/SIM DATA 2004–2023

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ABSTRACT

Introduction: Maternal mortality, monitored in Brazil through the Mortality Information System (SIM/DATASUS), encompasses direct deaths from anesthetic complications (ICD-10 O29 and O74) analyzed as surveillance of coded causes, underscoring the need to investigate national records given the relevance highlighted in international literature.
Objective: To describe the temporal distribution of maternal deaths associated with anesthesia complications in Brazil from 2004 to 2023 using official data from the Mortality Information System (SIM) made available by DATASUS.
Methods: A retrospective, ecological, descriptive epidemiological study was conducted using aggregated TABNET/DATASUS data. Maternal deaths were selected by year of death and ICD-10 categories O29, concerning complications of anesthesia administered during pregnancy, and O74, concerning complications of anesthesia during labor and delivery. Absolute frequencies, proportions among maternal deaths, category distribution, and descriptive temporal trends were calculated.
Results: From 2004 to 2023, 223 maternal deaths associated with O29 and O74 were recorded, corresponding to 0.648% of 34,414 maternal deaths recorded in the same period. O74 accounted for 189 deaths (84.8%) and O29 for 34 (15.2%). Annual counts ranged from 4 deaths in 2022 to 18 in 2006 and 2008. The annual mean decreased from 16.0 deaths in 2004–2008 to 8.2 in 2019–2023, a descriptive reduction of 48.8%. An exploratory log-linear regression of annual counts indicated an average annual percentage change of approximately −5.1%; this should not be interpreted as a definitive causal or inferential analysis.
Conclusion: SIM records indicate a low absolute frequency but persistent occurrence of maternal deaths associated with anesthesia complications in Brazil, with a predominance of the category related to labor and delivery. Interpretation must account for underreporting, changes in completeness and death-certificate quality, absence of information on anesthetic technique, and inability to estimate procedure-specific risk. Strengthening surveillance, safe obstetric anesthesia, and maternal-death review remains necessary.

Keywords: Maternal mortality, Obstetric anesthesia, Mortality information system, DATASUS, ICD-10, Brazil, Patient safety.

INTRODUCTION

Maternal mortality is a summary indicator of health conditions, the organization of healthcare services, and social inequalities affecting care during pregnancy, childbirth, and the puerperium. Although a large proportion of maternal deaths are preventable through timely diagnosis, qualified care, and access to

emergency services, identification of the specific cause remains dependent on the quality of death certificates, epidemiological investigations, and integration between information systems. In Brazil, the Mortality Information System (SIM), managed by the Ministry of Health, is the main national source for mortality surveillance, and aggregated data are made available through DATASUS/TABNET.[1,2]

Anesthesia-related complications account for a specific proportion of direct maternal deaths. In ICD-10, category O29 includes complications of anesthesia administered during pregnancy, whereas category O74 includes complications of anesthesia during labor and delivery. These categories do not necessarily encompass all events in which anesthesia may have contributed indirectly, nor do they identify the anesthetic technique used, the procedure performed, the type of healthcare facility, or the presence of failures in care. Therefore, their analysis in mortality databases should be understood as surveillance of coded causes rather than an individual clinical audit of cases.

The international literature demonstrates that anesthesia remains relevant to obstetric safety, particularly in settings with limitations in infrastructure, availability of healthcare professionals, and access to perioperative care. In a systematic review and meta-analysis of low- and middle-income countries, Sobhy et al. estimated that anesthesia was associated with 2.8% of all maternal deaths, 3.5% of direct maternal deaths, and 13.8% of deaths following cesarean delivery; general anesthesia was also associated with higher odds of maternal death than neuraxial anesthesia.[3] These findings cannot be directly extrapolated to Brazil but provide context for the importance of examining national records.

In Brazil, methodological studies emphasize that the measurement of maternal mortality depends on the quality and completeness of SIM data, the investigation of deaths among women of reproductive age, and the possibility of supplementing SIM information with hospital data. Ranzani et al. discussed the usefulness of the Hospital Information System in improving the identification and characterization of maternal deaths, while Domingues et al. presented a surveillance dashboard designed to integrate information on maternal health and its determinants.[4,5] In this context, a nationwide analysis specifically focusing on codes O29 and O74 may help assess the persistence of the problem and guide hypotheses for more detailed surveillance studies.

The objective of this study was to describe the occurrence and temporal distribution of maternal deaths associated with anesthesia-related complications in Brazil, according to ICD-10 categories O29 and O74, between 2004 and 2023, using official DATASUS/SIM data.

METHODS

An observational, ecological, retrospective, and descriptive epidemiological study was conducted, with the year of death in Brazil as the unit of analysis. Aggregated data were obtained from the table "Deaths of Women of Reproductive Age and Maternal Deaths — Brazil," available through the DATASUS TABNET system. The source identified in the database is the Ministry of Health, Secretariat of Health and Environmental Surveillance, General Coordination of Epidemiological Information and Analysis, Mortality Information System (Ministério da Saúde, Secretaria de Vigilância em Saúde e Ambiente, Coordenação-Geral de Informações e Análises Epidemiológicas, Sistema de Informações sobre Mortalidade).[1,2]

The main study period was defined as the most recent 20 complete years for which final data were uniformly retrieved for the categories analyzed: 2004 to 2023. Although the TABNET page consulted includes subsequent years, the source itself indicates that final data were available through 2024, whereas data for 2025 and 2026 were preliminary. To avoid combining final and preliminary data series, the period 2004–2023 was selected, representing a complete 20-year

period preceding the most recent year for which final data were available.

The primary outcome was the annual number of maternal deaths recorded under ICD-10 categories O29 and O74. Category O29 was defined as "complications of anesthesia administered during pregnancy," and category O74 as "complications of anesthesia during labor and delivery." A combined query for O29 + O74 was performed for the primary outcome, followed by separate queries to estimate the contribution of each category.

The total number of maternal deaths recorded in TABNET for each year, without restriction by ICD-10 category, was used as the descriptive denominator. This denominator was used exclusively to calculate the proportion of maternal deaths coded as O29/O74. The maternal mortality ratio per live births was not calculated because the specific objective was to describe the proportion of anesthesia-associated deaths among maternal deaths, rather than to estimate overall population-level maternal mortality.

The tabulation was configured with "Year of Death" in the rows, no active column variable, "Maternal Deaths" as the selected content, and annual data files from 2004 to 2023. For the primary outcome, categories O29 and O74 were selected simultaneously. Independent queries were then performed for O29, O74, and all categories to obtain the total number of maternal deaths.

Absolute frequencies, the percentage contribution of each category to the total number of anesthesia-related deaths, the annual proportion of O29/O74 deaths among all maternal deaths, and five-year averages were calculated. The relative change between 2004 and 2023 was calculated as the percentage difference between the two years. As an exploratory trend analysis, a simple log-linear model was fitted to the positive annual counts to estimate the average annual percentage change. This estimate was interpreted exclusively as a description

RESULTS

Between 2004 and 2023, DATASUS recorded 223 maternal deaths under categories O29 and O74. During the same period, 34,414 maternal deaths were recorded across all ICD-10 categories. Thus, deaths coded as anesthesia-related complications accounted for 0.648% of all maternal deaths recorded in SIM.

Category O74 accounted for 189 deaths, representing 84.8% of anesthesia-associated maternal deaths, while O29 accounted for 34 deaths, equivalent to 15.2%. This distribution indicates that, in the classification of the underlying cause of death, events related to labor and delivery were substantially more frequent than events related to anesthesia during pregnancy.

Table 1: Maternal Deaths Associated with ICD-10 Categories O29 and O74, Total Maternal Deaths, and Annual Proportions — Brazil, 2004–2023.

Year	O29	O74	O29 + O74	Total Maternal Deaths	Proportion of O29 + O74 (%)
2004	1	15	16	1,641	0.975
2005	3	12	15	1,620	0.926
2006	4	14	18	1,623	1.109

2007	5	8	13	1,590	0.818
2008	4	14	18	1,681	1.071
2009	1	15	16	1,872	0.855
2010	0	11	11	1,719	0.640
2011	1	14	15	1,610	0.932
2012	0	6	6	1,583	0.379
2013	1	6	7	1,686	0.415
2014	2	11	13	1,739	0.748
2015	0	10	10	1,738	0.575
2016	1	8	9	1,670	0.539
2017	1	6	7	1,718	0.407
2018	1	7	8	1,658	0.483
2019	3	6	9	1,576	0.571
2020	2	12	14	1,965	0.712
2021	1	4	5	3,030	0.165
2022	0	4	4	1,370	0.292
2023	3	6	9	1,325	0.679
Total	**34**	**189**	**223**	**34,414**	**0.648**

Note: The values correspond to official DATASUS/TABNET tabulations; the proportion is calculated as (O29 + O74) / total maternal deaths × 100.

The annual number of deaths associated with anesthesia-related complications ranged from 4 to 18. The highest counts occurred in 2006 and 2008, with 18 deaths in each year. The lowest frequency was observed in 2022, with 4 deaths. Between 2004 and 2023, the annual number decreased from 16 to 9,

corresponding to a relative reduction of 43.8% between the first and last years of the series.

The annual mean during the first five-year period, from 2004 to 2008, was 16.0 deaths, whereas the mean during the last five-year period, from 2019 to 2023, was 8.2 deaths, representing a descriptive reduction of 48.8%. The exploratory log-linear model indicated an approximate average annual percentage change of −5.1%. However, the series exhibited substantial fluctuations, and the number of events was small. Therefore, this value should not be interpreted as a causal trend or as a definitive estimate of population-level change.

In 2020, 14 anesthesia-related deaths were recorded, followed by 5 in 2021, 4 in 2022, and 9 in 2023. The variation observed during and after the COVID-19 pandemic does not allow these findings to be attributed to changes in anesthesia safety, as the total number of maternal deaths also fluctuated considerably, with 1,965 deaths recorded in 2020 and 3,030 in 2021. Changes in healthcare delivery, access to services, death investigations, coding practices, and completeness of records may have contributed simultaneously to these fluctuations.

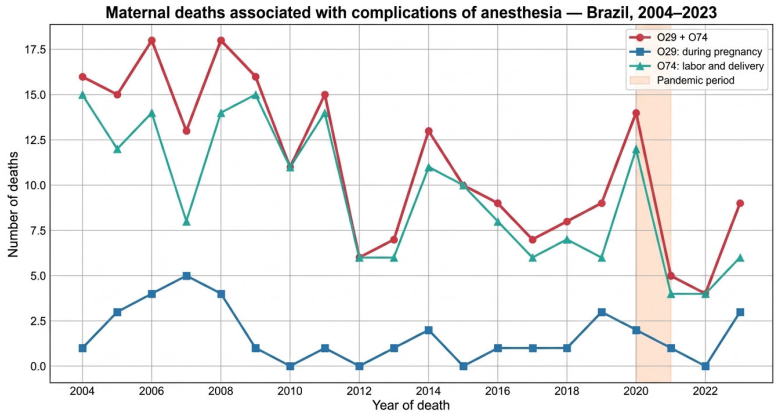

Figure 1: Annual distribution of maternal deaths coded under ICD-10 categories O29 and O74. Source: Authors' own elaboration based on official DATASUS/SIM tabulations. The shaded area represents 2020–2021 and is included for descriptive purposes only.

DISCUSSION

The nationwide analysis identified 223 maternal deaths associated with ICD-10 categories O29 and O74 over a 20-year period, with a marked predominance of category O74. This predominance is plausible from a healthcare perspective, since labor, operative delivery, and cesarean delivery involve greater exposure to anesthetic procedures than pregnancy without obstetric intervention. However, this finding should not be interpreted as evidence that anesthesia during childbirth is inherently more hazardous; TABNET does not provide information on the number of procedures performed, type of anesthesia, women's risk profiles, surgical indications, or quality of perioperative care.

The proportion of 0.648% of maternal deaths was lower than the pooled estimate of 2.8% reported by Sobhy et al. in low- and middle-income countries and also lower than the estimate of 3.5% among direct maternal deaths.[3] This difference may reflect actual characteristics of the Brazilian healthcare system, but it may also result from differences in definitions, study periods, quality of investigations, methods of cause attribution, and completeness of death certificates. The international meta-analysis included studies involving clinical audits and different surveillance systems, whereas the present

analysis relies exclusively on underlying cause-of-death categories recorded in SIM.

Obstetric anesthesia is influenced by the organization of the entire healthcare system, rather than solely by the choice between neuraxial and general anesthesia. The review by Lim et al. emphasizes that reducing anesthesia-related mortality depends on airway safety, aspiration prevention, monitoring, equipment availability, post-anesthesia recovery, and integration between anesthesiology, obstetrics, and intensive care.[6] Sobhy et al. observed higher odds of maternal death associated with general anesthesia compared with neuraxial anesthesia in low- and middle-income settings. However, this association may be partially influenced by confounding by indication, as women with more severe clinical conditions or undergoing emergency cesarean deliveries may be more likely to receive general anesthesia.[3]

The descriptive downward trend in recorded deaths between the first and last five-year periods should be interpreted with caution. The decrease from 16.0 to 8.2 deaths per year may suggest improvements in safety, more widespread use of neuraxial techniques, enhanced obstetric care, or greater capacity to prevent anesthetic complications. However, it may also result from underreporting, changes in underlying cause-of-death coding, differences in death investigations, and variations in the completeness of death certificates. National studies have recognized the quality of SIM data as a central component of maternal mortality surveillance, and integration with the Hospital Information System may improve the identification and characterization of cases.[4,5]

The data for 2020 and 2021 deserve particular attention but do not allow an isolated causal interpretation. The increase in total maternal deaths in 2021, accompanied by a decrease in O29/O74 records, demonstrates that the absolute number of deaths attributed to anesthesia does not necessarily follow the pattern of overall maternal mortality. During the pandemic, changes in access to healthcare, patient transfers, bed availability, service reorganization, and death investigations may have altered recording patterns. Therefore, future analyses should incorporate multiple causes of death, comorbidities, place of occurrence, region, race/skin color, age, type of delivery, number of live births, and hospital records.

Interpreting a rare event also requires avoiding conclusions based solely on absolute frequencies. The actual risk associated with anesthesia depends on the denominator of women exposed to obstetric procedures, the number of cesarean deliveries, the prevalence of general and neuraxial anesthesia, and clinical severity. During the study period, SIM allowed the occurrence of coded deaths to be estimated, but not the risk per anesthetic procedure, cesarean delivery, or anesthetic technique. The 223 deaths should be understood as an epidemiological signal for surveillance rather than a direct measure of anesthesia-related case fatality.

The analysis has implications for surveillance and healthcare management. The persistence of recorded deaths across all five-year periods, the predominance of O74, and the presence of annual fluctuations indicate that obstetric anesthesia should remain included in maternal death review processes. Audits should assess the indication and timing of the procedure, anesthetic technique, airway management, aspiration prevention, monitoring, blood availability, and post-anesthesia care. Integration of SIM, SIH, SINASC, medical records, and mortality review committees may help distinguish deaths directly caused by anesthesia, deaths in which anesthesia was a contributing factor, and deaths in which the category was used because of insufficient information.

This study has limitations inherent to the use of aggregated secondary data. First, it was not possible to access individual characteristics of the women, anesthetic techniques, obstetric procedures, clinical severity, comorbidities, or detailed information on the place of care. Second, selection based on underlying cause-of-death codes O29/O74 may underestimate the contribution

of anesthesia when the complication was recorded as a contributing cause or was not mentioned on the death certificate. Third, changes in coverage, investigation, completeness, and coding over the 20-year period may have generated temporal artifacts. Fourth, the analysis lacks a denominator reflecting exposure to anesthesia and therefore does not estimate risk or case fatality rates. Fifth, the small annual counts make percentage changes unstable and limit inferential analyses. Sixth, the nationwide analysis does not allow regional, racial, or socioeconomic inequalities to be identified.

CONCLUSION

Between 2004 and 2023, 223 maternal deaths associated with anesthesia-related complications under ICD-10 categories O29 and O74 were recorded in Brazil, accounting for 0.648% of all maternal deaths registered in SIM. Category O74, related to labor and delivery, accounted for 84.8% of the records. A descriptive reduction in the annual mean was observed, from 16.0 deaths during the 2004–2008 five-year period to 8.2 during the 2019–2023 five-year period, although the series exhibited fluctuations and does not allow causal conclusions to be drawn.

The findings indicate that anesthesia-associated maternal deaths are rare in absolute terms but persist as a sentinel event for obstetric safety. The use of DATASUS/SIM data alone is appropriate for initial assessment and temporal monitoring but is insufficient to estimate anesthetic risk, evaluate anesthetic techniques, or determine preventability. Strengthening the quality of death certificates, maternal death investigations, and integration between SIM, SIH, and SINASC, as well as conducting multicenter studies involving clinical audits of O29/O74 cases, is recommended.

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