Original Article

Temporal Trends of Stillbirth in Brazil Disaggregated by Maternal and Gestational Age

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Abstract

Objective: Stillbirth is a neglected problem that needs to be given a greater visibility, especially in developing countries. This study aimed to describe temporal trends of stillbirth rates disaggregated by maternal and gestational age.

Materials and methods: This is an ecological study conducted in Brazil. Stillbirth rates and temporal trends were calculated using data from 2011-2021, considering variables such as gestational age (≥ 22 weeks) and maternal age (10-19, 20-34, and ≥ 35 years old). Stillbirth rates were presented per 1,000 births, and trends were assessed via autoregressive models.

Results: There were 228,386 stillbirths in Brazil, corresponding to 1 event per 133 live births at ≥ 22 gestational weeks in singleton pregnancies. At ≥28 weeks, the average stillbirth rates were 139.46 per 1,000 births (28-31 weeks), 36.59 per 1,000 births (28-36 weeks), 6.07 per 1,000 births (28-41 weeks), and 5.94 per 1,000 births (28-42 weeks and more). Data disaggregation by maternal age showed that average stillbirth rates were 7.69 per 1,000 births (mothers aged 10-19 years), 6.90 per 1,000 births (mothers aged 20-34 years), and 10.34 per 1,000 births (mothers aged ≥ 35 years). The temporal trends showed statistically significant increase in stillbirth rates in almost all gestational age strata among adolescent mothers, but not among older women.

Conclusion: Older women experienced the highest stillbirth rates in Brazil but with a clear declining trend. The upward stillbirth trends revealed among adolescent mothers suggest that the fetal death prevention must be prioritized in the Brazilian adolescent health policy agenda.

Keywords: Stillbirth; Fetal Mortality; Gestational Age; Maternal Age; Time Series Studies

Introduction

The death of a baby before birth causes a strong and negative emotional burden on families and health professionals, with economic and psychosocial losses falling mainly on the poorest families (1). Even so, the death of a baby that could and should have been prevented receives little attention and continues to be

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ignored by policy makers (2). As a result, the problem receives disproportionately little research funding compared to neonatal losses (3).

Every year, about two million babies are stillborn worldwide, with an estimated 5,400 events occurring daily (4). The World Health Organization (WHO) intends to reduce the number of deaths by 2030. It is expected that the number of deaths per 1,000 births will be less than 12 taking into account pregnancies of ≥ 28 weeks (4).

Regarding pregnancies ≥ 28 weeks, an analysis of high- and middle-income countries showed that most countries have stillbirth rates lower than 3.2 per 1,000 births (5). These values are close to the threshold of 2.0 deaths per 1,000 births, which is considered a reasonable benchmark for developed countries to reach (5). These authors also analyzed the fetal deaths in Brazil and classified the country as an exception because the fetal mortality rate was higher than 7.0 per 1,000 births (gestational age ≥ 28 weeks) and 9.4 per 1,000 births (gestational age ≥ 22 weeks) (5). Although these coefficients are within the WHO thresholds, it is important to consider that these values can be further reduced.

Disaggregating stillbirth data into different categories is an alternative that could promote a better understanding and help face the problem more assertively (6). Our expectation is that the disaggregation of fetal death data into different strata of gestational age, maternal age and birth weight can outline patterns, and indicate pathways to cope with this disastrous event that affects a non-negligible number of pregnant women in Brazil and other developing countries. This study aimed to calculate rates and analyze trends in stillbirth by gestational age, maternal age and birth weight, in Brazil, from 2011 to 2021.

Materials and methods

Study scenario: This is an ecological study that analyzed stillbirth rates in Brazil. Brazil is an upper-middle- income country located in South America, with an estimated population of 203 million inhabitants, and an annual frequency of births higher than 2.5 million of babies. The study followed the definition of the International Statistical Classification of Diseases and Related Health Problems - 10th Revision (ICD-10) (7), which defines fetal death considering parameters of birth weight (≥500 grams) and/or gestational age (≥22 weeks). The research question was "What is the pattern of stillbirth rates revealed by the disaggregation of fetal weight, maternal age and duration of pregnancy variables, in Brazil?"

Data source: The data were obtained from the website of the Department of Informatics of the Brazilian Unified Health System (DATASUS), in the following steps: <Health Information> < Vital Statistics> <1996 Mortality> <Fetal Deaths> (to obtain the number of fetal deaths) or <Live Births > (to obtain the number of live births) (8). The selection included only singleton pregnancies that occurred from 2011 to 2021.

Data collection and variables of interest: Data collection took place in June 2023 and was based on the selection of the following variables: year of death (from 2011 to 2021), duration of pregnancy in weeks (22-27, 28-31, 32-36, 37-41, 42 weeks and more), mother's age in years (Mothers aged 10-19 years; Mothers aged 20-34 years, and Mothers aged 35-49 years) and birth weight in grams (500-999, 1,000-1,499, 1,500-2,499, 2,500-2,999, 3,000-3,999 and 4,000 grams and more). To describe the general characteristics, the following variables were collected: biological sex, Brazilian macro-region, place of delivery, mode of delivery, mothers' education, death in relation to partum and death investigation.

Calculation of indicators: Stillbirth rates were calculated and presented per 1,000 births (live and dead babies combined). The fetal mortality specific rates were estimated to obtain four different indicators (6) as shown below, where *n* = number, *ma* = maternal age, *ga* = gestational age, and *bw* = birth weight.

a) Equation to obtain specific fetal mortality rate by gestational age (FM by GA)

FM by GA = (n of stillbirths in specific ga)/(n of stillbirths in specific ga+n of living births in the same ga)*1,000

b) Equation to obtain specific fetal mortality rate by birth weight (FM by BW)

FM by BW = (n of stillbirths in specific bw)/ (n of stillbirths in specific bw + n of living births in the same bw)*1,000

c) Equation to obtain specific fetal mortality rate by maternal age (FM by MA)

FM by MA = (n of stillbirths in specific ma)/ (n of stillbirths in specific ma+n of living births in the same ma)*1,000

d) Equation to obtain specific fetal mortality rate by gestational age and maternal age strata (FM by GA/MA)

FM by GA/MA = (n of stillbirths in specific ga/ma)/ (n of stillbirths in specific ma and ga+ n of living births in the same ga and ma)*1,000

Data analysis: Descriptive statistics were used to describe the stillbirth data, which were summarized using absolute and relative numbers. To present the temporal trend analysis, the data were first *log*-transformed (logarithm with a base of 10). Then, autoregressive modeling was performed according to the Prais-Winsten Method (9). Annual Percentage Changes (APC) and 95% Confidence Intervals (95% CI) were calculated according to Antunes & Cardoso (10). The interpretation of trends was established as stationary, decreasing or increasing.

Ethical aspects: This study follows the Helsinki Declaration of 1975 and was developed in accordance to the Brazilian ethical recommendations for research involving human beings. It was conducted using secondary, de-identified, aggregated data, made freely available *online* by DATASUS, and the study was exempted from formal ethical assessment according to Brazilian research regulations (11).

Results

From 2011 to 2021, there were 228,386 fetal deaths in Brazil. These numbers represented 0.75% of the total live births, which suggests the occurrence of 1 fetal death for every 133 live births from singleton pregnancies. The highest proportion of fetal death (78.67%) was among babies at ≥ 28 gestational weeks, whose likelihood of surviving to extrauterine life is high considering the gestational age. At the macro-region level, the distribution of fetal death cases was more concentrated in the Southeast region (35.17%), followed by the Northeast region (33.95%), the North region (12.17%), the South region (10.86%), and the Midwest region (7.84%) (Table 1).

Table 1: Characterization of stillbirths and living births from singleton pregnancies at 22 weeks and more, Brazil, 2011-2021

Variables		Stillbirth (n: 228,386)		Live birth (n: 30,178,612)	
		n	(%)	n	(%)
Biological sex	Female	103,954	45.52	14,711,537	48.75
	Male	120,419	52.73	15,462,316	51.24
	Missing/Unknown	4,013	1.75	4,759	0.02
Brazilian macro-region	North	27,803	12.17	3,217,456	10.66
	Northeast	77,544	33.95	8,367,620	27.30
	Southeast	80,327	35.17	11,963,050	39.64
	South	24,800	10.86	4,121,381	13.66
	Midwest	17,912	7.84	2,509,105	8.31
Place of delivery	Hospital	214,857	94.07	29,717,687	98.47
	Other healthcare facility	2,411	1.06	211,106	0.70
	At home	6,208	2.72	185,763	0.62
	Street/car/taxi	711	0.31	MD[a]	MD
	Indigenous Community	x		16,419	0.05
	Other	1,938	0.85	46,278	0.15
	Missing/Unknown	2,261	0.99	1,359	0.00
Mode of delivery	Vaginal	154,183	67.51	13,353,197	44.25
	Cesarean	72,599	31.79	16,805,228	55.69
	Missing/Unknown	1,604	0.70	20,187	0.07
Mothers' education (n=19,290)	None	6,554	3.26	158,115	0.53
	1 to 3 years	16,575	8.25	809,753	2.72
	4 to 7 years	54,247	27.00	5,344,022	17.94
	8 to 11 years	100,141	49.85	17,785,210	59.70
	12 years and more	23,364	11.63	5,691,960	19.10
Death Investigation	Yes, with death form.	173,086	75.79	NA[b]	NA
	Yes, without death form.	7,746	3.39	NA	NA
	None	47,554	20.82	NA	NA
Antepartum death	Yes	215,596	94.40	NA	NA

[a]MD (Missing data). [b]NA (Not Applicable)

Overall data from Brazil suggest stillbirth rates ranging from 7.3 (2011) to 7.8 (2021) per 1,000 births in the country for pregnancies of ≥ 22 gestational weeks. Fetal deaths disaggregated by gestational age, maternal age and birth weight revealed patterns, especially at 28-36 weeks of gestation, and at extremes of maternal age, and birth weight of 1,500-2,999 grams (Table 2). Starting from 28th week of gestation, the highest average rate occurred at 28-31 weeks (139.46 per 1,000 births). The average rate at 28-36 gestational weeks was 36.59 per 1,000 births, which is 6.02 times higher than the stillbirth mortality rate for gestational age at 28-41 weeks (6.07 per 1,000 births), and 6.14 times higher than that at 28 to 42 weeks and more (5.94 per 1,000 births).

In terms of maternal age data, the average stillbirth rates for mothers aged 10-19 years (7.69 per 1,000 births) and mothers aged 30-34 years (6.90 per 1,000 births) were found to be close to the average global rate (7.5 per 1,000 births). The average rate (33.37 per 1,000 births) based on birth weight from 1,500 to 2,499 grams was 8.06 times higher than the indicator obtained for the group of deaths ≥2,500 grams (4.14 per 1,000 births) (Table 2).

Temporal trends throughout Brazil revealed a stationary pattern of stillbirth rates at ≥22 gestational weeks (APC: 0.35%; 95% CI: -0.10%; 0.80%) over those years. However, the temporal pattern revealed upward trends in the adolescent population with a statistically significant increase in stillbirth rates considering all gestational age strata, excluding full-term pregnancies (37 to 41 weeks) and post-term pregnancies (42 weeks and above), which showed stationary temporal trends in the adolescent group. The APC in the pre- term strata was greater than 2%. The highest APC (-5.74%) was observed in the 20-34 age group, indicating a statistically significant reduction in fetal deaths in the post-term pregnancies. The most promising temporal pattern was seen in mothers aged 35-49 years (Table 3).

Discussion

Brazil is experiencing average fetal death rates of 7.51 (≥ 22 weeks of gestation) and 5.94 (≥ 28 weeks of gestation) per 1,000 births including only singleton pregnancies, with values below the thresholds established by the 2030 Global Agenda (12 per 1,000).

Table 2: Fetal mortality by 1,000 births, according to gestational age, maternal age, and birth weight, Brazil, 2011-2021

Variables	Stillbirth rates per year										
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Gestational age in weeks											
22-27	287.2	272.4	259.0	270.7	298.6	293.4	295.9	291.0	289.7	280.4	298.1
28-31	138.4	131.9	131.8	141.5	142.1	139.8	136.7	141.2	138.0	144.6	149.3
28-36	38.5	32.6	34.1	35.4	38.2	36.4	37.4	37.2	36.3	38.2	39.1
28-41	5.9	6.1	6.1	6.0	6.2	6.0	6.0	6.0	5.8	6.1	6.2
28-42+	5.8	5.9	5.9	5.8	6.1	5.9	5.9	5.9	5.7	6.0	6.1
32-36	26.1	21.8	23.0	23.4	26.1	24.4	25.6	25.2	24.7	26.2	26.4
37-41	2.5	2.6	2.5	2.5	2.6	2.5	2.4	2.5	2.3	2.4	2.4
≥42	2.4	2.1	1.8	1.8	2.0	2.1	2.0	1.5	1.4	1.5	1.6
All	7.3	7.5	7.3	7.3	7.8	7.6	7.6	7.5	7.3	7.6	7.8
Maternal age in years											
10-19	6.9	7.1	7.2	7.2	7.9	7.9	8.0	7.8	7.8	8.3	8.7
20-34	6.8	6.9	6.8	6.8	7.1	6.8	6.9	6.9	6.6	6.8	7.1
35-49	11.3	11.0	10.8	10.3	11.0	10.8	10.1	9.9	9.5	9.9	9.6
All	7.3	7.4	7.3	7.3	7.7	7.5	7.5	7.5	7.3	7.5	7.8
Birth weight in grams											
500-999	315.9	307.4	295.4	302.9	327.8	320.2	318.4	322.0	316.3	312.1	323.4
1,000-1,499	168.2	174.6	173.2	176.0	171.8	170.3	152.1	166.3	159.1	165.1	170.3
1,500-2,499	32.1	34.1	32.9	33.5	34.8	33.6	33.5	32.7	31.5	34.0	33.9
2,500-2,999	3.9	4.0	4.1	4.0	4.2	4.0	4.2	4.2	4.0	4.3	4.1
3,000-3,999	1.8	1.7	1.7	1.6	1.8	1.7	1.6	1.6	1.5	1.6	1.6
≥4,000	5.2	4.6	5.0	5.1	4.9	4.9	4.6	4.9	4.4	4.4	4.3
All	7.3	7.4	7.3	7.3	7.7	7.5	7.5	7.5	7.3	7.5	7.8

Table 3: Fetal mortality rates and temporal trends according to gestational age disaggregating by maternal age, Brazil, 2011-2021

Gestational age*	Fetal mortality rates			Percent Change		Trends
	Mean	Initial year (2011)	Final year (2021)	APC[a] (%)	CI[b] (95%)	Interpretation
Mothers aged 10-19-years						
22-27	266.10	244.18	308.27	2.26	0.69; 3.85	Increasing
28-31	116.36	109.81	141.32	3.04	1.74; 4.35	Increasing
32-36	20.04	19.50	24.75	2.92	1.96; 3.89	Increasing
28-36	30.91	30.17	37.96	3.05	1.89; 4.22	Increasing
37-41	2.16	2.13	2.06	0.31	-0.04; 0.67	Stationary
42+	1.41	1.48	1.31	-1.91	-5.55; 1.85	Stationary
28-42+	5.63	5.16	6.27	1.67	1.14; 2.20	Increasing
Mothers aged 20-34-years						
22-27	287.28	296.39	291.50	0.09	-0.80; 1.00	Stationary
28-31	143.73	143.58	153.65	0.40	-0.24; 1.05	Stationary
32-36	24.60	26.20	26.14	1.00	0.06; 1.96	Increasing
28-36	36.48	38.73	39.11	0.79	-0.05; 1.64	Stationary
37-41	2.29	2.35	2.22	-0.98	-1.40; -0.57	Decreasing
42+	1.70	2.30	1.39	-5.74	-9.13; -2.22	Decreasing
28-42+	5.50	5.43	5.67	-0.09	-0.59; 0.39	Stationary
Mothers aged 35-49-years						
22-27	308.44	339.12	310.70	0.15	-1.14; 1.46	Stationary
28-31	154.64	166.39	142.67	-1.28	-2.09; -0.47	Decreasing
32-36	31.27	37.42	28.21	-1.69	-2.85; -0.51	Decreasing
28-36	44.18	52.42	39.89	-1.76	-2.88; -0.64	Decreasing
37-41	3.70	4.19	3.18	-2.80	-3.57; -2.03	Decreasing
42+	4.32	6.44	3.35	-3.28	-6.31; -0.17	Decreasing
28-42+	8.55	9.41	7.76	-2.01	-2.63; -1.39	Decreasing

[a]APC (Annual Percent Change). [b]95% CI (95% Confidence Intervals)

Disaggregation of the data by gestational age, maternal age and birth weight reveals a window of opportunity to face this dramatic perinatal outcome. The highest rates occurred in the preterm period affecting babies with high viability for surviving in extrauterine life (28-36 weeks of gestational age and 1,500-2,999 g of birth weight). The temporal analysis focused on the duration of pregnancy revealed a highly vulnerable scenario affecting adolescent mothers. Findings among mothers aged 35-49 years showed that stillbirth rate is high, but it is declining significantly in the country.

In Brazil, health monitoring relies on secondary data collected regularly, allowing transparency and consistency in surveillance actions, as well as national and international comparisons of maternal and child indicators. Current results suggest that, globally, rates in Brazil may be closer to values experienced in developed countries than in poorer countries (12). Stillbirth rates by gestational age in Brazil followed the pattern observed in the United States until 2012 (13). The coefficients were higher in earlier pregnancies, but gradually declined as the duration of gestation progressed to 39-41 gestational weeks. These coefficients increased again in post-term gestations. However, the disaggregation of the data suggested the presence of critical situation with a high loss of highly viable babies, maintaining a previously observed scenario (14). This context aligns with the issues related to the quality of prenatal care and childbirth care (15). In this way, the spotlight shifted to the 32-36 gestational weeks and teenage mothers, which this study proved to be two priority groups requiring more attention from health authorities.

In 2021, around 13% of stillbirths in Europe, North America, Australia and New Zealand occurred during childbirth (12). In contrast, Brazil presents an even lower proportion of deaths at the time of labor or birth (6%), which increases the responsibility for prenatal care. In this aspect, it is crucial to take steps back to better understand the monitoring carried out throughout pregnancy and to investigate occurrences that prevented timely interventions in an effort to avoid the loss of so many fetuses in advanced

pre- term and full- term ages.

The findings of the study on mothers aged 10-19 years bring additional challenges to the well-known problem of teenage pregnancy in Brazil. In addition to experiencing a high rate of fetal mortality, the indicator has been growing rapidly over the years with an APC of 1.67%. In the United States, from 1982 to 2017, the frequency of teenage pregnancies fell by 80%, accompanied by a 25.7% drop in the fetal mortality rate among mothers aged 10-14 years (14.8 to 11.0 per 1,000 births) and a 34.0% drop among mothers aged 15-19 years (10.0 to 6.6 per 1,000 births) (16). No new features were added to the risk model. Childhood pregnancy (10-14-years), dark skin color, chronic hypertension, diabetes, and eclampsia increased the risk of stillbirth. Delivery via cesarean section reduced the risk of stillbirth by 74% (16).

Comparability of fetal death rates between countries is affected by the use of non-standardized definitions, a fact that makes it difficult to estimate the real indicator and obscures the need to implement more effective maternal care (17). In a review of 58 studies originating from 21 countries, the definition of fetal death was most frequently based on the threshold of 20 weeks of gestation, ranging from 12 to 28 weeks, and only nine countries adopted the definition recommended by WHO (from 28 weeks of gestation) (17).

Disaggregation of data was a merit of the present study, but it did not cover pregnancies from 20-21 weeks. Even so, it is possible to estimate gestational age specific-rates using different thresholds that are often adopted internationally, thus facilitating the comparison and verification of the real situation in Brazil in relation to internationally observed parameters.

In Brazil, one out of every 133 singleton pregnancies results in stillbirth. In the United States, the frequency of fetal deaths, measured from 20 weeks onwards, reached a ratio of 1 stillbirth (n=20,854) for every 173 live births (n=3,613,647) in 2020, with an overall rate of 5.74 per 1,000 births. Higher rates were found in extremes of reproductive age and low birth weight babies (18). Data from different regions of the world indicated that Latin America and the Caribbean occupy an intermediate position (1:129) in terms of the ‘stillbirths:live births’ ratio, compared to developed countries (1:348 in Europe, North America, Australia and New Zealand) and less developed regions (1:48 in sub-Saharan Africa) (12).

Limitations: The present study has several limitations. First, the study included only singleton pregnancy of ≥ 22 weeks, and mothers aged 10-49 years. These decisions left out a fraction of fetal deaths and may have influenced the rate magnitude in an unknown direction. Another issue is that the practice of declaring the death of a newly born baby based on the absence of breathing, crying and muscle movements may result in misclassification of a possible neonatal death (19). This issue is more plausible when the birth occurs at home, without the assistance of a healthcare professional, and without checking the heart rate (19). Regarding the quality of the data, a positive perspective is provided by a Brazilian analysis of 425 perinatal deaths, of which 245 occurred before birth (20). The study indicated that only one of all reviewed cases was reclassified as a neonatal event (20). The authors also noted that the overall quality of stillbirth data regarding maternal age, gestational age and birth weight was good (20). Additionally, the publication entitled ‘Saúde Brasil-2018’, based on data from 2013-2016, found very few inconsistencies in the recording of stillborn babies with regard to gestational age and birth weight (21).

Conclusion

Although the stillbirth rate is within the thresholds established by the World Health Organization, data disaggregation revealed details that could support measures to prevent deaths of babies at late pre- term and full- term ages. Despite the more promising pattern observed among older mothers, the trend analysis showed that the adolescent population presented the poorest results and deserves more attention from the health authorities. Considering that deaths occurred predominantly before birth, it is crucial to take steps back to better understand prenatal care and identify gaps that may prevented timely interventions to avoid losing an excessive number of babies.

Conflict of Interests

Authors declare no conflict of interests.

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