

# Assessment of healthcare accessibility and travel distance on intrapartum fetal death: a retrospective cohort study

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## ABSTRACT

**Objective.** To determine if there was an association between intrapartum stillbirths and both traveled distance for delivery and delivery care accessibility, assessing periods before and during the COVID-19 pandemic.

**Methods.** This is a population-based cohort study. Patients had birth occurring after the onset of labor; the primary outcome was intrapartum stillbirth. City of residence was classified according to the ratio between deliveries performed and total births among its residents; values lower than 0.1 indicated low delivery care accessibility. Travel distance was calculated using the Haversine formula. Education level, maternal age, and birth sex were included. In each period, relative risk was assessed by generalized linear model with Poisson variance.

**Results.** There were 2 267 534 deliveries with birth occurring after the onset of labor. Most patients were between age 20 and 35 years, had between 8 and 11 years of education, and resided in cities with high delivery care accessibility. Low delivery care accessibility increased risk of intrapartum stillbirth in the pre-pandemic (relative risk [RR] 2.02; 95% CI [1.64, 2.47];  $p < 0.01$ ) and the pandemic period (RR 1.69; 95% CI [1.09, 2.55];  $p = 0.015$ ). This was independent of other risk-increasing factors, such as travel distance and fewer years of education.

**Conclusions.** Low delivery care accessibility is associated with the risk of intrapartum stillbirths, and accessibility reduced during the pandemic. Delivery of patients by family physicians and midwives, as well as official communication channels between primary care physicians and specialists, could improve patient health-care-seeking behavior.

## Keywords

Travel; health services accessibility; time-to-treatment; fetal mortality; Brazil.

During pregnancy, the intrapartum period brings increased risk for both mother and fetus. The most severe complication is intrapartum perinatal death, which is the sum of neonatal deaths and stillbirths attributable to asphyxia (1). Both share similar precursors (2), albeit not identical, as accessibility and

adequacy of delivery room resuscitation techniques impact neonatal deaths (1, 3).

Globally, more than 1 million stillbirths occur in the intrapartum period each year (2, 3). Precise rates vary substantially, as the definition of intrapartum death changes in low- and

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high-resource settings (3). Nevertheless, it has been demonstrated that stillbirth rates are higher in resource-poor countries (1, 4), and the percentage of those stillbirths attributable to asphyxia is higher in most socially vulnerable localities (4, 5).

Brazil has a stillbirth rate of 10.97 per 1 000 births, which sets it at an intermediate level when considering the rate of 34 per 1 000 births in Pakistan, while developed countries reach rates as low as 2 per 1 000 births (1, 4, 6). Depending on methodology and location, between 7.5% and 22% of such stillbirths would be attributable to intrapartum asphyxia (5, 7). In Brazil, stillbirth rates dropped between 1996 and 2010 (4) but have since become relatively stable (5). Both the rate of this reduction and the percentage of asphyxia-attributable intrapartum deaths are not homogeneous. Poorer regions display higher rates and slower rate reductions compared to richer regions (5).

Even within the State of São Paulo, asphyxia-related perinatal deaths are not homogeneously distributed: those residing in the rural areas more often had birthweights of 2 500 grams or greater, as well as gestational age of 37 weeks or over, when compared to deaths of residents of the metropolitan area (7).

While significant focus has been dedicated to the role of medical care, it has been demonstrated that sociodemographic and economic factors substantially impact the patient's health-care-seeking behavior and ability to reach proper care (1, 4, 5). Thaddeus and Maine (8) proposed the Three Delays Model, which encompasses delays in the decision to seek care in its Phase I, delays in reaching the appropriate health facility in its Phase II, and delays in receiving adequate medical care in its Phase III (8). Importantly, patients expecting delays in Phases II and III could have their behavior modified and delay even further in seeking medical attention in Phase I. Further research has brought attention to new variables, either by incorporating them into the existing framework or by changes in the perceived interconnection between these variables (9–11).

The range of variables acting upon each phase is significant, ranging from awareness regarding symptoms, women's autonomy, cost of care, perceived quality of healthcare services, distance traveled for care, and availability of transportation, among others (8, 11, 12). How these variables interact with one another depends on several factors, such as the country studied, education level, and socioeconomic status. Research in Brazil found adverse obstetric outcomes were associated with Phase I and Phase II delays; however, these variables were not separately studied to understand if they act independently of each other (13).

The complex social system that dictates patient behavior and impacts timely access to health care was further impacted by COVID-19, which was declared a pandemic in March 2020 (14). The first case in Brazil was described in February 2020, followed by rapid spread (15, 16). Brazil has significant focus on hospital-based obstetric care, high cesarean rates, and inequality of access associated with ethnicity and education level (17). The impact of the pandemic on obstetric care is not fully understood and could deepen inequalities in access to obstetric health care (18).

This study aims to identify if there is a higher risk of intrapartum death among patients who began labor with a live fetus in the State of São Paulo from 2015 to 2021, independently assessing the distance traveled for delivery and the accessibility of delivery care provided by the city of the residence itself.

Analysis was performed separately for pre-pandemic and pandemic groups.

## MATERIALS AND METHODS

### Study design and data sources

This study is a retrospective population-based cohort study. It is based on the Ministry of Health of Brazil databanks of all live births (SINASC) and all deaths (SIM), both publicly accessible. The cohort included all patients with a city of residence and delivery in the State of São Paulo who went into labor with a live fetus, and the primary outcome assessed was intrapartum fetal death. We downloaded publicly available files from SINASC and SIM containing live birth and fetal death records in the State of São Paulo from 2015 to 2021. All variables come from the SINASC and SIM databases. These databases provide individual-level, anonymized data for each delivery for all variables used in this research.<sup>1</sup>

### Setting

São Paulo, one of the 27 states of Brazil, is divided into 645 municipalities with a total area of 248 219.481 km<sup>2</sup> and a population of 44 420 459 people. Its Human Development Index value is 0.806 (19).

### Participants

We included data of patients if their cities of residence and delivery were in São Paulo State, considering that some patients may seek medical assistance in another state when their city of residence is close to the border with neighboring states. We did not consider them eligible for the study if the gestational age at the end of pregnancy was less than 20 weeks, or if there was missing information regarding gestational age, maternal age, sex, and city of residence or delivery. All patients who fulfilled these conditions were used to calculate the delivery accessibility ratio for each municipality.

We classified patients according to the city of residence and date of delivery; events occurring from March 2020 onwards were classified as the pandemic group, as opposed to the pre-pandemic group.

We proceeded with further exclusion criteria to develop the cohort of patients who delivered after starting labor with a live fetus. Among live births, we excluded patients with cesarians happening before the beginning of labor or without information. Stillbirth death certificates classify the moment of death as antepartum, intrapartum, postpartum, or unknown; we excluded those with an antepartum or unknown moment.

### Delivery care accessibility ratio

Using the first step described in the participants section, we were able to determine two values for each municipality. First,

<sup>1</sup> The data used in this research are made publicly available by the Ministry of Health of Brazil and can be downloaded from: <https://datasus.saude.gov.br/transferecia-de-arquivos/>. The raw datafiles and scripts used for statistical analysis and creation of tables and figures in this research can be found at: <https://drive.google.com/drive/folders/13ZpccCb-OOZ3MKrBuOhl2C4UShalQ8t4?usp=sharing>.

the total number of hospital deliveries occurring in each city, regardless of these patients' residences. Secondly, for each city, the total number of patients residing there who gave birth in a hospital in any city of the State. The ratio of hospital deliveries in a given city over the total deliveries among that same city's residents was named the delivery care accessibility ratio. Cities with ratios less than 0.1 were classified as having low delivery care accessibility, since even though some deliveries were performed there, most patients residing there would need to seek medical attention elsewhere. Those with ratios equal to or greater than 0.1 were classified as high accessibility. The decision for a value of 0.1 was taken considering the rates of public healthcare coverage in Brazil (20) and percentage of dual-use of both public and private health care (21), as to reflect a local level of delivery care that, while existent, might be either the result of sporadic and unexpected events, or expensive and widely unavailable for the majority of patients.

### Distance from residence to the delivery unit

We calculated the distance traveled from the city of residence to the city of delivery. It was determined by the Haversine formula as a straight line, using publicly available coordinates for the city of residence and city of delivery. If they were the same city, travel distance was zero.

### Study size

When designing the study, we estimated that more than 1 000 000 patients would be included in this population study. We considered the rate of the outcome, stillbirth, which is 8.34 cases per 1 000 deliveries in the southeast region of Brazil (22), where São Paulo State is located. Sample size was adequate because the logistic regression adjustment comprised fewer than 10 factors.

### Statistical methods

Descriptive statistics were used to display the results. Categorical variables were compared using the Chi-square test, and continuous variables used the Wilcoxon–Mann–Whitney test. To assess the relative risk of intrapartum fetal death, we used a generalized linear model with Poisson distribution and log link, using delivery care accessibility, travel distance, education level, maternal age, and birth sex. The alpha value was used as 0.05 for the significance of all tests.

As an exploratory analysis, we focused on the population of residents of low delivery care accessibility cities. We compared the characteristics of those who delivered in that city and all others who traveled to another city for delivery. We restricted this analysis to live births, since the live birth database has more sociodemographic information, such as ethnicity and place of delivery. Ethnicity could be classified as White, Mixed-race, Black, Asian, or Indigenous. Place of delivery could be hospital, another healthcare service, home, another, or unknown. Groups were compared with the same statistical tests as described above.

All analyses were performed separately for each time period. Data manipulation and statistical analysis were conducted using the software RStudio version 4.2.2 (2022-10-31).

### Ethics

All data are publicly available and anonymized. According to the Brazilian National Commission of Ethics in Research, research employing public domain data that does not identify participants does not require ethics board approval.

### RESULTS

The initial data included 2 895 045 live births and 63 981 stillbirths. Exclusion criteria regarding gestational age, birth sex, unspecified city of residence or delivery, and maternal age led to inclusion of 2 886 947 live births and 42 392 stillbirths, which were used to calculate the delivery care accessibility ratio in each period. Of this total, 697 109 occurred during the COVID-19 pandemic, and 2 232 230 happened in the pre-pandemic period. These allowed us to classify all municipalities in the state according to their delivery care accessibility ratio. In the pre-pandemic period, 274 were classified as high accessibility and 371 as low accessibility; during the pandemic, 248 cities were classified as high accessibility and 397 as low accessibility.

The cohort itself included only patients who underwent delivery after starting labor with a live fetus. After excluding 619 707 cesareans without prior labor and 532 live birth deliveries without information regarding type of birth, there were 2 266 708 live births. As for stillbirths, 27 526 were excluded due to fetal demise occurring antepartum, and 14 040 did not have information about moment of death, thus leading to 826 stillbirths. When adding live births and stillbirths who began labor with a live fetus, there were 2 267 534 deliveries, with 1 717 399 patients in the pre-pandemic period and 550 135 during the COVID-19 pandemic.

Patients in the pre-pandemic period mostly lived in high delivery care accessibility cities, had predominantly 8 to 11 years of education, and had a mean age of 27.7 years, while the median was 28 years, with a standard deviation of 6.7 years. When comparing both outcomes, patients with intrapartum fetal death in the pre-pandemic period had a higher proportion of residents in cities with a low delivery care accessibility ratio, traveled longer distances for delivery, were younger, had fewer years of education, and had a higher proportion of male fetuses. All tests had a  $p$ -value  $< 0.01$ . Chi-square post hoc analysis for education level had all categories being statistically significant with a  $p$ -value  $< 0.01$ ; the same analysis for age group revealed statistically significant differences in the proportion of patients aged younger than 20 years ( $p = 0.04$ ) and from 20 to 35 years ( $p < 0.01$ ). These results are summarized in Table 1. During the pandemic, only differences in the proportion of low delivery care accessibility ratio, travel distance for delivery, and education level remained statistically significant ( $p < 0.01$ ), with a higher proportion of patients with intrapartum fetal deaths residing in cities classified as low accessibility. Post hoc analysis of education level differences found significant results ( $p < 0.01$ ) solely among the unknown education level group. These findings are detailed in Table 2.

In the pre-pandemic period, an unadjusted relative risk (RR) of 2.58 for intrapartum fetal death (95% CI [2.12, 3.11];  $p < 0.01$ ) and an adjusted RR of 2.02 (95% CI [1.64, 2.47];  $p < 0.01$ ) was found among patients residing in cities with a low delivery care accessibility ratio. Other variables produced significant relative risks as well, such as travel distance, with both an unadjusted

**TABLE 1. Characteristics of pregnant patients who began labor with a live fetus grouped according to outcome in the State of São Paulo from 2015 to 2020, before the COVID-19 pandemic**

	Intrapartum fetal death (N = 679)	Live birth after labor (N = 1 716 720)	Overall (N = 1 717 399)	p-value
<b>Delivery care accessibility</b>				
High accessibility	552 (81.3%)	1 576 136 (91.8%)	1 576 688 (91.8%)	<0.01
Low accessibility	127 (18.7%)	140 584 (8.2%)	140 711 (8.2%)	
<b>Distance (km)</b>				
Mean (SD)	10.8 (22.1)	5.55 (16.0)	5.55 (16.0)	<0.01
Median [min, max]	0 [0, 183]	0 [0, 673]	0 [0, 673]	
<b>Age group</b>				
From 20 to 35 years	456 (67.2%)	1 265 087 (73.7%)	1 265 543 (73.7%)	<0.01
Less than 20 years	108 (15.9%)	214 310 (12.5%)	214 418 (12.5%)	
More than 35 years	115 (16.9%)	237 323 (13.8%)	237 438 (13.8%)	
<b>Birth sex</b>				
Female	299 (44.0%)	842 322 (49.1%)	842 621 (49.1%)	<0.01
Male	380 (56.0%)	874 398 (50.9%)	874 778 (50.9%)	
<b>Years of education</b>				
Up to 8 years	150 (22.1%)	167 781 (9.8%)	167 931 (9.8%)	<0.01
From 8 to 11 years	345 (50.8%)	1 124 179 (65.5%)	1 124 524 (65.5%)	
12 or more years	89 (13.1%)	420 111 (24.5%)	420 200 (24.5%)	
Unknown	54 (8.0%)	1 716 (0.1%)	1 770 (0.1%)	
Missing	41 (6.0%)	2 933 (0.1%)	2 974 (0.1%)	

Source: Prepared by the authors based on the study data.

**TABLE 2. Characteristics of pregnant patients who began labor with a live fetus grouped according to outcome in the State of São Paulo between 2020 and 2021, after the beginning of the COVID-19 pandemic**

	Intrapartum fetal death (N = 147)	Live birth after labor (N = 549 988)	Overall (N = 550 135)	p-value
<b>Delivery care accessibility</b>				
High accessibility	118 (80.3%)	500 226 (91.0%)	500 344 (90.9%)	<0.01
Low accessibility	29 (19.7%)	49 762 (9.0%)	49 791 (9.1%)	
<b>Distance (km)</b>				
Mean (SD)	16.6 (31.7)	5.96 (16.8)	5.96 (16.8)	<0.01
Median [min, max]	0 [0, 196]	0 [0, 724]	0 [0, 724]	
<b>Age group</b>				
From 20 to 35 years	103 (70.0%)	406 361 (73.9%)	406 464 (73.9%)	0.11
Less than 20 years	22 (15.0%)	54 121 (9.8%)	54 143 (9.8%)	
More than 35 years	22 (15.0%)	89 506 (16.3%)	89 528 (16.3%)	
<b>Birth sex</b>				
Female	66 (44.9%)	270 278 (49.1%)	270 344 (49.1%)	0.34
Male	81 (55.1%)	279 710 (50.9%)	279 791 (50.9%)	
<b>Years of education</b>				
Up to 8 years	18 (12.2%)	37 689 (6.8%)	37 707 (6.8%)	<0.01
From 8 to 11 years	81 (55.1%)	364 686 (66.3%)	364 767 (66.3%)	
12 or more years	27 (18.5%)	146 772 (26.7%)	146 799 (26.7%)	
Unknown	18 (12.2%)	424 (0.1%)	442 (0.1%)	
Missing	3 (2.0%)	417 (0.1%)	420 (0.1%)	

Source: Prepared by the authors based on the study data.

and adjusted RR of 1.01 per kilometer in a straight line (95% CI [1.01, 1.01],  $p < 0.01$  for the unadjusted model; 95% CI [1.00, 1.01],  $p < 0.01$  for the adjusted model). Maternal age above 35 years, fewer years of education, and male birth sex all had statistically significant RR in the adjusted model. A summary of these results can be found in Table 3.

The overall characteristics of patients in the pandemic period were similar to the pre-pandemic period. Most patients lived in municipalities with high delivery care accessibility, had between 8 and 11 years of education, and had a mean age of 28.3 years and a median age of 28 years, with standard deviation of 6.7 years. When considering both outcomes,

**TABLE 3. Unadjusted and adjusted relative risk for intrapartum fetal death in the State of São Paulo from 2015 to 2020, before the COVID-19 pandemic**

Characteristic	Univariate			Multivariable		
	RR	95% CI	p-value	RR	95% CI	p-value
<b>Delivery care accessibility</b>						
High accessibility	—	—	N/A	—	—	N/A
Low accessibility	2.58	2.12, 3.11	<0.001	2.02	1.64, 2.47	<0.001
<b>Distance (km)</b>	1.01	1.01, 1.01	<0.001	1.01	1.00, 1.01	<0.001
<b>Age group</b>						
From 20 to 35 years	—	—	N/A	—	—	N/A
Less than 20 years	1.40	1.13, 1.72	0.002	1.19	0.95, 1.47	0.13
More than 35 years	1.34	1.09, 1.64	0.005	1.30	1.04, 1.60	0.017
<b>Years of education</b>						
12 or more years	—	—	N/A	—	—	N/A
From 8 to 11 years	1.45	1.15, 1.84	0.002	1.46	1.16, 1.86	0.002
Up to 8 years	4.22	3.25, 5.50	<0.001	4.00	3.07, 5.24	<0.001
Unknown	144	102, 201	<0.001	138	97.3, 193	<0.001
<b>Birth sex</b>						
Female	—	—	N/A	—	—	N/A
Male	1.22	1.05, 1.43	0.009	1.23	1.05, 1.44	0.009

Note: RR, relative risk; CI, confidence interval.

Source: Prepared by the authors based on the study data.

**TABLE 4. Unadjusted and adjusted relative risk for intrapartum fetal death in the State of São Paulo between 2020 and 2021, after the beginning of the COVID-19 pandemic**

Characteristic	Univariate			Multivariable		
	RR	95% CI	p-value	RR	95% CI	p-value
<b>Delivery care accessibility</b>						
High accessibility	—	—	N/A	—	—	N/A
Low accessibility	2.47	1.62, 3.65	<0.001	1.69	1.09, 2.55	0.015
<b>Distance (km)</b>	1.01	1.01, 1.01	<0.001	1.01	1.00, 1.01	<0.001
<b>Age group</b>						
From 20 to 35 years	—	—	N/A	—	—	N/A
Less than 20 years	1.60	0.99, 2.49	0.044	1.52	0.93, 2.38	0.081
More than 35 years	0.97	0.60, 1.51	0.9	0.98	0.60, 1.54	>0.9
<b>Years of education</b>						
12 or more years	—	—	N/A	—	—	N/A
From 8 to 11 years	1.21	0.79, 1.90	0.4	1.15	0.74, 1.83	0.6
Up to 8 years	2.60	1.41, 4.68	0.002	2.40	1.29, 4.37	0.005
Unknown	221	120, 399	<0.001	182	97.2, 333	<0.001
<b>Birth sex</b>						
Female	—	—	N/A	—	—	N/A
Male	1.19	0.86, 1.65	0.3	1.16	0.84, 1.62	0.4

Note: RR, relative risk; CI, confidence interval.

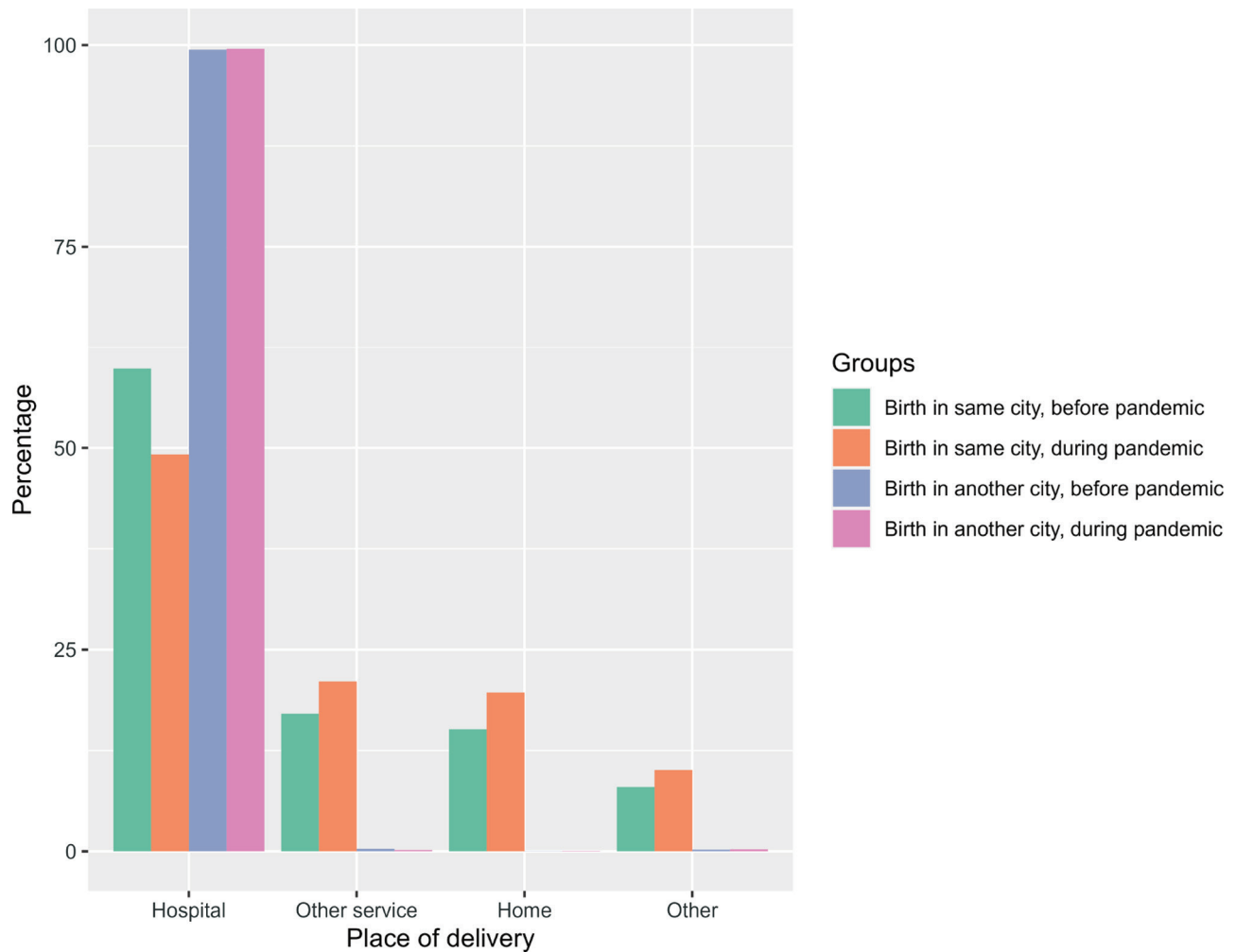
Source: Prepared by the authors based on the study data.

residents in a low delivery care accessibility ratio city displayed an unadjusted RR for intrapartum fetal death of 2.47 (95% CI [1.62, 3.65];  $p < 0.01$ ) and an adjusted RR of 1.69 (95% CI [1.09, 2.55];  $p = 0.015$ ). Each kilometer of travel distance in a straight line had an impact of an RR of 1.01 for both the unadjusted and adjusted analysis (95% CI [1.01, 1.01],  $p < 0.01$  for the unadjusted model; 95% CI [1.00, 1.01],  $p < 0.01$  for the adjusted model). Only fewer years of education yielded statistically significant RR in the adjusted model. These results are shown in Table 4.

In the exploratory analysis, in both periods, live birth patients residing in a low delivery care accessibility city who had their delivery in a different city had a higher proportion of White ethnicity, had more years of education, and had higher proportions of hospital birth. The proportion of hospital births among low delivery care accessibility city residents who had their live birth delivery in the same city was 49.2% in the pandemic period and 59.8% in the pre-pandemic period. In comparison, patients who went to another city for delivery had 99.5% proportion of hospital births in both periods. This relationship is shown in Figure 1.



**FIGURE 1. Proportion of live births among patients residing in low delivery care accessibility cities in the State of São Paulo, according to location of delivery, before and during the COVID-19 pandemic**



Source: Prepared by the authors based on the study data.

## DISCUSSION

### Main findings

We identified a higher risk of intrapartum fetal death among pregnant patients who began labor with a live fetus when residing in cities with low delivery care accessibility ratios. Notably, this result was also independent of and more clinically impactful than the distance between the city of residence and childbirth.

During the COVID-19 pandemic, hospital deliveries among patients both residing and giving birth in low delivery care accessibility cities reduced even further. There was also an increase in the number of cities with low delivery care accessibility compared to the previous period.

### Interpretation

Travel distance may hold ambiguous and divergent meanings in retrospective studies, mainly when analyzed in the context

of the superposition of private and public healthcare providers. Patients may face long distances between their hometowns and cities of delivery due to the inexistence of adequate care nearby or as part of a planned approach to receive the best possible private care in the state, even if reasonable care was provided closer to their residence. Conversely, a patient might display low travel distance if they were incorrectly diagnosed as not requiring specialized care in the public sector or if they had enough resources to access private care in cities that do not have equally specialized public services. Distance is a component of the Phase II delay in the Three Delays Model proposed by Thaddeus and Maine (8); it is contextual and requires consideration regarding the origin's conditions.

We interpret these results as evidence favoring a Phase I delay among patients residing in low delivery care accessibility ratio, resulting in intrapartum fetal death. Patients could be less motivated to seek care when presenting symptoms if their hometowns are not equipped well enough to judiciously select which patients require further assessment in a maternity hospital and which can safely wait for the next prenatal visit.

Patients could be discouraged from seeking their local health service if they are frequently referred to nearby cities, just to be discharged hours later without needing further intervention, spending significant time on what could potentially be solved at the primary care level. This hypothesis is partially corroborated by research in Brazil, which observed high rates of nonurgent or low-priority cases among pregnant patients of all gestational ages in obstetric emergency departments (23, 24) or high discharge rates from the specialized obstetric emergency department after clinical assessment and verbal orientation (25).

A study from the Netherlands found regional differences in perinatal mortality rates (26). A subsequent study from the same country identified a higher risk of neonatal and perinatal mortality among patients with travel time to the hospital equal to or greater than 20 minutes (27). The Dutch obstetric healthcare system significantly differs from the Brazilian system; patients are described as beginning labor at home, even when hospital birth is planned. This matter obscures the comparison regarding healthcare-seeking behavior and Phase I delays and further reflects the importance of the overall healthcare structure in which patients are inserted.

These differences in overall structural conditions are seen not only between countries but also between regions within countries. A study from Benin found that while travel distance impacted both antenatal care and delivery service utilization, the magnitude of this impact was higher in the northern part of the country, reflecting local conditions beyond the simple measurement of travel distance (28). These findings concur with our results, demonstrating travel distance and accessibility conditions as independent variables inside the region of the study.

A study in the Republic of Korea aimed to assess the impact of residence in areas underserved in obstetric care. This research found higher rates of adverse obstetric outcomes in these regions, such as abortion, obstetric hemorrhage, and pyelonephritis (29). These results concur with our own, as they describe the negative impact that could arise from living in cities with suboptimal access to medical services. As the Republic of Korea has a single public healthcare insurance system, their definition of underserved areas ends up being different than the delivery care accessibility ratio described in this research; when both private and public health care coexist, the presence of care does not equate to accessibility, as deep socioeconomic divisions segregate healthcare access.

Available research is not unanimous regarding how the COVID-19 pandemic might have impacted medical-seeking behavior among pregnant patients. A report from the beginning of the outbreak demonstrated a reduction in visits and births in a tertiary center (30). Conversely, a cross-sectional study using web-based surveys in California did not find a reduction in perinatal healthcare access between the first and second COVID-19 waves (31). Our findings suggest reduced delivery care accessibility during the pandemic. Differences in the COVID-19 response, previous healthcare structure, and outcome definition could be associated with these divergences.

## Strengths and limitations

This study has several strengths. It utilizes databases with individual-level data from birth and death certificates, which are mandatory in Brazil, reducing the chance of data loss. It also

includes a large number of patients during a significant period. Limitations include the retrospective nature of the study. Linear distance, as calculated, does not consider terrain and is likely to underestimate actual distance traveled; furthermore, it does not consider in-city distance from home to hospital. There are also limitations inherent in using administrative databases, such as potential errors or missing information. Notably, of all variables, moment of death for stillbirths was the most impacted, with about one-third of stillbirths being excluded for this reason. However, there is no indication this failure to record would happen more often in one group than another, representing an inherent deficiency in the recording system as a whole. Thus, missing information and exclusion should not, on its own, change the overall results. Analysis comparing live births and stillbirths was also limited due to differences in how both are recorded; stillbirths in Brazil follow a death certificate model very similar to the adult death certificate model, with little additional information. For example, the current system does not record the mother's ethnicity in stillbirths. Despite these limitations, these do not seem to invalidate the current findings.

## Conclusion

In summary, pregnant patients residing in low delivery care accessibility cities have a higher risk for intrapartum fetal death in the State of São Paulo, independently of the distance traveled for delivery. This represents a delayed decision to seek medical care due to a possible combination of disincentives caused by the known travel distance and perceived efficacy of care. The COVID-19 pandemic seems to have reduced delivery care accessibility.

Delivery care accessibility could be improved by reconsidering the hospital-based delivery system and increasing focus on family physicians or midwives for low-risk pregnant patients. Another option to reduce Phase I delays and improve primary care in these cities could be investment in official communication channels between primary care physicians and specialists in tertiary centers. This could potentially avoid unnecessary time spent traveling to and from tertiary centers and improve efficacy as perceived by patients, thus increasing the likelihood the patient will actually seek medical care when necessary. Finally, stillbirth death certificate models should be revised in order to register more obstetric information, such as the mother's ethnicity.

**Author contributions.** VCM, JFA, and VTMB conceptualized the study, with contributions by CGFF, ND, NJWMJ, and LBBGM. VCM, JFA, VTMB, CGFF, NJWMJ, and LBBGM developed the methodology. All authors carried out the investigation. VCM curated and analyzed the data. VCM, JFA, VTMB, CGFF, NJWMJ, and LBBGM validated the findings. VCM drafted the manuscript. All authors reviewed and edited the manuscript and approved the final version.

**Conflict of interest.** None declared.

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## REFERENCES

- Rani S, Chawla D, Huria A, Jain S. Risk factors for perinatal mortality due to asphyxia among emergency obstetric referrals in a tertiary hospital. *Indian Pediatr.* 2012;49(3):191–4.
- Goldenberg RL, McClure EM, Kamath BD. Intrapartum perinatal mortality. *Indian Pediatr.* 2012;49(3):187–90.
- Moshiro R, Mdoe P, Perlman JM. A Global View of Neonatal Asphyxia and Resuscitation. *Front Pediatr.* 2019 Nov 26;7:489.
- Barbeiro FMD, Fonseca SC, Tauffer MG, Ferreira MDSS, Silva FPD, Ventura PM, et al. Fetal deaths in Brazil: a systematic review. *Rev Saude Publica.* 2015;49(0). Available from: [http://www.scielo.br/scielo.php?script=sci\\_arttext&pid=S0034-89102015000100402&lng=en&tlng=en](http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0034-89102015000100402&lng=en&tlng=en).
- Nobrega AAD, Mendes YMMBE, Miranda MJD, Santos ACCD, Lobo ADP, Porto DL, et al. Mortalidade perinatal no Brasil em 2018: análise epidemiológica segundo a classificação de Wigglesworth modificada. *Cad Saude Publica.* 2022;38(1):e00003121.
- Wiegerinck MMJ, Eskes M, Van Der Post JAM, Mol BW, Ravelli ACJ. Intrapartum and neonatal mortality in low-risk term women in midwife-led care and obstetrician-led care at the onset of labor: A national matched cohort study. *Acta Obstet Gynecol Scand.* 2020;99(4):546–54.
- Daripa M, Caldas HMG, Flores LPO, Waldvogel BC, Guinsburg R, Almeida MFB. Asfixia perinatal associada à mortalidade neonatal precoce: estudo populacional dos óbitos evitáveis. *Rev Paul Pediatr.* 2013;31(1):37–45.
- Thaddeus S, Maine D. Too far to walk: Maternal mortality in context. *Soc Sci Med.* 1994;38(8):1091–110.
- Say L, Raine R. A systematic review of inequalities in the use of maternal health care in developing countries: examining the scale of the problem and the importance of context. *Bull World Health Organ.* 2007;85(10):812–9.
- Gabrys S, Campbell OM. Still too far to walk: Literature review of the determinants of delivery service use. *BMC Pregnancy Childbirth.* 2009;9(1):34.
- Actis Danna V, Bedwell C, Wakasiaka S, Lavender T. Utility of the three-delays model and its potential for supporting a solution-based approach to accessing intrapartum care in low- and middle-income countries. A qualitative evidence synthesis. *Glob Health Action.* 2020;13(1):1819052.
- Umer A, Zinsstag J, Schelling E, Tschopp R, Hattendorf J, Osman K, et al. Antenatal care and skilled delivery service utilisation in Somali pastoral communities of Eastern Ethiopia. *Trop Med Int Health.* 2020;25(3):328–37.
- Franchi JVDO, Pelloso SM, Ferrari RAP, Cardelli AAM. Access to care during labor and delivery and safety to maternal health. *Rev Lat Am Enfermagem.* 2020;28:e3292.
- Liu YC, Kuo RL, Shih SR. COVID-19: The first documented coronavirus pandemic in history. *Biomed J.* 2020;43(4):328–33.
- Croda J, Oliveira WK de, Frutuoso RL, Mandetta LH, Baia-da-Silva DC, Brito-Sousa JD, et al. COVID-19 in Brazil: advantages of a socialized unified health system and preparation to contain cases. *Rev Soc Bras Med Trop.* 2020;53:e20200167.
- Castro MC, Kim S, Barberia L, Ribeiro AF, Gurzenda S, Ribeiro KB, et al. Spatiotemporal pattern of COVID-19 spread in Brazil. *Science.* 2021;372(6544):821–6.
- Freitas PF, Drachler MDL, Leite JCDC, Marshall T. Inequalities in cesarean delivery rates by ethnicity and hospital accessibility in Brazil. *Int J Gynecol Obstet.* 2009;107(3):198–201.
- Onwuzurike C, Meadows AR, Nour NM. Examining Inequities Associated With Changes in Obstetric and Gynecologic Care Delivery During the Coronavirus Disease 2019 (COVID-19) Pandemic. *Obstet Gynecol.* 2020;136(1):37–41.
- Instituto Brasileiro de Geografia e Estatística. Cities and States: São Paulo. Rio de Janeiro: IBGE; 2023 [cited 2023 Oct 12]. Available from: <https://www.ibge.gov.br/en/cities-and-states/sp.html>.
- Becerril-Montekio V, Medina G, Aquino R. Sistema de salud de Brasil. *Salud Publica Mex.* 2011;53(Suppl. 2):S120–S131.
- Silva B, Hens N, Gusso G, Lagaert S, Macinko J, Willems S. Dual Use of Public and Private Health Care Services in Brazil. *Int J Environ Res Public Health.* 2022;19(3):1829.
- Carvalho TS, Pellanda LC, Doyle P. Stillbirth prevalence in Brazil: an exploration of regional differences. *J Pediatr (Rio J).* 2018;94(2):200–6.
- Herreira Trigueiro T, Vicari K, Da Luz Janiacki K, Paula Da Rosa A, Karine Kissula F. Caracterização dos atendimentos de urgência clínica em uma maternidade de risco habitual: estudo transversal. *Cogitare Enferm.* 2022;27(1):1–14.
- Brilhante A de F, Vasconcelos CTM, Bezerra RA, Lima SKM de, Castro RCMB, Fernandes AFC. Implementação do protocolo de acolhimento com classificação de risco em uma emergência obstétrica. *Rev Rene.* 2016;17(4):569–75.
- Santos MB dos, Diaz CMG, Naidon AM, Zamberlan C. Perfil da demanda obstétrica atendida após implantação da classificação de risco em maternidade de risco habitual. *Discip Sci Saude.* 2019;20(1):191–9.
- Tromp M, Eskes M, Reitsma JB, Erwich JJH, Brouwers HA, Rijninks-van Driel GC, et al. Regional perinatal mortality differences in the Netherlands; care is the question. *BMC Public Health.* 2009;9(1):102.
- Ravelli A, Jager K, de Groot M, Erwich JJ, Rijninks-van Driel GC, Tromp M, et al. Travel time from home to hospital and adverse perinatal outcomes in women at term in the Netherlands. *BJOG.* 2011;118(4):457–65.
- Tanou M, Kishida T, Kamiya Y. The effects of geographical accessibility to health facilities on antenatal care and delivery services utilization in Benin: a cross-sectional study. *Reprod Health.* 2021;18(1):205.
- Kwak MY, Lee SM, Lee TH, Eun SJ, Lee JY, Kim Y. Accessibility of Prenatal Care Can Affect Inequitable Health Outcomes of Pregnant Women Living in Obstetric Care Underserved Areas: a Nationwide Population-Based Study. *J Korean Med Sci.* 2019;34(1):e8.
- Justman N, Shahak G, Gutzeit O, Ben Zvi D, Ginsberg Y, Solt I, et al. Lockdown with a Price: The impact of the COVID-19 Pandemic on Prenatal Care and Perinatal Outcomes in a Tertiary Care Center. *Isr Med Assoc J.* 2020;22(9):533–7.
- Whipps MDM, Phipps JE, Simmons LA. Perinatal health care access, childbirth concerns, and birthing decision-making among pregnant people in California during COVID-19. *BMC Pregnancy Childbirth.* 2021;21(1):477.

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## Relación de la accesibilidad de la atención de salud y la distancia de desplazamiento con la muerte fetal durante el parto: un estudio de cohorte retrospectivo

### RESUMEN

**Objetivo.** Determinar si hubo una asociación entre la mortinatalidad durante el parto y la distancia recorrida o la accesibilidad de la atención para el parto, mediante la evaluación de un período anterior y de otro coincidente con la pandemia de COVID-19.

**Métodos.** Se realizó un estudio de cohorte de base poblacional. Se incluyó a las pacientes que dieron a luz tras el inicio de un trabajo de parto; el criterio de valoración principal fue la mortinatalidad durante el parto. Se clasificaron las ciudades de residencia conforme al cociente entre el número de partos atendidos y el total de partos habidos entre sus residentes; los valores inferiores a 0,1 indican que la accesibilidad de la atención del parto es baja. La distancia recorrida para el parto se calculó utilizando la fórmula de Haversine. Se utilizaron datos del nivel de estudios y la edad de la madre y del sexo biológico neonatal. Para cada período, se evaluó el riesgo relativo mediante un modelo lineal generalizado con varianza de Poisson.

**Resultados.** Hubo 2 267 534 partos que se produjeron tras el inicio de un trabajo de parto. La mayoría de las pacientes tenían edades comprendidas entre 20 y 35 años, tenían entre 8 y 11 años de estudios y residían en ciudades donde la accesibilidad de la atención del parto era alta. Una accesibilidad baja de la atención del parto se asoció a un aumento del riesgo de mortinatalidad durante el parto en el período prepandémico (riesgo relativo [RR] = 2,02; IC del 95% = [1,64, 2,47];  $p < 0,01$ ) y también durante la pandemia (RR = 1,69; IC del 95% = [1,09, 2,55];  $p = 0,015$ ). Este resultado fue independiente de otros factores que incrementan el riesgo, como la distancia recorrida para dar a luz y un menor nivel de estudios.

**Conclusiones.** Una accesibilidad baja de la atención del parto se asocia a un mayor riesgo de mortinatalidad durante el parto; y se observó una reducción de la accesibilidad durante la pandemia. Los partos asistidos por personal de medicina de familia o de partería y los canales de comunicación oficiales entre el personal médico de atención primaria y el especializado podrían mejorar el comportamiento de las pacientes a la hora de buscar atención de salud.

### Palabras clave

Viaje; accesibilidad a los servicios de salud; tiempo de tratamiento; mortalidad fetal; Brasil.

## Avaliação do impacto do acesso ao sistema de saúde e da distância percorrida na morte fetal intraparto: estudo retrospectivo de coorte

### RESUMO

**Objetivo.** Determinar se existe alguma relação entre a morte fetal intraparto e dois fatores: a distância percorrida para o parto e o acesso à assistência ao parto, avaliando o período antes e durante a pandemia de COVID-19.

**Métodos.** Este é um estudo de coorte de base populacional. As pacientes tiveram parto após o início do trabalho de parto; o desfecho primário foi morte fetal intraparto. A cidade de residência foi classificada de acordo com a razão entre os partos realizados e o total de nascimentos entre os residentes; valores inferiores a 0,1 indicavam baixo acesso à assistência ao parto. A distância percorrida foi calculada usando a fórmula de Haversine. Foram incluídos o nível de escolaridade, a idade materna e o sexo de nascimento. Em cada período, o risco relativo foi avaliado usando um modelo linear generalizado com variância de Poisson.

**Resultados.** Foram registrados 2 267 534 partos com nascimento após o início do trabalho de parto. A maioria das pacientes tinha entre 20 e 35 anos de idade, entre 8 e 11 anos de escolaridade e residia em cidades com alto nível de acesso à assistência ao parto. O baixo acesso à assistência ao parto aumentou o risco de morte fetal intraparto no período anterior à pandemia (risco relativo [RR]: 2,02; intervalo de confiança [IC] de 95%: 1,64–2,47;  $p < 0,01$ ) e durante a pandemia (RR: 1,69; IC 95%: 1,09–2,55;  $p = 0,015$ ). Isso ocorreu independentemente de outros fatores de aumento de risco, como a distância percorrida e menor escolaridade.

**Conclusões.** O baixo acesso ao atendimento de parto está associado ao risco de morte fetal intraparto, e a acessibilidade diminuiu durante a pandemia. A realização do parto por médicos de família e obstetrites, bem como a existência de canais oficiais de comunicação entre médicos de atenção primária e especialistas, poderiam melhorar o comportamento de busca de saúde por parte das pacientes.

**Palavras-chave** Viagem; acesso aos serviços de saúde; tempo para o tratamento; mortalidade fetal; Brasil.