Epidemiological profile, spatial patterns and preventability of fetal mortality in Pernambuco

Perfil epidemiológico, padrões espaciais e evitabilidade da mortalidade fetal em Pernambuco

Perfil epidemiológico, patrones espaciales y evitabilidad de la mortalidad fetal en Pernambuco

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Abstract

Objective: To describe the epidemiological characteristics, preventability and spatial distribution of fetal deaths.

Methods: Ecological study conducted in the state of Pernambuco between 2010 and 2017 with the health regions as the unit of analysis. Data from Mortality and Live Birth Information Systems were used. The classification of the preventability of deaths followed the criteria of the Brazilian List of causes of preventable deaths by interventions of the National Health Service. Descriptive statistics and the chi-square test were used for comparisons of proportions. Maps with the spatial distribution of fetal mortality and of preventable and ill-defined causes were prepared

Results: There were 12,337 fetal deaths, of which 8,927 (72.3%) from preventable causes. The variables mother's age, number of dead children, type of pregnancy, type of delivery and birth weight were related to preventability of death. The fetal mortality rate for the state of Pernambuco was 10.9 per 1,000 births, ranging from 10.1 to 16.6, with a higher rate of 16.6 in region XI. The rate of fetal mortality from preventable causes was 7.9, with a minimum of 6.7 and a maximum of 13.2 in region XI. The rate for ill-defined causes was 2.3 per 1,000 births, and the highest rate was 6.2 in region IX.

Conclusion: The results of the study showed the characterization of fetal deaths, mostly preventable, and contributed to understand the chain of factors involved in the occurrence of deaths. Priority health regions for actions to reduce fetal deaths were identified by mapping the mortality rates.

Resumo

Objetivo: Descrever características epidemiológicas, evitabilidade e distribuição espacial dos óbitos fetais.

Métodos: Estudo ecológico realizado no estado de Pernambuco entre 2010 e 2017, cuja unidade de análise foram regiões de saúde. Utilizou-se dados dos Sistemas de Informações sobre Mortalidade, e sobre Nascidos Vivos. A classificação da evitabilidade dos óbitos seguiu os critérios da Lista brasileira de causas de mortes evitáveis por intervenções do Sistema Único de Saúde. Utilizou-se estatística descritiva e o teste Qui-quadrado para comparações de proporções. Elaborou-se mapas com a distribuição espacial da mortalidade fetal e por causas evitáveis e mal definidas.

Resultados: Registou-se 12.337 óbitos fetais, sendo 8.927 (72,3%) por causas evitáveis. As variáveis idade da mãe, número de filhos mortos, tipo de gravidez, tipo de parto e peso ao nascer estiveram relacionadas a evitabilidade do óbito. A taxa de mortalidade fetal para o estado de Pernambuco foi de 10,9 por 1000 nascimentos, variando de 10,1 a 16,6, com maior taxa de 16,6 na região XI. A taxa de mortalidade fetal por

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causas evitáveis foi 7,9, com a mínima de 6,7, e máxima de 13,2 na XI região. A taxa por causas mal definidas foi de 2,3 por 1000 nascimentos, com a maior taxa de 6,2 na IX região.

Conclusão: Os resultados do estudo apresentaram a caracterização dos óbitos fetais, na maior parte evitáveis, e contribuíram para a compreensão da cadeia de fatores envolvidos na ocorrência das mortes. O mapeamento das taxas da mortalidade identificou regiões de saúde prioritárias para as ações de redução dos óbitos fetais.

Resumen

Objetivo: Describir las características epidemiológicas, la evitabilidad y la distribución espacial de la muerte fetal.

Métodos: Estudio ecológico, realizado en el estado de Pernambuco entre 2010 y 2017, cuyas unidades de análisis fueron regiones de salud. Se utilizaron datos del Sistema de Información sobre Mortalidad y sobre Nacidos Vivos. La clasificación de evitabilidad de las muertes se realizó de acuerdo con los criterios de la Lista brasileña de causas de muertes evitables por intervenciones del Sistema Único de Salud. Se utilizó la estadística descriptiva y la prueba χ^2 de Pearson para comparar las proporciones. Se elaboraron mapas con la distribución espacial de la mortalidad fetal por causas evitables y mal definidas.

Resultados: Se registraron 12.337 muertes fetales, de las cuales 8.927 (72,3 %) fueron por causas evitables. Las variables edad de la madre, número de hijos fallecidos, tipo de embarazo, tipo de parto y peso al nacer estuvieron relacionadas con la evitabilidad de la muerte. El índice de mortalidad fetal en el estado de Pernambuco fue de 10,9 cada 1.000 nacimientos, con una variación de 10,1 a 16,6, y el mayor índice de 16,6 fue en la región XI. El índice de mortalidad fetal por causas evitables fue de 7,9, con una mínima de 6,7 y una máxima de 13,2 en la región XI. El índice por causas mal definidas fue de 2,30 cada 1.000 nacimientos, con un índice mayor de 6,2 en la región IX.

Conclusión: Los resultados del estudio presentaron la caracterización de las muertes fetales, en su mayoría evitables, y contribuyeron a la comprensión de la cadena de factores relacionados con los casos de muerte. El mapeo de los índices de mortalidad identificó regiones de salud prioritarias para acciones de reducción de muertes fetales.

Introduction

Fetal mortality is a public health problem in most countries.[1] In particular, because it results from socio-economic disparities characterized as inequities, which are preventable through effective health actions.[2]

Fetal death occurs with the death of the pregnancy product before expulsion or complete extraction of the maternal organism, regardless of the pregnancy duration.[3] Death is indicated by the absence of breathing or any other sign of life after maternal separation.[3]

Fetal mortality rate is an important indicator of reproductive health and quality of antenatal and intra-natal care.[4] According to the International Statistical Classification of Diseases and Health-Related Problems - 10th Revision, this rate expresses the number of fetal deaths occurring from 22 full weeks of gestation or with birth weight equal to or greater than 500g, body length of 25 cm or more, per thousand total births in the population residing in a given geographic space in the period considered.[3]

Around 2.6 million fetal deaths occur per year worldwide, approximately half at the time of delivery, and most are preventable deaths.[5] In 2015, the fetal mortality rate was 18.4 per 1,000 births, 25.5% lower than the rate of year 2000, 24.7 per 1,000 births.[6] In Brazil, in the same period, the rate decreased by 8.9%, from 12.2 to 10.8 per 1,000. In 2015, the Northeast region had the highest rate in the country with 12.1 per 1,000 births.[7]

Despite the magnitude of this indicator, fetal mortality was deemed less important in national and international policy agendas.[8] The discussion of fetal deaths was not included in the Millennium Development Goals (MDGs) nor in the Sustainable Development Goals (SDGs) of the United Nations (UN), global agreements that presented goals for the decline of maternal and infant mortality.[9] Fetal deaths have gained greater visibility after being included in the Every Newborn Action Plan, a global movement for the elimination of preventable fetal mortality and reduction of disparities in its occurrence.[8]

The historical invisibility of fetal deaths in maternal and child health policies have made a more significant reduction in fetal mortality difficult, especially in areas of greater social vulnerability.[8] In Brazil and worldwide, the unequal distribution of mortality in the territory reveals segregations between population groups, according to issues related to education, work, income, situation of the place of residence and access to health.[10]

The development of research on fetal mortality brings a broader understanding of the factors influencing their occurrence.[11] They enable the identification of social inequalities in population groups

and the monitoring of the occurrence of deaths in different geographic spaces.[2] When observing the spatial distribution of mortality, these studies can support the planning of actions aimed at reducing preventable fetal deaths in vulnerable populations and territories.[2,12]

This study is justified by the magnitude of fetal deaths, although most of them are preventable with appropriate antenatal and obstetric health care. These deaths are still considered less important in epidemiological research compared to maternal and child mortality. In addition, few studies consider the influence of social determinants of health in the spatial dynamics of fetal mortality.

The aim of this study was to describe the epidemiological characteristics, preventability and spatial distribution of fetal deaths.

Methods

An ecological study was conducted in the state of Pernambuco, which has a territorial extension of 98,076,021 km² and a population of 9,496,294 inhabitants.[13] The units of analysis for the study were the 12 health regions of Pernambuco: I (19 municipalities), II (20 municipalities), III (22 municipalities), IV (32 municipalities), V (21 municipalities), VI (13 municipalities), VII (7 municipalities), VIII (7 municipalities), IX (11 municipalities), X (12 municipalities), XI (10 municipalities) and XII (10 municipalities).

The data sources were the records of the Mortality Information System and the Live Birth Information System. All fetal deaths of mothers living in Pernambuco registered in the Mortality Information System between 2010 and 2017 were included.

For the classification of preventability of deaths, the Brazilian List of causes of preventable deaths by interventions of the National Health Service was used. The list categorizes deaths into: preventable (reducible by immunoprevention actions, appropriate care for women during pregnancy and labor and for the newborn; appropriate diagnostic and treatment actions; appropriate health promotion and

care actions); ill-defined causes (symptoms, signs and abnormal findings of clinical and laboratory tests not classified elsewhere; fetal death of unspecified cause; unspecified conditions originating in the perinatal period) and other causes not clearly avoidable (the other causes and deaths).[14]

Fetal mortality rates were calculated (number of fetal deaths divided by the total number of births multiplied by 1,000) for preventable causes, for ill-defined causes and for not clearly preventable causes. For fetal deaths by preventability category, variables related to the following were analyzed; maternal characteristics: mother's age in years (<20, 20-34 and> 34), mother's education in years (<9 and ≥9), number of children alive (none and ≥1), number of dead children (none and ≥1); pregnancy: type of pregnancy (singlet and twin or triplets), weeks of pregnancy (<37 and ≥37); delivery: type of delivery (vaginal and cesarean); and birth: birth weight (<2500g and ≥2500g) and sex (male and female). Descriptive statistics and the chi-square test with significance level <0.05 were applied to compare proportions using the R Project version 3.6*.

The spatial distribution was investigated by thematic maps of fetal mortality and by preventable and undefined causes in the health regions prepared in the QGis spatial distribution* program, version 2.14.3. Data were grouped by tertiles and mortality rates were stratified into low, medium and high. The digital mesh used is available on the website of the Brazilian Institute of Geography and Statistics (Portuguese acronym: IBGE)[15] and features the Sirgas 2000/UTM zone 25S coordinate reference system.

The study project was approved by the Research Ethics Committee of the Health Sciences Center of the Universidade Federal de Pernambuco (CAEE: 13981419.6.0000.5208).

Results

During the study period, 12,337 fetal deaths occurred, of which 8,927 (72.4%) due to preventable causes. The fetal mortality rate was 10.9 per 1,000 births, the rate for preventable causes was 7.9 and the rate for ill-defined causes was 2.3 (Table 1).

Table 1. Number, proportion and rate of fetal deaths according to preventability criteria

Preventability*	n(%)	Mortality rate
Preventable causes	8927(72.4)	7.9
Ill-defined causes of death	2628(21.3)	2.3
Other causes (not clearly preventable)	780(6.3)	0.7
Total	12337(100)	10.9

number/percentage of ignored: 2/<0.1%*

Table 2. Characteristics of fetal deaths according to preventability criteria of the Brazilian List of causes of preventable deaths by interventions of the National Health Service

Variables	Fetal death		p-value
	Preventable causes n(%)	Ill-defined/ not clearly preventable causes n(%)	
Mother's age in years [n= 10,921 (a)]			
<20	1181(70.2)	502(29.8)	0.009
20- 34	5489(73.8)	1947(26.2)	
>34	1322(73.4)	480(26.6)	
Mother's schooling in years [n= 9,948 (b)]			
<9	3949(72.5)	1497(27.5)	0.238
≥9	3312(73.6)	1190(26.4)	
Number of live children [n= 10,586 (c)]			
None	3265(72.9)	1213(27.1)	0.446
≥1	4494(73.6)	1614(26.4)	
Number of dead children [n= 10,256 (d)]			
None	2972(70.8)	1223(29.2)	<0.001
≥1	4541(74.9)	1520(25.1)	
Type of Pregnancy [n= 11,545 (e)]			
Singlet	7976(73.1)	2940(26.9)	0.021
Twins or triplets	486(77.3)	143(22.7)	
Weeks of pregnancy [n= 10,295 (f)]			
<37	5220(73.8)	1853(26.1)	0.918
≥37	2381(73.9)	841(26.1)	
Type of delivery [n= 11,456 (g)]			
Vaginal	6017(70.0)	2579(30.0)	<0.001
Cesarean	2372(82.9)	488(17.1)	
Birth weight [n= 11,130 (h)]			
<2500g	5519(72.5)	2097(27.5)	<0.001
≥2500g	2668(75.9)	846(24.1)	
Sex [n= 11,645 (i)]			
Male	4500(73.7)	1609(26.3)	0.084
Female	3999(72.2)	1537(27.8)	

Number/percentage of ignored (a) 1,416/11.5%; (b) 2,389/19.4%; (c) 1,751/14.2%; (d) 2,081/16.9%; (e) 792/6.4%; (f) 2,042/16.6; (g) 881/7.1%; (h) 1,202/9.8%; (i) 692/5.6%

The comparison of maternal characteristics between preventable fetal deaths and those not clearly preventable showed a statistically significant difference between maternal age and the number of dead children. In the age group of older than 34 years, mainly preventable deaths were found, 1,322 (73.4%), similarly to the group of 20-34 years old, 5,489 (73.8%). Regarding the characteristics of pregnancy, labor and birth, among preventable deaths,

twin or triplet pregnancy (n=486; 77.3%), cesarean delivery (n=2372; 82.9%) and weight less than 2500g (n=5519; 72.5%) predominated (Table 2).

Fetal mortality had the highest rate of 16.6 per 1,000 births in health region XI, and the lowest rate of 10.1 per 1,000 in region X. Mortality from preventable causes ranged from 6.7 in region X to 13.2 per 1,000 in region XI. Mortality from ill-defined causes had a maximum rate of 6.2 in region IX (Figure 1).
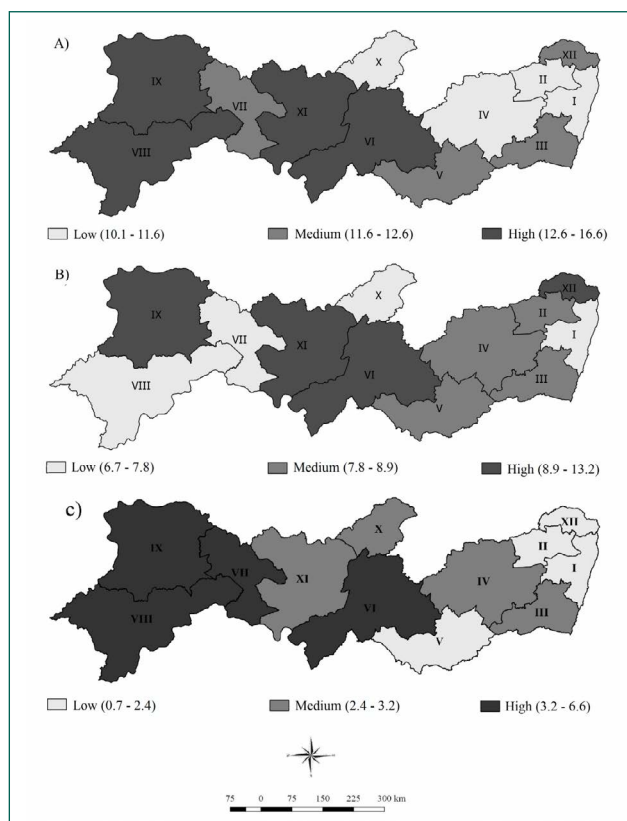
Figure 1. Spatial distribution of fetal mortality (A) and from preventable causes (B) and undefined causes (C) according to health region

Discussion

In the studied period, most fetal deaths occurred from preventable causes. The maternal characteristics related to the extremes of age and the previous death of other children were related to the preventability of fetal deaths. Twin or triplet pregnancies, births by cesarean section and low birth weight occurred mainly in preventable fetal deaths. Health

region XI had simultaneously the highest rates of fetal mortality and from preventable causes. The highest mortality rate from undefined causes occurred in region IX.

The maternal age group of over 34 years presented mainly preventable fetal deaths. The literature shows adverse perinatal results, a 50% higher risk of fetal death in late pregnancy compared to pregnant women in other age groups.[16] Late pregnancies are more prone to specific pathologies, such as gestational diabetes and hypertension with negative repercussions to the fetus,[17] and have a higher incidence of congenital malformations and deformities incompatible with life.[17]

Most cesarean deliveries occurred in fetal deaths from preventable causes. In a study, it was observed that cesarean delivery is indicated for the preservation of maternal life in pregnant women with a dead conceptus resulting from an obstetric urgency.[18] As the practice of elective cesarean sections can increase the risk of premature delivery and fetal death, the vaginal delivery route is more recommended if there are good vitality conditions.[19]

Mortality was higher among low birth weight fetuses. There is a consensus that the lower the birth weight, the greater the risk of fetal and infant mortality.[20,21] The access to antenatal care starting in the first trimester of pregnancy, an appropriate frequency in consultations and quality care are important to reduce births with insufficient weight.[22]

Providing effective antenatal care can promote health, prevent, diagnose and treat diseases with appropriate management to reduce low birth weight and consequently, preventable fetal deaths.[22,23] Research indicates that fetal deaths occur mainly at the antepartum moment due to maternal conditions that could have been prevented, identified, monitored and controlled with appropriate antenatal care.[24] In turn, intrapartum deaths would be amenable to preventability, especially by improving care conditions during labor with timely access to quality services.[24]

Good practices during labor and delivery include humanized care without unnecessary interventions performed by a multidisciplinary team that provides user embracement and monitors pregnant women since their admission to the service.[25] Access to health units with structural and sufficient human resources for adequate obstetric care is also essential for fetal survival, whereas pregnant women's pilgrimage in search of access to the hospital network increases the risk of preventable death for the mother and the fetus.[26]

Preventable causes of death were in higher proportion among fetal deaths and these are considered sentinel events. The monitoring of undesirable events can indicate the quality of care provided by health systems[27] and allow the assessment of the performance of services and establishment of comparisons between regions and municipalities.[28]

The highest rates of fetal mortality and from preventable causes were found in health region XI, and the highest rate of mortality from ill-defined causes in region IX. Municipalities in these regions were among the ten lowest municipal human development indexes in income according to data from year 2010.[29] Studies recommend strengthening intersectoral public policies and actions in regions of high infant and fetal mortality rates with a view to expand the coverage of the family health strategy and qualify childbirth care.[2,30]

Child and fetal death surveillance is another initiative that can help reduce mortality in these regions.[31] This initiative has also contributed to rectify the basic causes, which allows for a correct specification and appropriate classification according to preventability.[31]

The reliability of information systems allows the performance of studies like this, using secondary data. It also enables that public management gains knowledge about population groups at greatest risk of death through the development of public health indicators.[32] In the state of Pernambuco, vital information is considered reliable, but as it moves away from the capital city, information is in the consolidation phase in some municipalities, and albeit few, it has incomplete coverage and quality of records.[33]

The spatial distribution of fetal mortality rates performed in this study contributes to identify health regions with higher rates and can collaborate in the development of strategies to reduce inequalities in mortality. Spatial analysis can support

health managers in defining areas that need priority in health care and surveillance actions. Research on fetal mortality has used georeferenced data to assess the spatial distribution of the risks of death in the territory[2,30], to monitor the occurrence of deaths, to assist in the development of public health actions and programs aimed at the needs of the population, and to monitor the performance of strategies proposed for mortality reduction.[34,35]

The limitations of this study include the possible underreporting of deaths and incompleteness of information systems that can influence the calculation of rates, although the completeness and reliability of vital records in the state of Pernambuco are considered appropriate. Another limitation is the use of the Brazilian List of causes of preventable deaths, which is not exclusive to fetal deaths, but includes neonatal deaths with circumstances and etiologies similar to those of fetal deaths. The health region analysis unit may contain spatial inequalities, although these units are used routinely by health management. The results of this study can support the planning and performance of public policies.

Conclusion

The results of the study showed the characterization of fetal deaths, mostly preventable, and contributed to the understanding of the chain of factors involved in the occurrence of deaths. The variables of mother's age, number of dead children, type of pregnancy, type of delivery and birth weight showed a statistically significant difference between preventable and not clearly preventable fetal deaths. The highest rates of mortality and mortality from preventable causes occurred respectively in regions XI and IX. The mapping identified priority areas for the development of health surveillance actions and for improvement of the quality of maternal and child care.

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Collaborations

Canuto IMB, Bonfim CV and Macêdo VC contributed to the study design, analysis and interpretation of data, writing of the manuscript, critical review and of intellectual content. Oliveira CM and Frias PG contributed to the analysis and interpretation of data and writing of the manuscript. All authors approved the final version of the manuscript.

References

1. Egbe TO, Ewane EN, Tendongfor N. Stillbirth rates and associated risk factors at the Buea and Limbe regional hospitals, Cameroon : a case-control study. BMC Pregnancy and Childbirth. 2020;8:1–8.

2. Loiacono, KV. Evolution of fetal mortality in the setting of Argentine socioeconomic inequalities . Period 2007-2014. Arch Argent Pediatr. 2018;116(4):567–74.

3. World Health Organization. International Statistical Classification of Diseases and Related Health Problems: 10. revision. 2.ed. Geneva: WHO; 2004.

4. Dev A, O'Hern K, Domerçant JY, Lucien G, Lafortune L, Grand-Pierre R, et al. A retrospective review of facility-level obstetric complications and stillbirths in southern Haiti, 2013 – 2016. Rev Panam Salud Publica. 2019;(3):1–8.

5. Aminu M, Bar-Zeev S, White S, Mathai M, Broek NVD. Understanding cause of stillbirth : a prospective observational multi-country study from sub-Saharan Africa. BMC Pregnancy and Childbirth. 2019;7:1–10.

6. Blencowe H, Cousens S, Jassir FB, Say L, Chou D, Mathers C, et al. National , regional , and worldwide estimates of stillbirth rates in 2015 , with trends from 2000 : a systematic analysis. The Lancet Global Health. 2016;4(2):98–108.

7. Brasil, Ministério da saúde. Departamento de informática do SUS, 2018. Brasília (DF): Ministério da Saúde; 2018. [citado 2021 Jan 25]. Disponível em: <http://datasus.saude.gov.br/informacoes-de-saude/tabnet/estatisticas-vitais>.

8. Nonterah EA, Agorinya IA, Kanmiki EW, Kagura J, Tamimu M, Ayamba EY et al. Trends and risk factors associated with stillbirths : A case study of the Navrongo War Memorial Hospital in Northern Ghana. Plos one. 2020;1–13.

9. Iqbal S, Maqsood S, Zakar R, Zakar MZ, Fischer F. Continuum of care in maternal, newborn and child health in Pakistan : analysis of trends and determinants from 2006 to 2012. BMC Health Serv Res. 2017;17(189):1–15.

10. Barros P S, Aquino EC, Souza MR. [Fetal mortality and the challenges for women's health care in Brazil]. Rev Saude Publica. 2019; 53:(12)1–10. Portuguese.

11. Smith RB, Beevers SD, Gullivera J, Dajnak D, Fecht D, Blangiardo M, et al. Impacts of air pollution and noise on risk of preterm birth and stillbirth in London. Environment International. 2020;134:1–12.

12. Callander EJ, Hons JTBA, Fox MPH, Ellwood D, Flenady V. What are the costs of stillbirth ? Capturing the direct health care and macroeconomic costs in Australia. Birth, n. September. 2019;00:1–8.

13. Instituto Brasileiro de Geografia e Estatística (IBGE). Portal On-line Cidades. Rio de Janeiro: IBGE; 2018. [citado 2018 Dez 15]. Disponível em: <https://cidades.ibge.gov.br/brasil/pe/panorama>. Acesso em: 15 dez. 2018.

14. Malta DC, Prado RR, Saltarelli RMF, Monteiro RA, Souza MFM, Almeida MF. [Update of avoidable causes of deaths due to interventions at the Brazilian Health System]. Epidemiol Serv Saúde. 2010;19(2):173-6. Portuguese.

15. Instituto Brasileiro de Geografia e Estatística (IBGE). Malhas digitais. 2020. Rio de Janeiro: IBGE; 2020. [citado 202018 Dez 15]. Disponível em:<https://mapas.ibge.gov.br/en/bases-e-referenciais/bases-cartograficas/malhas-digitais>.

16. Dongarwar D, Aggarwal A, Barning K, Salihu HM. Stillbirths among Advanced Maternal Age Women in the United States : 2003-2017. International Journal of Maternal and Child Health and AIDS. 2020;9(1):153–6.

17. Hidalgo-Lopezosa P, Cobo-Cuenca AI, Carmona-Torres JM, Luque-Carrillo P, Rodríguez-Muñoz PM, Rodríguez-Borrego MA. Factors associated with late fetal mortality. Archives of Gynecology and Obstetrics. 2018;296(6):145-1420.

18. Lima KJ, Chaves CS, Gomes EO, Lima MA, Candeira ECP, Teófilo EKS, et al. [Health situation analysis: fetal mortality in the health region of Ceará]. Revista Brasileira em Promoção da Saúde. 2017;30(1):30-37. Portuguese.

19. Mascarello KC, Horta BL, Silveira MF. [Maternal complications and cesarean section without indication: systematic review and meta-analysis]. Rev Saude Publica. 2017;51:105. Portuguese.

21. Garcia LP, Fernandes CM, Traebert J.[Risk factors for neonatal death in the capital city with the lowest infant mortality rate in Brazil]. Jornal de Pediatria. 2019;95(2):194–200. Portuguese.

22. Esteves APP, Viellas EF, Domingues RMSM, Gama SGN. [Prenatal care in the Brazilian public health services]. Rev. SaúdePública, 2020;54:08. Portuguese.

23. Monteiro MFV, Barbosa CP, Vertamatti MAF, Tavares MNA, Carvalho ACO, Alencar APA. [Access to public health services and integral care for women during the puerperal gravid period period in Ceará, Brazil. BMC Health Services Research]. 2019;19(851):1–8. Portuguese.

24. Salazar-Barrientos M, Zuleta-Tobón JJ. Application of the International Classification of Diseases for Perinatal Mortality (ICD-PM) to vital statistics records for the purpose of classifying perinatal deaths in Antioquia, Colombia. Rev Colomb Obstet Ginecol. 2019; 70:228- 242.

25. Leal MC, Bittencourt SA, Esteves PAP, Ayres BVS, Silva LBRAA, Thomaz EBAF, et al. [Avances en la asistencia al parto en Brasil: resultados preliminares de dos estudios evaluativos]. Cad. Saúde Pública [Internet]. 2019; 35(7): e00223018. Portuguese.

26. Lima SS, Braga MC, Vanderlei LCM, Luna CF, Frias. [Assessment of the impact of prenatal, childbirth, and neonatal care on avoidable neonatal deaths in Pernambuco State, Brazil: an adequacy study]. Cadernos de Saude Publica. 2020;36(2). Portuguese.

27. Malta DC, Prado RR , Saltarelli RMF , Monteiro RA, Souza MFM, Almeida MF. [Preventable deaths in childhood, according to actions of the Unified Health System, Brazil]. Rev Bras Epidemiol. 2019;22:1–15. Portuguese.

28. Berman Y, Ibiebele I, Patterson JA, Randal D, Ford JB, Nippita T, et al. Rates of stillbirth by maternal region of birth and gestational age in New South Wales, Australia 2004 – 2015. Aust N Z J Obstet Gynaecol. 2019:1–8.

29. Atlas do desenvolvimento humano no Brasil. Rio de Janeiro, PNUD, IPEA, Fundação João Pinheiro, 2020.

30. Canuto IMB, Alves FAP, Oliveira CM, Frias PG, Macêdo VC, Bonfim CV. [Intraurban differentials of perinatal mortality: modeling for identifying priority areas]. Rev Esc Anna Nery. 2019; 23(1):1-8. Portuguese.

31. Oliveira CM, Bonfim CV, Guimarães MJ, Frias PG, Medeiros ZM. [Infant mortality: temporal trend and contribution of death surveillance]. Acta Paul Enferm. 2016;29(3):282-90. Portuguese

32. Figueirôa BQ, Frias PG, Vanderlei LC, Vidal SA, Carvalho PI, Pereira CC, et al. [Evaluation of the implantation of the Mortality Information System in Pernambuco state, Brazil, in 2012]. Epidemiol. Serv. Saúde. 2019;28(1): e2018384. Portuguese.

33. Szwarcwald CL, Leal MC, Esteves- Pereira AP, Almeida WS, Frias PG, Damacena GN, et al. [Evaluation of data from the Brazilian Information System on Live Births (SINASC)]. Cad. Saúde Pública 2019;35(10):e00214918. Portuguese.

34. Adeyinka DA, Olakunde BO, Muhajarine N. Evidence of health inequity in child survival : spatial and Bayesian network analyses of stillbirth rates in 194 countries. Scientific Reports. 2019;9:1–11.

35. Luque-Fernandez MA, Thomas A, Gelaye B, Racape J, Sanchez MJ, Williams MA. Secular trends in stillbirth by maternal socioeconomic status in Spain 2007 – 15: a population-based study of 4 million births. European Journal of Public Health. 2019;29(6):1043–8