Factors associated to fetal death in Cuiabá, Mato Grosso

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Abstract

Objectives: to investigate the causes and the factors associated to fetal death in Cuiaba, Mato Grosso, 2006-2010.

Methods: a population based case-control study in a ratio of 1:3 (300:900), was based on secondary data on Live Births and Mortality Information Systems. A hierarchical logistic regression was used.

Results: remains independently associated to fetal death: low maternal schooling (OR=1.58, CI95%=1.02;2.47), low weight (OR=5.59, CI95%=3.22;9.70) gestational age <37 weeks (OR=9.34, CI95%=5.38;16.21), previous fetal death (OR=6.65, CI95%=4.35;10.15). The type of cesarean delivery remained as a protective factor (OR=0.35, CI95%=0.24;0.54). The main causes of fetal deaths were by unspecified cause (15.4%), followed by maternal hypertensive disorders (14.7%). The fetal mortality rate (TMF) decreased from 10.0 in 2006 to 7.5 deaths per thousand births in 2010 (decreased 24.5%). The TMF during the study period was below the goal set for 2030 by the World Health Organization.

Conclusions: approximately one third of fetal deaths causes were potentially avoidable. Factors such as low maternal schooling, low birth weight, prematurity and previous fetal death history constitute as main determinants for fetal deaths in Cuiaba and suggests that socioeconomic situation still determines quality care for pregnant women and that actions should be directed to improve prenatal care.

Key words *Fetal death, Risk factors, Health Information Systems, Fetal mortality*

Introduction

In recent decades there have been significant progress in the health of mothers and children around the world,[1] especially after the goals were established in the Millennium Development Goals (ODM) which closed in 2015.[2] However, these goals were not contemplated to prevent fetal deaths.[2-3] The Ministry of Health of Brazil considers fetal death as a conception product with weight greater than or equal to 500g and/or gestational age greater than or equal to 22 weeks, while the fetal mortality rate (TMF) is expressed by the number of fetal deaths divided by the number of total births added to fetal deaths and multiplied by one thousand.[4]

It is estimated that around 2.6 million of fetal deaths occur per year in the world and that 98% of these deaths occur in low and middle income countries.[5] However, this is not just a problem in developing countries.[6] In the last 15 years, the United States of America and the United Kingdom only reduced 1% per year of fetal deaths, accounting for two thirds of perinatal deaths in these countries.[5-7]

The cause of low visibility in the political agenda, few investments in the countries and incompleteness of vital registered information, a reduction on fetal deaths occurs at a slower pace than the reduction of deaths of children under five years of age and maternal deaths.[2,8] Moreover, part of the causes of these deaths are considered avoidable,[9] in other words, preventable, totally or partly, by effective actions of the health services that are accessible in a determined location and time.[10]

As a strategy to undo this unfavorable situation in 2014, the World Health Organization (OMS) and the United Nations Children's Fund (Unicef) have established a goal to be achieved by 2030 for fetal mortality rate (TMF) of 12 or less stillbirths per 1.000 births.[5-6] The Committees to Prevent Infant and Fetal Death in Brazil also accompany and monitor these deaths and propose interventions to reduce mortality.[4]

In developed countries, the TMF varies from two to seven deaths per thousand births.[3,6] In Latin America, the TMF is around 8.2 deaths per thousand births[6] and in Brazil, the TMF was 10.0 deaths per thousand births in 2013.[11]

Although in the last decade, Brazil has reduced social disparities, economic and health indicators,[1,9] although the differences in intra and inter regional in fetal deaths still persist.[9,11-12] In 2013, the North region of the country showed rates that ranged from 9.2 to 14.8 deaths/1.000 births; in the Northeast region, the TMF was between 10.0 and 15.0 deaths/1.000 births; in the Southeast and South regions, the TMF varied less between 6.2 and 10.2 deaths/1.000 births.[11] The capitals in the Midwest region have TMF very similar among themselves ranging from 7.7 to 8.7 deaths/1.000 births.[11]

Factors associated to fetal deaths have been studied considering distal determinants (socioeconomics), intermediates (assistances) and proximal (biological), were carried out by means of hierarchical analyzes.[13-14] The hierarchical statistical analysis is based on a conceptual model that describes the relation among risk factors.[15]

In Brazil, there are few studies available that analyze separately the fetal period, perhaps by subnumeral of deaths and low completeness.[9,14,16] Despite such relevance in the period of 2003 to 2013, there are no publications of any articles on fetal deaths in the Midwest region, therefore this study aimed to investigate the causes of fetal and the factors associated to deaths in a capital in the region of this country.

Methods

This is a population based case-control study with a descriptive component and the other analytical.

The area of interest was in the city of Cuiabá, MT with an estimated population of 551,098 inhabitants, with a Human Development Index (IDH) of 0.785, and the Gini Index of 0.601.[17] In the period of 2006 to 2010, an average of 9404 births and 140 infant deaths occurred per year. During this same period an average rate of maternal mortality was 55.9/100 000 stillbirths, the average rate of infant mortality (TMR) was 13.0/1.000 stillbirths and the fecundity rate was 1.8 children per woman at childbearing age.[11,17]

The population of the case-control study was composed on fetal deaths (cases) and live births (controls), children of mothers living in Cuiabá in the period of 2006 to 2010, at a ratio of 1:3. The study included fetal deaths followed by weight greater than or equal to 500g and gestational age greater than or equal to 22 weeks,[4] and as for controls, live births with weight greater than or equal to 500g and gestational age greater than or equal to 22 weeks. Cases and controls that presented 50% of the information in blank and/or ignored were excluded, totaling 102 cases.

The gender variables and the same day of birth to pair between case and control were used. In the event of more than three controls for a case, it was ordered to register from the smallest to the largest birth among all possible controls questioned; subse-

quently, the first control was randomly to be picked and the other two controls were selected at constant intervals and systematic in two registrations.

The data source was from the Mortality Information System (SIM) and the Live Births Information System on (SINASC), authorized by the Epidemiological Surveillance Center and provided by management on monitoring births and deaths in the city of Cuiabá.

The databases were typed in each year, the management team of surveillance of births and deaths in the city of Cuiabá stored in Microsoft Excel® as well, subsequently, the junction between the two databases into a single common variable effected both banks.

The study variables were: maternal schooling (≥8 and <8 years of study); type of hospital (private and non private); type of delivery (vaginal and cesarean deliveries); mother's age (<35 and ≥35 years of age); type of pregnancy (singleton and multiple); gestational age (≥37 and <37 weeks); birth weight (≥2500 and <2500 grams); gender (male and female); mother´s occupation (housewife and others); live children (have or not) and children died (have or not). To classify the basic cause of death, the 10th review on the International Classification of Diseases (CID-10) was used.[18]

A descriptive analysis was performed on the variables studied by means of proportions expressed in percentages and calculated the percentage of variation in the rates of fetal mortality in the period of 2006 to 2010.

To investigate factors associated to fetal deaths, gross and adjusted *odds ratios* (OR) along with its respective confidence intervals of 95% were estimated. The multiple hierarchical logistic regression 15 and Hosmer and Lemeshow test were used to verify the variable means of the final model.

To analyze the hierarchical model, we took distal determinants as (socioeconomic variables): maternal schooling in years of studying; determinants intermediaries as (assistances): type of delivery and type of hospital and for proximal determinants as (biological): gestational age in weeks, birth weight in grams and previous child´s death.

In this study, the hierarchical analysis followed the distal-proximal sense by using as a starting point of the variables in block 1, which is added to the variables in block 2 and finally to block 3, forming the hierarchical model to the end. In each of the blocks, the variables that had *p* value <0.20 in the univariate analysis were included in the model of its block, using the stepwise forward procedure. Each block remained the variables of those that had a *p* value of <0.05 and those with biological plausibility. The statistical software used was Stata version 12.0. This study was approved by the Research Ethics Committee of the Hospital Universitário Júlio Müller, CAAE: 37971214.4.0000.5541.

Results

In the capital of Cuiabá in the period of 2006 to 2010, there were 402 fetal deaths with an average of 80.4 fetal deaths/year. Of the 402, 300 met the criteria for inclusion in this study, totaling 300 cases and 900 controls.

Maternal characteristics and assistances related to fetal mortality were represented mostly by maternal age belonging to the age group of 20 to 34 years (67.5 %) being the minimum age of 12 years and the maximum of 43 years, schooling greater than or equal to 8 years (64.4 %), type of pregnancy (96.0%), type of vaginal delivery (69.4%), gestation less than 37 weeks (74.2%) and predominantly as place of occurrence as the hospital (98.3%) (Table 1).

Most of fetal deaths occurred in males (56.6%), antepartum (97.3%) and presented low weight (72.9%). The 2.7% (n=11) of fetal deaths occurred in the period of intrapartum, seven of them received medical assistance, while four had no information (Table 1).

The main basic causes of fetal deaths in this study were “cause of fetal death not specified" (15.4%), “fetus and newborn affected by maternal hypertension disorders (14.7%), “fetus and newborn affected by other forms of placenta abruption and bleeding” (11.9%) and 15.2% for “other causes” (Table 2).

In the period of TMF in Cuiabá, there was 8.7/1.000 births and decreased from 10.0 deaths per thousand births in 2006 to 7.5 deaths per 1.000 births in 2010, a reduction of 24.5%.

In the univariate analysis, the maternal age, type of pregnancy, gender, mother´s occupation and has live children showed no association with fetal death (Table 3).

Table 4 presents the results of the model applied to each block in the first column. In the second column shows there is an intermediate model, composing block 1 (distal determinant) with block 2 (intermediate determinant). In the third column there is the final model, added to two blocks before block 3 (proximal determinants). As it is hierarchical, the results can be read horizontally (in a given variable along the adjusted) and diagonally (adjusted between blocks), as shown in Table 4.

In block 1 (distal determinant), the low maternal schooling level was associated to fetal death, both in the univariate analysis as in the final model (OR=1.58; CI95%: 1.02; 2.47). In block 2 (intermediate determinant), the type of cesarean delivery remained independently associated to death in the final model as a protective factor (OR=0.35; CI95%: 0.24; 0.54). In block 3 (proximal determinants), low birth weight (OR=5.59; CI95%: 3.22;9.70), gestational age <37 weeks (OR=9.34; CI95%: 5.38;16.21) and previous stillbirth (OR=6.65; CI95%: 4.35;10.15) remained independently associated to fetal death.

Table 1

Distribution of maternal characteristics, assistances on fetal deaths, Cuiabá-MT, from 2006 to 2010.

Variables	N	%	Incompleteness (%)
Maternal age (years) n=385			4.2
< 20	80	20.8	
20-34	260	67.5	
≥ 35	45	11.7	
Schooling (years) n=354			11.9
< 8	126	35.6	
≥ 8	228	64.4	
Type of pregnancy n=400			0.5
Singleton	384	96.0	
Multiple 96.0	16	4.0	
Type of delivery n=396			1.5
Vaginal	275	69.4	
Cesarean	121	30.6	
Duration of pregnancy (weeks) n=396			1.5
< 37	294	74.2	
37-41	95	24.0	
≥ 42	07	1.8	
Place of occurrence n=399			0.7
Hospital	392	98.2	
Other	07	1.8	
Gender n=401			0.2
Males	227	56.6	
Females	174	43.4	
Birth weight (grams) n=391			2.7
< 2500	285	72.9	
≥ 2500	106	27.1	
Death related to birth n=401			0.2
Before	390	97.3	
During	11	2.7	

Table 2

Distribution of causes of fetal deaths in Cuiabá-MT, in the period of 2006 to 2010.

The Basic Cause (CID-10)	N	%
Cause of fetal death not specified (P95)	62	15.4
Fetus and newborn affected by maternal hypertension disorders (P00.0)	59	147
Fetus and newborn affected by other forms of placenta abruption and bleeding (P02.1)	48	11.9
Intrauterine hypoxia not specified (P20.9)	33	8.2
Fetus and newborn affected by premature rupture of the membranes (P01.1)	28	7.0
Intrauterine hypoxia diagnosed before the beginning of labor (P20.0)	27	6.7
Fetus and newborn affected by other morphological abnormalities and functional of the placenta and the not specified (P02.2)	17	4.2
Fetus and newborn affected by other compression of umbilical cord (P02.5)	14	3.5
Fetus and newborn affected by maternal kidney and the urinary tract diseases (P00.1)	11	2.7
Fetus and newborn affected by oligohydramnios (P01.2)	10	2.5
Fetus and newborn affected by the mother´s infectious and parasitic diseases (P00.2)	08	2.0
Fetus and newborn affected by maternal trauma (P00.5)	07	1.7
Anencephaly (Q00.0)	05	1.2
Fetus and newborn affected by the use of drugs that cause dependency by the mother (P04.4)	04	1.0
Fetus and newborn affected by other circulatory diseases and respiratory diseases of the mothers (P00.3)	04	1.0
Congenital malformations not specified (Q89.9)	04	1.0
Other causes	61	15.2
Total	402	100.0

Table 3

Distribution of cases and controls, *odds ratio*, confidence interval and *p* -value of cases and controls, Cuiabá-MT, 2006-2010.

Variables	Cases		Controls		OR gross	CI95%	*p*
	n (300)	%	n (900)	%			
Maternal schooling (years)							
≥ 8	199	21.5	725	78.4	1.0	1.57; 2.81	<0.001
< 8	101	36.5	175	63.4	2.1		

continue

Table 3 **concluded**

Distribution of cases and controls, *odds ratio*, confidence interval and *p* -value of cases and controls, Cuiabá-MT, 2006-2010.

Variables	Cases		Controls		OR gross	CI95%	*p*
	n (300)	%	n (900)	%			
Type of hospital							
Private	253	23.2	836	76.7	1.0	1.62; 3.63	<0.001
Non Private	47	42.3	64	57.6	2.4		
Type of delivery							
Vaginal	212	35.0	393	64.9	1.0	0.24; 0.43	<0.001
Cesarean	88	14.7	507	85.2	0.3		
Age (years)							
< 35	266	24.3	828	75.6	1.0	0.96; 2.26	0.078
≥ 35	34	32.0	72	67.9	1.4		
Type of pregnancy							
Singleton	289	24.7	881	75.3	1.0	0.83; 3.75	0.135
Multiple	11	36.6	19	63.3	1.7		
Gestational age (weeks)							
≥ 37	77	8.5	827	91.4	1.0	23.06;46.68	<0.001
< 37	223	75.3	73	24.6	32.8		
Birth weight (grams)							
≥ 2500	84	9.2	827	90.7	1.0	20.58; 41.24	<0.001
< 2500	216	74.7	73	25.2	29.1		
Gender							
Female	150	25.0	450	75.0	1.0	0.77; 1.30	1.000
Male	150	25.0	450	75.0	1.0		
Mother´s occupation							
Housewife	123	24.8	372	75.1	1.0	0.78; 1.32	0.919
Other	177	25.1	528	74.8	1.0		
Live children							
Do not have	105	22.2	367	77.7	1.0	0.88;1.53	0.284
Have	176	24.9	529	75.0	1.1		
Previous episode of fetal death							
Never had	120	13.6	758	86.3	1.0	5.73; 10.40	<0.001
Had	165	55.0	135	45.0	7.7		

Table 4

Factors associated to fetal death according to the block of determinants in Cuiabá, 2006-2010.

Model/Variable	Model I		Model II (n=1200)		Model III (n=1178)	
	1, 2 and 3 isolated		1 + 2		1+2+3	
	OR_a	CI95%	OR_a	CI95%	OR_a	CI95%
1. Block I (distal determinant)						
Maternal schooling						
≥ 8 years	1.0		1.0		1.0	
< 8 years	2.1	1.57; 2.81	1.8	1.39; 2.54	1.5	1.02; 2.47

continue

Table 4 **concluded**

Factors associated to fetal death according to the block of determinants in Cuiabá, 2006-2010.

Model/Variable	Model I		Model II (n=1200)		Model III (n=1178)	
	1, 2 and 3 isolated		1 + 2		1+2+3	
	OR_a	CI95%	OR_a	CI95%	OR_a	CI95%
2. Block II (intermediate determinant)						
Type of delivery						
Vaginal	1.0		1.0		1.0	
Cesarean	0.3	0.24; 0.42	0.3	0.26; 0.45	0.3	0.24; 0.54
3. Block III (proximal determinants)						
Birth weight						
> 2500 grams	1.0				1.0	
< 2500 grams	6.2	3.68; 10.62			5.5	3.22; 9.70
Gestational age						
≥ 37 weeks	1.0				1.0	
< 37 weeks	8.5	5.09; 14.50			9.3	5.38; 16.21
Previous episode of fetal death						
Never had	1.0				1.0	
Had	7.2	4.77; 10.93			6.6	4.35; 10.15

Pearson adjustable test (p=0.06) and Hosmer-Lemeshow test (p=0.16) indicate a good adjustment of the model; OR_a= adjusted *odds ratio*; CI95%=Confidence Interval 95%; SUS=Unified Health System.

Discussion

From 2006 to 2010 showed a decrease of 24.5% in the TMF in the capital of Cuiabá, similar to that one observed in the Midwest region and in countries of middle income as Brazil.[7-8,11] Although the period of time is relatively short to verify trend, it is possible to observe a positive result of the actions of the Towns Committee of Maternal and Infant Mortality established in 2007. Furthermore, in past decades, there was a reduction in fetal mortality in several Brazilian regions and improved notification coverage of vital events in the country.[1,9,12,19]

In the world, about two-thirds of newborns have birth certificates, but less than 5% of fetal deaths are registered.[3] Despite the improvement of the information systems in Cuiabá in recent years, the TMF is below the goal recommended by WHO and Unicef and could be the result of underreporting these deaths, as observed in other regions in this country.[1-2,4,14]

According to the list of causes of preventable deaths by interventions of the Unified Health System,[10] the majority (66.6%) of the causes of fetal deaths described in this study could have been avoided. The preventability is an indicator of the effectiveness of health assistance and can direct the managers to resources in improving prenatal care and delivery.[9]

The finding, as pointed out by other authors,[4,12] on "cause of fetal death not specified" still constitutes a limitation in determining the causes of fetal deaths and becomes difficult to make preventive actions to reduce TMF. In this study, " fetus and newborn affected by maternal hypertension disorders" and "other forms of placenta abruption and bleeding" were responsible for almost a third of fetal deaths, potentially preventable morbidities or treatable through detection and treatment during prenatal and delivery.

As for the factors associated to the occurrence of fetal deaths and low school level are a reflection of a maternal social condition and may be part of an unsuccessful gestational failure.[7] Barber *et al*.[9] in a systematic review found low schooling associated to fetal death in several studies, including in high-income countries as Australia and New Zealand.[7] On the other hand, other authors have not found these associations.[13]

Similar found in other studies,[3,7,20] low weight

and prematurity were associated to fetal death. It is important to emphasize that there is a growing world trend of premature births and declines on fetal deaths.[21] It is possible that premature babies are dying at a later time and elevating neonatal mortality rate, especially early neonatal which was responsible for 48.1% of all infant deaths in the period of 2006 to 2010 in Cuiabá.[22]

As for the reproductive risk in confirming the association between previous episode of fetal death and new occurrence of death as observed in other national and international studies, as the history of fetal death may characterize current pregnancy as high risk.[8,13]

In contrast of other authors´report,[3,7,9] that the advanced maternal age over 35 years showed to be a risk to fetal death, in this study, its occurrence was predominant in young women below 35 years of age (88.3%). Although there are no findings associating fetal death to maternal age, but there is a need for further new studies to understand why there is a high proportion of fetal deaths in women under 35 years of age.

There was less chance of occurrence in fetal death associated to the type of cesarean section. Although the proportion of cesarean sections in Cuiabá is high (59.2%),[23] in urgency/emergency situations, the cesarean section when properly indicated, shortens the duration of labor.[8]

A limitation of this study is referred to the use of secondary data, whose incompleteness of variables, especially the sociodemographic led to the exclusion of 102 fetal deaths. However, this difficulty does not invalidate the researches and systems as SINASC and SIM, which are important tools to identify the possibility of risk factors in deaths.[24-27]

There was a decrease in fetal mortality in Cuiabá with approximately one third of the potential avoidable deaths. Low maternal schooling, low birth weight, prematurity and history of fetal death before the main factors were associated to the occurrence of fetal deaths, suggesting that the socioeconomic situation still determines quality assistance to pregnant women and that public policies should be directed to improve the quality of prenatal care in the city.

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