Original Articles

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Perinatal mortality in the municipality of Salvador, Northeastern Brazil: evolution from 2000 to 2009

ABSTRACT

OBJECTIVE: To describe and analyze the evolution of perinatal mortality with regards the scale and extent of the problem.

METHODS: A descriptive time trend study with 10,994 perinatal deaths to mothers living in Salvador, Bahia, Northeastern Brazil, with a gestational age of ≥ 22 weeks, newborn age of up to six days and birth weight of 500 grams or more, recorded from 2000 to 2009. Data from the Information Systems on Live Births and Mortality of DATASUS/Ministry of Health available on the website were used. Rates of perinatal and fetal mortality per 1,000 births and early neonatal mortality per 1,000 live births were calculated. The Pearson's Qui-square test for differences in proportions, sequence (runs) test, the calculation of moving averages and linear coefficient of determination (R^2) were used for trend analysis. The Wigglesworth classification of causes of death was used.

RESULTS: The rates of perinatal mortality showed a decreasing trend, of -42.0% in the period (from 33.1 (2000) to 19.2 (2009)), with a greater share of rates of neonatal mortality (-56.3%). Fetal mortality accounted for a large proportion (61.9%) of rates of perinatal mortality in 2009. The classification of deaths showed the following most frequent causes of perinatal deaths: intrapartum asphyxia (8.8/1,000), immaturity (7.1/1,000) and congenital malformations (1.3/1,000).

CONCLUSIONS: Perinatal mortality remains high despite the downward trend, and the predominance of fetal mortality indicates recent changes in the profile of causes of death and impact on prevention activities. The quality of prenatal care with risk control and improving care during the delivery may reduce the occurrence of preventable causes of death.

DESCRIPTORS: Perinatal Mortality, trends. Fetal Mortality. Early Neonatal Mortality. Mortality Registries.

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INTRODUCTION

Worldwide, perinatal death predominantly involves fetal, rather than early neonatal component. These events, relevant public health problems, share identifiable causes, susceptible to preventative actions, with those associated with prematurity and low birth weight.[20,21,23] The Millennium Development Goals[a] encourage countries to strive to reduce infant mortality rates and, consequently, neonatal mortality. In spite of the advances that have been made, in some regions this represents over 40.0% of deaths occurring in the first year of life.

Infant mortality has been part of the process of demographic and epidemiological transition in Brazil over the last 60 years. It is characterized by declining rates of birth and of infant death, accompanied by changes in the profile of causes of death and an increase in the ratio of neonatal deaths to postneonatal deaths. In recent years, the decrease in postneonatal mortality attracted attention to neonatal mortality, and above all to its causes, such as prematurity and congenital abnormalities,[7,16,21] and to fetal deaths, the share of perinatal deaths most infrequently dealt with.

Neonatal mortality has been the main component in infant mortality in Brazil since the end of the 1980s. The highest proportion of deaths occurs in the early neonatal period, mainly on the first day. The concentration of deaths in this period indicates the existence of a tight relationship between risk of early neonatal death and access to and quality of health care provided to the pregnant and post-partum women and to their newborns.[2,10,22] Causes of neonatal death are due to factors such as pre-term births, low birth weight and complications during pregnancy, birth and delivery.[10,17] Data from the Ministry of Health for 2009[b] suggest this, as they show that 52.2% of infant deaths were early neonatal.

Although there are a growing number of studies on perinatal mortality, there are few for the North and Northeast of Brazil,[7,8] limiting the view of the real dimension of this problem and the extent and effectiveness of means of tackling it. The aim of this study was to analyze the evolution of perinatal mortality with regards the size and extent of the problem.

METHODS

A descriptive time trend study carried out in Salvador, Bahia. According to the Brazilian Institute of Geography and Statistics[c] (IBGE), in 2009, 37,652 births were recorded in the municipality, with the birth rate tending to decrease and approximately 1/3 of the population living in neighborhoods with precarious socioeconomic conditions.

The sources of data were the *Sistema de Informações sobre Mortalidade* database (SIM – Mortality Information System), and that of the *Sistema de Informações sobre Nascidos Vivos* (SINASC – Live Births Information System)), provided by the DATASUS/ Brazilian Ministry of Health on their website, accessed in April 2013.[b] Eligible cases were perinatal deaths that occurred in between 2000 and 2009 in Salvador, to mothers resident in the city, with a gestational age of ≥ 22 weeks to six days old and with a birth weight of ≥ 500 grams.[d] The ICD-10th Revision definition of perinatal death was that adopted, except for the limit of six days old. The classification includes the seventh day; however, when data from the death certificates (DC), registered in the SIM were obtained, length of life was classified as zero to six days, seven to 27 days and other categories.

The variables of the DC studied were: sex of the newborn; mother's age (in years), mother's schooling (years of study), length of pregnancy (weeks); type of pregnancy; type of birth; race/skin color of the newborn; and birth weight (grams). The perinatal (PMR) and fetal (FMR) antepartum and intrapartum mortality rates, the early neonatal mortality rate (ENMR) were calculated for each year, using published methods,[e] as were the percentage variation in the rates between the first and last years in the series studied.

The temporal evolution analysis was carried out using graphic representations of the trend curves of the mortality rates, compared with the curves for the autoregressive integrated moving averages of order 2. Test sequences (runs) were used to verify whether the series occurred randomly. The trend was estimated by calculating the linear coefficient of determination (R^2). The characteristics of the fetal and early neonatal deaths were compared for the last year according to categories

[a] United Nations Millennium Declaration. Resolution adopted by the General Assembly [*without reference to a Main Committee (A/55/L.2)*]. 55/2. United Nations Millennium Declaration. New York; 2000. (A/RES 55/2). [cited 2013 Nov 06]. Available from: http://www.un.org/millennium/declaration/ares552e.htm

[b] Ministério da Saúde, Departamento de Informática do SUS. Datasus. Brasília (DF): 2013 [cited 2013 Sept 14]. Available from: http://www2.datasus.gov.br/DATASUS/index.php?area=0205

[c] Instituto Brasileiro de Geografia e Estatística. Indicadores sociodemográficos e de saúde no Brasil 2009. Rio de Janeiro; 2009 [cited 2013 Oct 22]. Available from: http://www.ibge.gov.br/home/estatistica/populacao/indic_sociosaude/2009/

[d] Organização Mundial da Saúde. Classificação estatística internacional de doenças e problemas relacionados a saúde - CID-10: 10ª revisão. 8.ed. São Paulo: EDUSP; 2000. v.1, p.1184.

[e] Ministério da Saúde, Secretaria de Vigilância em Saúde, Departamento de Análise de Situação em Saúde, Coordenação Geral de Informação e Análise Epidemiológica. Manual de vigilância do óbito infantil e fetal e do Comitê de Prevenção do Óbito Infantil e Fetal. Brasília (DF); 2009. (Série A. Normas e Manuais Técnicos).

of maternal variables. Pearson's Chi-square test, with a level of significance of 5% was used to test the differences between proportions.

The Wigglesworth[24] classification was applied to the analyses of causes of perinatal death for the 2009 cases. This is a classification that focuses on preventability of deaths and passive aspects of intervention by health care services and presents the causes of death in five categories: antepartum fetal deaths, congenital malformations, intrapartum asphyxia, prematurity and other specific causes, which include infections that, although common, are serious in pregnancy, such as toxoplasmosis, rubella, cytomegalovirus and herpes. This classification from 1980 is widely used in studies of perinatal mortality and uses clinical data that are easily understood by health care professionals and managers.

The Stata version 10® and the EpiInfo version 6.04d statistics package were used in processing and analyzing the data. The project was approved by the Research Ethics Committee of the *Instituto de Saúde Coletiva, Universidade Federal da Bahia* (Process no. 021-09).

RESULTS

Of the 10,994 deaths registered between 2000 and 2009, an overall trend for perinatal mortality and its

components to decrease was observed. In contrast with the progressive decrease in the total number of deaths recorded, which went form 1,513 in 2000 to 722 in 2009 (-52.3%), the proportion of fetal deaths increased from 49.7% in the first year to 61.9% in the final year of the series (Figure 1). The number of live births had decreased 17.3% by 2009, considering the total of 44,976 in 2000.

PMR varied from 33.1/1,000 births in 2000 to 19.2 in 2009 (a negative variation of 42.0%). This trend for decreases in PMR is also shown by the value of 92.3% for R^2 between the years of the series and the figures for this rate. Of the components of PMR, FMR varied relatively little from the figure of 16.4 in 2000, with a slight decrease by 2006 (15.7) and some oscillation. The figures fell more consistently in 2007, until reaching 11.9 in 2009 (a decrease of 27.8% at the end of the series). The ENMR showed a more significant decrease (56.3%), going from 16.9 to 7.4/1,000 live births in the period (Figure 2).

Application of the test sequences (runs) to verify if any randomness had occurred in the temporal distribution of the values for the series resulted in the rejection of this null hypothesis with $p < 0.05$ for perinatal, early neonatal and ante- and intrapartum fetal mortality rates.

Among the 722 perinatal deaths recorded in the final year of the series, 61.9% were fetal and 38.1% were
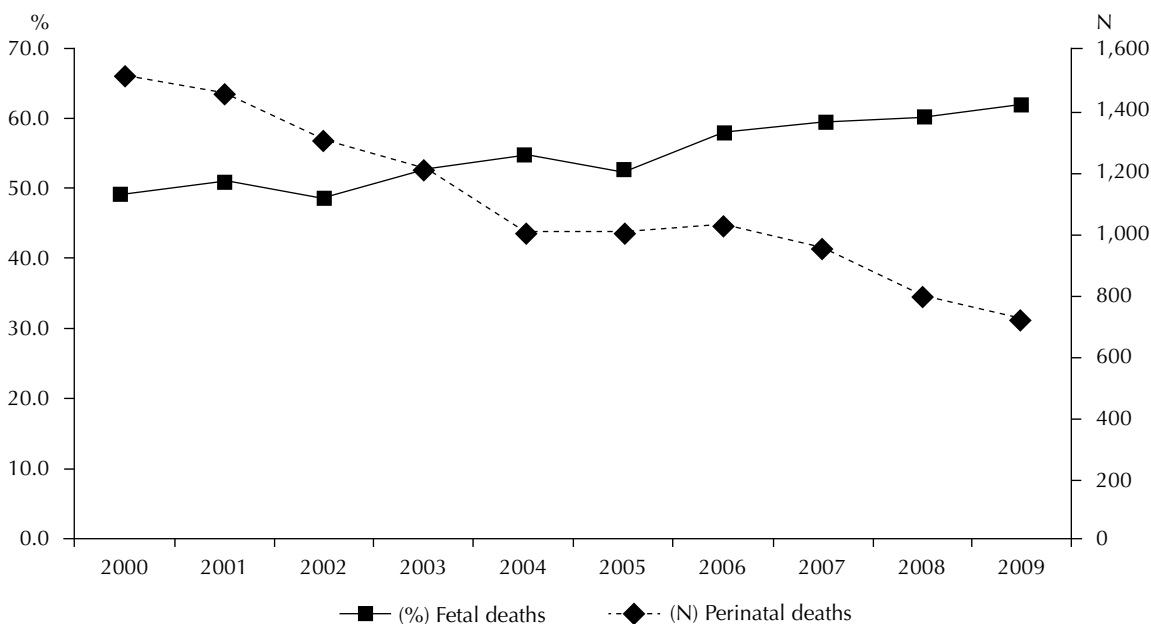
Source: *Sistema de Informação sobre Mortalidade/DATASUS/Ministério da Saúde*. [cited 2013 Nov 6]. Available from: http://tabnet.datasus.gov.br/cgi/deftohtm.exe?sim/cnv/inf10ba.def, http://tabnet.datasus.gov.br/cgi/deftohtm.exe?sim/cnv/fet10ba.def and http://tabnet.datasus.gov.br/cgi/deftohtm.exe?sinasc/cnv/nvba.def

Figure 1. Evolution in the number of perinatal deaths and in the proportion of total perinatal deaths that were fetal deaths. Salvador, BA, Northeastern Brazil, 2000 to 2009.
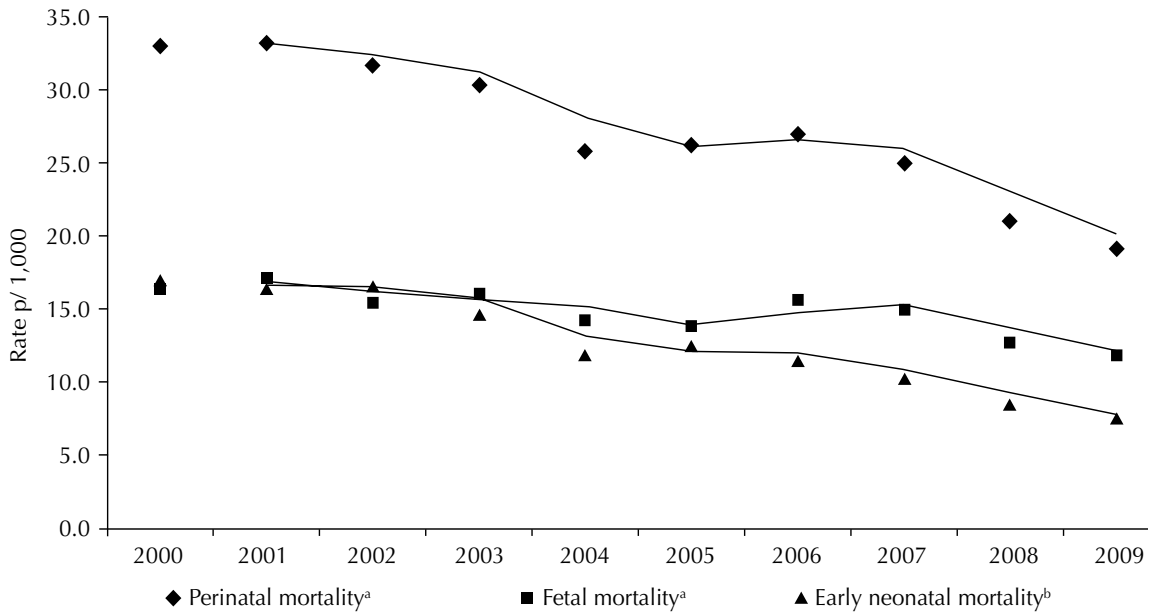
Source: *Sistema de Informações sobre Mortalidade, Sistema de Informações sobre Nascidos Vivos DATASUS/Ministério da Saúde*. [cited 2013 Nov 6]. Available from: http://tabnet.datasus.gov.br/cgi/deftohtm.exe?sim/cnv/inf10ba.def, http://tabnet.datasus.gov.br/cgi/deftohtm.exe?sim/cnv/fet10ba.def and http://tabnet.datasus.gov.br/cgi/deftohtm.exe?sinasc/cnv/nvba.def
Dots represent observed values and lines represent moving averages of order 2
[a] Rate per 1,000 births
[b] Rate per 1,000 live births

Figure 2. Evolution in observed fetal, early neonatal and perinatal mortality rates and in moving averages. Salvador, BA, Northeastern Brazil, 2000 to 2009.

early neonatal. Of the fetal deaths, 93.5% occurred antepartum. For 6.55 this data was not recorded. In 72.7% of the fetal and in 83.6% of the early neonatal deaths prematurity occurred, and low birth weight was recorded in 71.4% and 83.6% respectively.

Comparing with the other categories of variables studied in 2009, PMR was higher among mothers aged over 20, with fewer than eight years of schooling, with pregnancies lasting between 22 and 27 weeks and with birth weight between 500 and 999 grams. However, the differences between the rates in these categories were not statistically significant (Table 1).

When the Wigglesworth[12] classification was applied, it was verified that the most frequent causes of perinatal death in 2009 were, in decreasing order: intrapartum asphyxia (8.8/1,000), prematurity (7.1/1,000) and congenital malformations (1.3/1,000) (Table 2). Three causes accounted for a little over 75.0% of fetal deaths: Intrauterine hypoxia - P20 (44.7%); fetus and newborn affected by complications of placenta, umbilical cord and membranes - P02 (18.3%); fetus and newborn affected by maternal conditions, not necessarily related with the current pregnancy - P00 (15.2%). For early neonatal deaths, 54.2% were related to six causes, such as: Disorders related to short gestation and low birth weight - P07 (20.4%), respiratory distress of the

newborn - P22 (10.2%), bacterial sepsis of newborn - P36 (8.0%), birth asphyxia - P21 (6.2%), and with equal value (4.7%) other infections specific to the perinatal period - P39 and other conditions originating in the perinatal period - P96.

Over the years, there was a significant decrease in the underreporting of data on maternal characteristics, with the exception of the variables race/skin color and mother's schooling, which underwent a slight decrease. In 2009, loss of data did not exceed 10.0% (6.6%) for time of death in relation to the birth; 4.4% for length of pregnancy; 4.2% for birth weight, 3.0% for type of delivery; 3.0% for type of pregnancy. Lack of data remained high for: schooling (40.6%), age (13.0%) and race/skin color of the newborn (41.1%), considering that this is not recorded on the DC for fetal death.

DISCUSSION

The North and Northeast were the regions that had the highest perinatal mortality rates in 2009 (20.9 and 20.1/1,000 births), compared with a rate of 13.3 in the South, the lowest rate in the country in that year according to DATASUS/Brazilian Ministry of Health.[b] The PMR in the municipality of Salvador (19.2 per thousand) was close to that calculated for

Table 1. Number of deaths and fetal, early neonatal and perinatal mortality rates according to the variables selected. Salvador, BA, Northeastern Brazil, 2009.

Variable	Fetal		Early neonatal		Perinatal	
	n	Rate[a]	n	Rate[b]	n	Rate[a]
Sex						
Male	216	11.2	157	8.3	373	19.4
Female	205	11.2	113	6.2	318	17.3
Unknown	26		5			
Mother's age (years)						
10 to 19	55	9.7	39	6.9	94	16.5
20 and +	335	10.5	199	6.3	534	16.7
Unknown	57		37			
Maternal schooling (years)						
0 to 7	110	10.7	64	6.3	174	16.9
8 and +	161	6.0	94	3.5	255	9.5
Unknown	176		117			
Length of pregnancy (weeks)						
22 to 27	126	278.8	134	411.0	260	575.2
28 to 31	96	193.9	60	150.4	156	315.2
32 to 36	103	39.7	36	14.4	139	53.5
37 and +	102	3.0	33	1.0	135	4.0
Unknown	20		12			
Type of pregnancy						
Single	417	11.3	246	6.8	663	18.0
Multiple	20	23.4	17	20.4	37	43.4
Unknown	10		12			
Type of delivery						
Vaginal	324	16.6	188	9.8	512	26.2
Cesarean	114	6.3	74	4.1	188	10.4
Unknown	9		13			
Birth weight (grams)						
500 to 999	128	235.3	144	346.2	272	500.0
1,000 to 2,499	191	51.4	86	24.4	277	74.5
2,500 and +	112	3.4	31	0.9	143	4.3
Unknown	16		14			

Sources: *Ministério da Saúde. Sistema de Informações sobre Mortalidade.* [cited 2013 Nov 6]. Available from: http://tabnet. datasus.gov.br/cgi/deftohtm.exe?sim/cnv/inf10ba.def and http://tabnet.datasus.gov.br/cgi/deftohtm.exe?sim/cnv/fet10ba.def
Ministério da Saúde. Sistema de Informações sobre nascidos vivos. [cited 2013 Nov 6]. Available from: http://tabnet.datasus. gov.br/cgi/deftohtm.exe?sinasc/cnv/nvba.def
DATASUS/Ministério da Saúde Ministério da Saúde, Departamento de Informática do SUS. Datasus. Brasília (DF): 2013. [cited 2013 Sept 14]. Available from: http://www2.datasus.gov.br/DATASUS/index.php?area=0205
[a] per 1,000 births
[b] per 1,000 live births

the Northeast, exceeding the rate for the country as a whole (17.3/1,000). These rates are high compared to those recorded in Germany (5.3), Portugal (5.2), Spain (4.7), Finland (2.6) and the United States (6.6) per thousand births.[f]

Although the figures are high, the PMR decreased significantly in Salvador, with a difference (42.0%) greater than that observed in the North East (11.4%) or in the country as a whole (19.9%). This decrease was due, primarily, to the decrease in early neonatal

[f] World Health Organization, Regional Office for Europe. European Health for All Database (HFA-DB). Stockholm; 2010 [cited 2013 Sept 14]. Available from: http://data.euro.who.int/hfadb/

Table 2. Number, percentage and rates of perinatal mortality (per thousand births) according to cause of death. Wigglesworth classification.[24] Salvador, BA, Northeastern Brazil, 2009.

Groups of causes of death	n	Percentage of all deaths (%)	Mortality rate /1,000
Antepartum fetal death	40	5.5	1.1
Congenital malformations	49	6.8	1.3
Prematurity	266	36.8	7.1
Intrapartum asphyxia	332	46.0	8.8
Other	35	4.8	0.9
Total	722	100.0	19.2

Sources: *Sistema de Informações sobre Mortalidade, Sistema de Informações sobre Nascidos vivos/DATASUS/ Ministério da Saúde*. [cited 2013 Nov 6]. Available from: http://tabnet.datasus.gov.br/cgi/deftohtm.exe?sim/cnv/ inf10ba.def, http://tabnet.datasus.gov.br/cgi/deftohtm. exe?sim/cnv/fet10ba.def and http://tabnet.datasus.gov.br/ cgi/deftohtm.exe?sinasc/cnv/nvba.def

mortality. These results were expected in view of the prioritization of health care actions aimed at improving neonatal health care over the last decade.[g] There has been an increase in the number of beds in intensive care units, increased coverage of both primary care and the *Programa de Saúde da Família* (Family Health Care Program), and in the functioning of the *Comitê de Prevenção do Óbito Infantil e Fetal* (Committee for Preventing Infant and Fetal Death), factors which may have influenced the favorable evolution in PMR.

In Salvador, in recent years, fetal mortality has been the principle perinatal mortality problem. The fetal component was greater than that of the early neonatal component in 2009, with the majority of fetal deaths occurring antepartum. These results differ from those observed in Sao Paulo, SP (63.0% fetal deaths, with 95.0% antepartum),[4] in Caxias do Sul, RS (79.5% fetal deaths),[12] in Belo Horizonte, MG (62.5% fetal deaths),[h] and in Recife, PE (57.8% fetal deaths).[5] Advances are still needed in reducing fetal mortality as a strategy for reducing perinatal mortality and in promoting maternal health.

The categories adopted in the Wigglesworth[24] classification refer to the health care processes for the mother and baby during pregnancy, birth and in the postpartum period. This may result in early diagnosis, more effective treatment and in the prevention of health risks and problems. The main causes of perinatal death observed in this study, intrapartum asphyxia and prematurity would be related to failures in obstetric management and/or neonatal resuscitation. This indicates deficiencies in prenatal care, care during the birth and for the newborn. In 2009, the proportion of pregnant women who had prenatal care (93.7%) and who had had the appropriate number of appointments for the gestational age (89.6%) was high. However, this information does not agree with the unfavorable pregnancy outcomes reported.[9,14,19] There are deficiencies in the quality of health care appointments, in the treatment of complications during the pregnancy, of which intrauterine growth restriction, one of the causes of low birth weight, stands out, as do maternal-fetal infections.

Low levels of maternal schooling is described as a determining factor in neonatal mortality.[5,11,18] In Salvador, the high percentage of DC that do not record this variable (40.6%) means that its relationship with PMR cannot be defined, it is possible that perinatal deaths occur with greater frequency in the group with lower levels of schooling, for whom no information was obtained or was able to be obtained. The high level of incompleteness for the variable of maternal schooling and that of the newborn's race/skin color deserves greater attention from health care service professionals and managers. These variables are necessary for the study of social inequalities in health care,[6,13] for analyzing the situation of the most vulnerable groups in society and for better planning of health care actions.

Caution is needed when examining the data presented, due to deficiencies in the data used to calculate indicators of perinatal mortality. This is a significant problem for developing countries and areas, such as Brazil and its Northeast. Lack of data, errors in classifying neonatal death as stillbirth, incomplete or incorrect DCs, not recording gestational age, type of pregnancy, birth weight are all problems, along with other under-recording and underreporting. These factors could lead to rates being underestimated and the need to calculate indicators based in estimates.[1,3,15] There was a reduction in almost all causes of death by symptoms, signs and abnormal findings in clinical and laboratorial examinations, suggesting the existence of initiatives in improving clinical diagnosis and completing the DC.

Originally, the study aimed to study a longer time series, including data from 1998 to 1999. However, large discrepancies were found in the data between 1999 and from 2000 onwards; in 1999, according to the DATASUS,[b] 288 fetal deaths were recorded, compared with 752 in 2000. This sharp increase can probably be

[g] Secretaria Municipal de Saúde. Relatório anual da atenção básica para manutenção do incentivo financeiro estadual. Salvador, BA, dezembro, 2008. [cited 2013 Nov 6]. Available from: http://www.google.com.br/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CCgQFjAA&url=htt p%3A%2F%2Fxa.yimg.com%2Fkq%2Fgroups%2F20809189%2F1276467147%2Fname%2FUNKNOWN_PARAMETER_VALUE&ei=Ddt6Upve E43qkQepj4HQCw&usg=AFQjCNEiSdelbOOf444090MvXrjI9kDT_Q&sig2=OTZeIzJFgqPxIZjOhBKqSw&bvm=bv.55980276,d.eW
[h] Martins EF. Mortalidade perinatal e avaliação da assistência ao pré-natal, ao parto e ao recém-nascido em Belo Horizonte [tese de doutorado]. Belo Horizonte: Escola de Enfermagem da Universidade Federal de Minas Gerais; 2010.

attributed to improvements in recording, with the adoption of the 10th revision of the ICD in 1996, which may have contributed to the increased number of perinatal deaths recorded, as this classification considered the perinatal period to be from the 22nd week of pregnancy, in contrast to the previous classification, which considered this period to start at 28 weeks. Another limitation in studying perinatal morality and its risk factors and determinants is in the separate systems for registering births and deaths, which do not give a single identifying reference number to the same case.

The results of this study attract more attention to the prevention of fetal and neonatal death and the need for research into the magnitude, trends and factors associated with perinatal mortality.

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