AVOIDABLE CHILD MORTALITY AND SOCIAL VULNERABILITY IN VALE DO JEQUITINHONHA, MINAS GERAIS, BRAZIL

MORTALIDADE INFANTIL EVITÁVEL E VULNERABILIDADE SOCIAL NO VALE DO JEQUITINHONHA, MINAS GERAIS, BRASIL

MORTALIDAD INFANTIL EVITABLE Y VULNERABILIDAD SOCIAL EN EL VALLE DEL JEQUITINHONHA, MINAS GERAIS, BRASIL

🗅 Thania Aparecida Gomes da Silva Barbosa¹

Andrea Gazzinelli¹

Gisele Nepomuceno de Andrade¹

¹ Universidade Federal de Minas Gerais – UFMG, Escola de Enfermagem – Departamento de Enfermagem Materno Infantil e Saúde Pública. Belo Horizonte, MG – Brazil.

Corresponding author: Thania Aparecida Gomes da Silva Barbosa E-mail: thaniabarbosa@yahoo.com.br

Author's Contribuitions:

Conceptualization: Thania A. G. S. Barbosa, Andrea Gazzinelli. Gisele N. Andrade; Data Collection: Thania A. G. S. Barbosa, Andrea Gazzinelli, Gisele N. Andrade; Funding Acquisition: Andrea Gazzinelli; Investigation: Thania A. G. S. Barbosa, Andrea Gazzinelli, Gisele N. Andrade; Methodology: Thania A. G. S. Barbosa, Andrea Gazzinelli, Gisele N. Andrade; Project Management: Thania A. G. S. Barbosa, Andrea Gazzinelli, Gisele N. Andrade; Resources Management: Thania A. G. S. Barbosa, Andrea Gazzinelli, Gisele N. Andrade; Statistical Analysis: Thania A. G. S. Barbosa; Supervision: Thania A. G. S Barbosa, Andrea Gazzinelli, Gisele N. Andrade; Validation: Thania A. G. S. Barbosa, Andrea Gazzinelli, Gisele N. Andrade; Visualization: Thania A. G. S. Barbosa, Andrea Gazzinelli, Gisele N. Andrade; Writing – Original Draft Preparation: Thania A. G. S. Barbosa, Andrea Gazzinelli, Gisele N. Andrade; Writing - Review and Editing: Thania A. G. S. Barbosa, Andrea Gazzinelli, Gisele N. Andrade.

Funding: No funding.

Submitted on: 2019/01/05 Approved on: 2019/07/21

ABSTRACT

Objective: to analyze the occurrence of child mortality according to avoidability and social vulnerability criteria in Vale do Jequitinhonha, Minas Gerais. Methods: a crosssectional study conducted with data from the Ministry of Health's information systems between 2009 and 2014. The social vulnerability index of the cities was considered and the causes of death were classified according to the list of preventable causes by SUS intervention. The proportions, and corrected rates of general and stratified child mortality were calculated. The differences were assessed using the Chi-square test, throughout the period and between the three year periods of 2009-11 and 2012-14. Results: the mean infant mortality rate was 19.5 deaths/1,000 live births. In the total, 69.6% of the deaths were classified as preventable. Reductions were observed of 35.7% and 26.1% in the preventable deaths due to actions of care to women during pregnancy (p = 0.00) and newborns (p = 0.04), respectively, and an increase of 71.3% in preventable deaths due to actions of care to women in childbirth (p = 0.01). A predominance of preventable deaths was demonstrated in municipalities with greater social vulnerability (p = 0.00). **Conclusions:** the results highlighted the importance of preventable causes related to health care at delivery and, despite the observed reductions, in pregnancy and the newborn. They also evidenced the highest proportion of preventable deaths in the most vulnerable population. The challenge of reducing this mortality indicates the urgency for actions aimed at reducing social inequalities, as well as the need for improvements in access and quality of care services.

Keywords: Child Mortality; Death Causes; Social Indicators; Ecological Studies.

RESUMO

Objetivo: analisar a ocorrência de mortalidade infantil segundo critérios de evitabilidade e de vulnerabilidade social no Vale do Jequitinhonha, Minas Gerais. Métodos: estudo transversal realizado com dados dos sistemas de informação do Ministério da Saúde, entre 2009 e 2014. Foi considerado o índice de vulnerabilidade social das cidades e as causas de morte foram classificadas conforme lista de causas evitáveis por intervenção do SUS. Foram calculadas as proporções, taxas corrigidas de mortalidade infantil geral e estratificadas. Diferenças foram avaliadas por meio do teste qui-quadrado em todo o período e entre os triênios 2009-11 e 2012-14. Resultados: a taxa de mortalidade infantil média foi de 21,7 óbitos /1.000 nascidos vivos. No total, 69,5% dos óbitos foram classificados como evitáveis. Foram observadas reduções de 34,9 e 26,5% nos óbitos evitáveis por ações de atenção à mulher na gestação (p=0,00) e ao recém-nascido (p=0,04), respectivamente, e aumento de 65,8% nos óbitos evitáveis por ações de atenção à mulher no parto (p=0,01). Foi demonstrada predominância de óbitos evitáveis nos municípios de mais vulnerabilidade social (p=0,00). Conclusões: os resultados destacaram a importância das causas evitáveis relacionadas ao cuidado em saúde no momento do parto e, apesar das reduções observadas, na gestação e ao recém-nascido. Também evidenciaram a maior proporção de óbitos evitáveis na população mais vulnerável. O desafio de reduzir

How to cite this article:

Barbosa TAGS, Gazzinelli A, Andrade GN. Avoidable child mortality and social vulnerability in *Vale do Jequitinhonha, Minas Gerais*, Brazil. REME – Rev Min Enferm. 2019[cited _______];23:e-1246. Available from: ______DOI: 10.5935/1415-2762.20190094

essa mortalidade indica a urgência por ações que visem à redução das desigualdades sociais, bem como a necessidade de melhorias no acesso e na qualidade dos serviços assistenciais.

Palavras-chave: Mortalidade Infantil; Causas de Morte; Indicadores Sociais; Estudos Ecológicos.

RESUMEN

Objetivo: analizar la incidencia de mortalidad infantil según los criterios de prevención y vulnerabilidad social en el Valle del Ieauitinhonha, Minas Gerais, **Métodos:** estudio transversal realizado con datos de los sistemas de información del Ministerio de Salud. entre 2009 y 2014. Se consideró el índice de vulnerabilidad social de las ciudades y las causas de muerte se clasificaron según la lista de causas evitables por intervención del SUS. Se calcularon las proporciones, las tasas corregidas de mortalidad infantil general y estratificadas. Las diferencias se evaluaron mediante la prueba de chi-cuadrado durante todo el período y entre los trienios 2009-11 y 2012-14. Resultados: la tasa promedio de mortalidad infantil era de 21,7 muertes / 1.000 nacimientos vivos. En total, el 69,5% de las muertes se clasificaron como evitables. Se observaron reducciones de 34,9 y 26,5% en muertes prevenibles debido a acciones de atención de las mujeres durante el embarazo (p = 0.00) y recién nacidos (p =0.04), respectivamente, y un aumento de 65, 8% en muertes evitables mediante acciones de atención a mujeres en el parto (p = 0.01). La prevalencia de muertes evitables se demostró en municipios con mayor vulnerabilidad social (p = 0,00). **Conclusiones:** los resultados realzaron la importancia de las causas evitables relacionadas con la atención médica en el parto y, a pesar de las reducciones observadas, en el embarazo y el recién nacido. También mostraron la mayor proporción de muertes evitables en la población más vulnerable. El desafío de reducir esta mortalidad indica la urgencia de acciones dirigidas a reducir las desigualdades sociales, así como la necesidad de mejorar el acceso y la calidad de los servicios asistenciales.

Palabras clave: Mortalidad Infantil; Causas de Muerte; Indicadores Sociales; Estudios Ecológicos.

INTRODUCTION

Mortality in the first year of life represents a severe public health problem in developing countries, despite significant advances in improving child survival in recent decades. In Brazil, the Child Mortality Rate (CMR) has decreased by 70% since 1990, decreasing from 51 deaths per 1,000 live births (LBs) to 15 in 2015. However, the national rate remains high and with differences between the federal units.¹

The challenge of reducing child mortality has been included in the "Sustainable Development Goals" (SDGs) and the global community has made, among other goals, a commitment to eradicate preventable deaths in children under five by the year 2030. For this to happen, monitoring the occurrence of child deaths represents a fundamental strategy to assess the health status of populations and to develop measures aimed at reducing the risk of death in this age group. Child deaths from preventable causes are preventable events under satisfactory conditions of availability and utilization of health care resources.² In Brazil, most childhood deaths are considered totally or partially preventable by actions of accessible and effective health care services.^{1;3} An example of this is communicable diseases and maternal, neonatal and nutritional disorders considered responsible for more than half of child deaths in 2015, showing a large share of preventable causes related to health care during pregnancy, labor and birth.¹

In this national scenario that presents a predominance of preventable causes of infant deaths, the risk of death in the first year of life involves, in addition to maternal and child biological factors, the social and economic conditions in which the mother and child live, as well as failures in the health care system.⁴ Inequities related to the level of socioeconomic development and access to health services lead to a higher concentration of child deaths in the poorer population.^{5,6}

The risk of death in the first year of life is higher in the North, Northeast and some areas of southeastern Brazil, such as *Vale do Jequitinhonha*. It is believed that a broader understanding of the diagnosis of child mortality in these admittedly more vulnerable territories may contribute to the better targeting of actions and policies necessary for their reduction.⁶

This study aimed, therefore, to analyze the occurrence of child mortality according to avoidability and social vulnerability criteria in *Vale do Jequitinhonha*, *Minas Gerais*.

METHODS

This cross-sectional study was conducted with secondary data from the Mortality Information System (MIS) and the Live Birth Information System (LBIS) regarding infant deaths and live births of women living in the 51 municipalities of *Vale do Jequitinhonha, Minas Gerais,* from 2009 to 2014. The selected period was divided into two trienniums: 2009 to 2011 and 2012 to 2014.

Vale do Jequitinhonha is located in the northeast of *Minas Gerais*; it is formed by 51 municipalities and has 50,000 km² of territorial extension, where approximately 730 thousand people live. Characterized by poverty rates that place it among the poorest regions of the state, the region has severe environmental, economic, social and health problems.⁷

Local vulnerability is evidenced by low schooling rates, low labor market dynamism and relatively high rates of drug and alcohol use, sexual exploitation of minors, family breakdown, teenage pregnancy, child labor and violence against the elderly. Nearly 40% of the population lives in rural areas and less than half of households have access to basic sanitation and household solid waste collection services.⁷ Regarding the health system, the municipalities of *Vale do Jequitinhonha* have good population coverage estimated in primary care, corresponding to 95% considering the number of Family Health and Primary Care teams per 3,000 inhabitants. The region also has 27 public and private hospitals, distributed in 24 of the municipalities.⁸

Of this total, 16 hospitals offer assistance in surgical obstetrics, with 56 beds for this type of care by the Brazilian Unified Health System (*Sistema Único de Saúde*, SUS). The most complex care in neonatology and pediatrics is concentrated in 5 cities, as follows: Araçuaí, Diamantina, Itamarandiba, Jequitinhonha, Pedra Azul and Turmalina. There are 23 public intermediate and intensive care beds for child care in the region in the whole region.⁸

Child deaths were classified into two groups (preventable and non-avoidable), according to criteria described in the update of the list for causes of preventable deaths by SUS intervention and codes of the International Classification of Diseases (ICD-10). The avoidable causes were further subdivided into six subgroups according to the type of health intervention: 1- reducible by immunoprevention actions, 2reducible by adequate care to women during pregnancy, 3reducible by adequate care to women in childbirth, 4- reducible by adequate care to the newborn, 5- reducible by appropriate diagnostic actions and treatment, 6- reducible by appropriate health promotion actions.³

To assess the vulnerability conditions, the Social Vulnerability Index (SVI) of each municipality was considered for 2010. This is a synthetic index that is complementary to the Municipal Human Development Index (MHDI) that supports the identification of regions where situations indicative of exclusion and social vulnerability coexist.

The SVI can range from 0 to 1, with a value closer to 1 indicating greater social vulnerability. The strata adopted for the classification of this indicator were the following: very low vulnerability, if SVI between 0 and 0.200 – low vulnerability, if SVI between 0.201 and 0.300 – medium vulnerability, if SVI between 0.301 and 0.400 – high vulnerability, if SVI between 0.401 and 0.500 – and very high vulnerability for any value between 0.501 and 1.⁹ In the analyses, the strata of very low with low vulnerability and medium with high vulnerability were grouped.

Considering the existence of problems regarding the completeness of vital MIS and LBIS statistics, two methodological procedures were adopted for their correction. The first was the proportional redistribution of the ill-defined causes of death among the other causes;^{10,11} the second was the correction of sub-records and unspecific records according to information adequacy level and population size.¹²

For data analysis, proportions and corrected rates of overall child mortality and by municipality were calculated by grouping according to avoidability criteria and by social vulnerability strata. The percentage variations of the rates between the three years were estimated and, for the evaluation of the differences between the proportions, the chi-square test with a significance level of 5% was used. The main death causes were described in a table.

This study is in accordance with the ethical principles contained in Resolution N° 466/12 of the Brasilian *Conselho Nacional de Saúde* and was approved by the Ethics and Research Committee of the *Universidade Federal de Minas Gerais* (CAAE: 40882815.0.0000.5149).

RESULTS

Between the years 2009 and 2014, there were 1061 deaths among children under one year old and 54,319 live births born to women living in *Vale do Jequitinhonha, Minas Gerais.* The corrected CMR of the general population was 19.5 deaths per thousand LBs, having declined from 21.7 deaths per thousand LBs in 2009 to 15.2 in 2014.

Of the 51 municipalities included in the study, 21 cities had corrected rates higher than the overall mean. *Cachoeira de Pajeú* (48.9) and *Salto da Divisa* (43.2) stood out, with estimated values equivalent to twice the general mean; the municipalities of *Aricanduva* (6.7), *Carbonita* (11.7), *Mata Verde* (9.3) and *Santo Antônio do Jacinto* (6.9) had the lowest estimated values (Figure 1).

In general, the municipalities had a high social vulnerability, with a mean SVI of 0.420 (SD \pm 0.06%), with the lowest index in Leme do Prado (0.267) and the highest in Caraí and Monte Formoso (0.519) (Figure 1).

From 2009 to 2014, 69.6% of the child deaths were classified as preventable (n=738), with a significant reduction between the three-year periods analyzed (14.8%). The avoidability subgroups for adequate care to women during pregnancy (n=307; 29.1%), at delivery (n=132; 12.5%) and to the newborn (n=182; 17.1%) were predominant.

The comparison of the percentages of preventable deaths among the three-year periods showed a significant difference in the subgroups of deaths that could be reduced due to adequate care actions for pregnant women and newborns. The corrected mortality rates specific for these groups showed falls of 35.7% (p = 0.00) and 26.1% (p = 0.04), respectively, from one triennium to the next (Table 1). On the other hand, the proportion of deaths in the group of potentially preventable deaths due to adequate care to women at delivery increased significantly between three years. Specific rates for this subgroup of causes ranged from 1.8 to 3.1 preventable deaths per 1,000 LBs, representing a 71.3% increase (p=0.00) (Table 1).



Municipalities	CMR	SVI	Municipalities	CMR SVI
1 - Gouveia	20.9		27 - Itinga	14.7
2 - Diamantina	19.6		28 - Comercinho	17.0
3 - Datas	13.6		29 - Caraí	20.7
4 - Presidente Kubitschek	27.9		30 - Ponto dos Volantes	17.3
5 - Couto de Magalhães de Minas	14.6		31 - Padre Paraíso	17.1
6 - São Gonçalo do Rio Preto	18.7		32 - Medina	22.8
7 - Senador Modestino Gonçalves	25.4		33 - Cachoeira de Pajeú	48.9
8 - Felício dos Santos	15.1		34 - Itaobim	18.7
9 - Carbonita	11.7		35 - Jequitinhonha	14.8
10 - Itamarandiba	17.7		36 - Pedra Azul	23.8
11 - Turmalina	14.2		37 - Monte Formoso	22.0
12 - Veredinha	16.6		38 - Joaíma	16.7
13 - Leme do Prado	0.0		39 - Divisópolis	14.0
14 - José Gonçalves de Minas	14.9		40 - Almenara	16.9
15 - Aricanduva	6.7		41 - Felisburgo	29.9
16 - Capelinha	16.4		42 - Mata Verde	9.3
17 - Minas Novas	25.0		43 - Bandeira	29.8
18 - Chapada do Norte	19.3		44 - Rio do Prado	27.4
19 - Berilo	14.1		45 - Rubim	34.1
20 - Virgem da Lapa	19.8		46 - Palmópolis	15.6
21 - Francisco Badaró	23.0		47 - Jordânia	21.8
22 - Angelândia	32.6		48 - Jacinto	19.1
23 - Jenipapo de Minas	13.1		49 - Santo Antônio do Jacinto	6.9
24 - Coronel Murta	12.4		50 - Santa Maria do Salto	37.1
25 - Araçuaí	17.1		51 - Salto da Divisa	43.2
26 - Novo Cruzeiro	25.9			

 Social Vulnerability Index (SVI)

 Low – Up to 0.300

 Medium – From 0.301 to 0.400

 High – From 0.401 to 0.500

 Very high – Above 0.501

Figure 1 - Social Vulnerability Indexes and corrected child mortality rates in the 51 municipalities of *Vale do Jequitinhonha*, MG, 2010.

	Child Death									CMD 1000 LD-		
Death Causes	2009 to 2011				2012 to 2014					CIVIN PET 1000 LBS		
										2009-11	2012 -14	Difference %
Avoidable death causes (738)	412	(1.5)	27759	(98.5)	326	(1.2)	25822	(98.8)	0.03	14.84	12.64	-14.8%
Care to women in pregnancy (307)	192	(0.7)	27979	(99.3)	116	(0.4)	26032	(99.6)	0.00	6.87	4.46	-34.9%
Care to the newborn (182)	109	(0.4)	28062	(99.6)	74	(0.3)	26074	(99.7)	0.04	3.87	2.85	-26.5%
Care to women in childbirth (132)	52	(0.2)	28119	(99.8)	82	(0.3)	26066	(99.7)	0.00	1.84	3.13	+69.8%
Diagnosis and treatment (57)	28	(0.1)	28143	(99.9)	28	(0.1)	26120	(99.9)	0.78	0.99	1.09	-10.2%
Health promotion/Immunoprevention (60)	33	(0.1)	28138	(99.9)	26	(0.1)	26122	(99.9)	0.53	1.17	0.99	-15.2%
Not clearly avoidable (323)	168	(0.6)	28003	(99.4)	156	(0.6)	25992	(99.4)	0.99	6.00	5.99	-0.16%
Total (1061)	580	(2.1)	27591	(97.9)	482	(1.8)	25666	(98.2)	0.07	21.03	18.79	-10.6%

Table 1 - Corrected infant mortality in major cause groups according to avoidability criteria. Vale do Jequitinhonha, 2009 to 2011 and 2012 to 2014

The main causes of death showed few changes between the three year periods. In the subgroup of preventable deaths due to adequate care to women during pregnancy, shortterm gestational disorders and low birth weight (P07) presented the highest proportion in both trienniums, followed by newborn respiratory distress syndrome (P22.0) and maternal complications of pregnancy affecting the fetus or newborn (P01) (Figure 2).

For the subgroup of deaths preventable by appropriate newborn care, perinatal period-specific infections (P35 to P39.9 except P35.0 andP35.3) and perinatal-period-specific respiratory disorders (P22.1, P22.8, P22.9, P23, P25, P27, P28) were the leading causes of death in the two trienniums. From 2012, the other disorders originating in the perinatal period (P90 to P96.8) occupied the third highest proportion of mortality (11.3%) in this grouping (Figure 2).

In the subgroup of preventable deaths due to adequate actions of care to women in childbirth, the highlights were deaths due to intrauterine hypoxia and asphyxia at birth (P20, P21) and neonatal aspiration (P24, except for P24.3). In the second triennium, deaths secondary to childbirth trauma (P10 to P15) accounted for 11.9% of the total causes in this subgroup (Figure 2).

Avoidable causes due to adequate care to the woman during pregnancy (N=226)										
2009-2011 (n=142)			2012-2014 (n=84)							
Disorders related to short-term pregnancy and low birth weight (P07)	64,1%		Disorders related to short-term pregnancy and low birth weight (P07)	44,0%						
Respiratory anguish syndrome in the newborn (P22.0)	21,1%		Respiratory anguish syndrome in the newborn (P22.0)	22,6%						
Maternal complications of pregnancy affecting the fetus or the newborn (P01)	6,3%		Maternal complications of pregnancy affecting the fetus or the newborn (P01)	13,1%						
Maternal conditions affecting the fetus or the newborn (P00, P04)	2,1%		Maternal conditions affecting the fetus or the newborn (P00, P04)	6,0%						
Hemolytic diseases of the fetus or of the newborn due to isoimmunization (P55.8 to P57.9)	2,1%		Pulmonary hemorrhage originated in the perinatal period (P26)	6,0%						
Necrotizing enterocolitis of the fetus and of the newborn (P77)	1,4%	\downarrow	Necrotizing enterocolitis of the fetus and of the newborn (P77)	3,6%						
Fetus and newborn affected by placenta and membranes complications (P02.2, P02.3, P02.7, P02.8, P02.9)	1,4%	K	Hemolytic diseases of the fetus or of the newborn due to isoimmunization (P55.8 to P57.9)	1,2%						
Pulmonary hemorrhage originated in the perinatal period (P26)	1,4%	Ì	Fetus and newborn affected by placenta and membranes complications (P02.2, P02.3, P02.7, P02.8, P02.9)	1,2%						
Non-traumatic intracranial hemorrhage of the fetus and of the newborn (P52)	0,0%		Non-traumatic intracranial hemorrhage of the fetus and of the newborn (P52)	1,2%						
Rh and ABO isoimmunization of the fetus or of the newborn (P55.0, P55.1)	0,0%		Rh and ABO isoimmunization of the fetus or of the newborn (P55.0, P55.1)	1,2%						

Avoidable causes due to adequate care to the newborn (N=133)											
2009-2011 (n=80)			2012-2014 (n=53)								
Specific infections of the perinatal period (P35 to P39.9, except P35.0 and P35.3)	62,5%		Specific infections of the perinatal period (P35 to P39.9, except P35.0 and P35.3)	56,6%							
Specific respiratory disorders of the perinatal period (P22.1, P22.8, P22.9, P23, P25, P27, P28)	17,5%		Specific respiratory disorders of the perinatal period (P22.1, P22.8, P22.9, P23, P25, P27, P28)	15,1%							
Other perinatal jaundices (P58, P59)	5,0%	a a a a a a a	Other disorders originated in the perinatal period (P90 to P96.8)	11,3%							
Conditions compromising the tegument and the thermal regulation of the newborn (P80 a P83)	3,8%	\mathbb{N}	Other perinatal jaundices (P58, P59)	7,5%							
Hematologic disorders of the newborn (P60, P61)	3,8%	Nx	Specific temporary endocrine and metabolic disorders and of the newborn (P70 a P74)	5,7%							
Neonatal hemorrhage (P50 a P54)	2,5%		Conditions compromising the tegument and the thermal regulation of the newborn (P80 a P83)	3,8%							
Specific temporary endocrine and metabolic disorders and of the newborn (P70 a P74)	2,5%		Neonatal hemorrhage (P50 a P54)	0,0%							
Other disorders originated in the perinatal period (P90 to P96.8).	1,3%		Hematologic disorders of the newborn (P60, P61)	0,0%							
Digestive tract disorders of the newborn (P75, P78)	1,3%	ľ	Digestive tract disorders of the newborn (P75, P78)	0,0%							

Avoidable causes due to adequate care to the woman during childbirth (N=97)											
2009-2011 (n=38)			2012-2014 (n=59)								
Intrauterine hypoxia and asphyxia at birth (P20, P21)	47,4%		Intrauterine hypoxia and asphyxia at birth (P20, P21)	37,3%							
Neonatal aspiration (P24, except P24.3)	39,5%		Neonatal aspiration (P24, except P24.3)	33,9%							
Fetus and newborn affected by conditions of the umbilical cord (P02.4 to P02.6)	5,3%	\mathbb{N}	Other complications of labor or childbirth affecting the newborn (PO3)	11,9%							
Placenta praevia and premature detachment of the placenta (P02.0 to P02.1)	5,3%	X	Placenta praevia and premature detachment of the placenta (P02.0 to P02.1)	6,8%							
Other complications of labor or childbirth affecting the newborn (PO3)	2,6%	ľX	Childbirth trauma (P10 to P15)	6,8%							
Childbirth trauma (P10 to P15)	0,0%	ľ	Fetus and newborn affected by conditions of the umbilical cord (P02.4 to P02.6)	2,9%							

Figure 2 - Death cuases in the main avoidability groupings. Vale do Jequitinhonha, 2009-2011 and 2012-2014 trienniums.

The comparison of preventable and unavoidable child mortality according to social vulnerability ratings showed higher proportion of preventable deaths in the most vulnerable population (p=0.00). During the study period, the population with the highest SVI had a rate of 14.8 preventable deaths per thousand LBs, while in the population with the lowest SVI this rate was estimated at 11.4 preventable deaths per thousand LBs (Table 2).

Regarding the deaths classified as not clearly preventable, there was no significant difference in occurrences between the most and least vulnerable municipalities (Table 2).

		Social vulnerability											
Death Causes			High/Very hi			Low/Medium					navalue		
Death (%) Not death		CMR per 1000 LBs	Death		Not death		CMR per 1000 LBs						
Avoidable causes (738)	523	(1.5)	34916	(98.5)	14.76	215	(1.1)	18665	(98.9)	11.39	0.00		
Not clearly avoidable (324)	208	(0.6)	35231	(99.4)	5.87	116	(0.6)	18764	(99.4)	6.14	0.69		

Table 2 - Child mortality corrected according to avoidability criteria and social vulnerability strata. Vale do Jequitinhonha, MG, 2009 to 2014

DISCUSSION

Overall infant mortality in *Vale do Jequitinhonha* decreased over the study period, but is still considered high and, according to the avoidability criteria, presented a percentage of preventable deaths close to 70%. The groups of causes sensitive to adequate care to women during pregnancy and the newborn stood out, with the highest proportions throughout the period despite the reduction between the trienniums and at delivery, which showed a significant increase over the analyzed years.

The data shown here, as well as the high percentages of preventable deaths already reported in the country,^{13:14} suggest problems in access and quality of care provided by the Brazilian health services. The very concept of deaths from preventable causes refers to failures of maternal and child health care resources, as such occurrences are considered "sentinel events" that could be prevented if such services functioned properly.²

The reduction in child deaths in the municipalities of *Vale do Jequitinhonha* during the analyzed period may have been influenced by the expansion of primary care and, consequently, of elementary services for following up prenatal and child care.⁴ However, the prevalence of preventable child deaths in municipalities with favorable provision of basic services seems to signal the need to strengthen the quality of primary care, as well as to better integrate health care levels through the implementation of health care routines for the risk delivery from prenatal care to hospital care.¹³

Despite having shown significant reductions between the three year periods analyzed, preventable deaths due to adequate actions of care to women during pregnancy and the newborn were the most prevalent, corresponding to 29.1% and 17.1%, respectively, of the total number of child deaths. In the central region of Minas Gerais, the subgroup of preventable causes of child deaths related to health care during pregnancy presented larger proportions and smaller reduction when compared to the other subgroups, between 1999 and 2011.¹⁴ In *Espírito Santo*, the subgroup of preventable deaths due to adequate care for the newborn was predominant among deaths classified as preventable in the period between 2006-2013.²

Our results show that, even with the increased access to primary health care and, consequently, to prenatal and

childcare consultations, preventable deaths due to actions that are performed during pregnancy and the newborn are highlighted. Among the death causes, disorders related to low weight, prematurity and perinatal period were predominant in *Vale do Jequitinhonha*. In fact, low birth weight and prematurity are determinants strongly associated with infant deaths and may explain most of them.^{14;15}

It is noticed that, besides access, also the quality of health care needs to be urgently reviewed.¹⁶ Some studies evaluating the quality of prenatal care in the country show that issues such as the beginning of prenatal care and the performance of basic procedures recommended by the Ministry of Health are flawed in several regions of the country, especially in certain economically and socially disadvantaged population groups.^{17,18}

The significant increase of 71.3% in deaths reducible by adequate care to women in childbirth is extremely worrying, when it comes to a country where the deliveries occur predominantly in hospital institutions.¹⁹ The Brazilian results are, in fact, unsatisfactory compared to other countries where deliveries in health facilities have shown a protective effect against mortality, especially neonatal^{20:21} and among disadvantaged women with obstetric complications.²²

Specifically in *Vale do Jequitinhonha*, hospital institutions that provide childbirth and birth care have severe weaknesses of human, physical and material resources, as well as of clinical practices during the parturition process, when considering the recommendations and norms of the Ministry of Health for the operation of such services.²³ In this scenario, our results pointed to the predominance of causes of death related to the occurrence of intrauterine hypoxia, asphyxia at birth, neonatal aspiration and birth trauma.

Obsolete and iatrogenic practices, in addition to stressful situations to parturients, still negatively impact Brazilian perinatal outcomes.¹⁹ The qualification of childbirth and birth care therefore deserves to be pointed out as a fundamental strategy for improving survival and also the quality of life in Brazilian childhood.¹

The health care network should ensure urgent care for women in labor, as well as care with the appropriate level of complexity for at-risk newborns. However, the pilgrimage of pregnant women to childbirth, as well as the birth of lowweight children in hospitals without a neonatal intensive care unit are care markers that show weaknesses in the Brazilian perinatal care system.¹⁹ Although the coverage of childbirth care is practically universal, the lack of linkage of pregnant women to a maternity ward represents an important risk factor for child mortality in smaller Brazilian cities and a large contingent of rural residents.⁶

Health services tend to be concentrated in urban, capital and central areas, culminating in disparities in the provision of skilled care and lack of integration with primary health care compared to the more vulnerable and peripheral rural regions.²⁴ Thus, there is an inverse relationship between the population size of the municipalities and the need for inter-municipal displacement for childbirth care, with attempts to seek childbirth care more prevalent in smaller and poorer cities.²⁴

The highest proportion of preventable child deaths in the population with the worst social vulnerability index shown here endorses the problem of inequality. In general, the poorest population is concentrated in areas marked by deficiencies in infrastructure and basic services that have a negative effect on health.⁶ In fact, socioeconomic and environmental factors impact child mortality outcomes in different locations and countries, showing that reducing mortality as a public health problem is related to reducing inequalities.^{25;26}

In recent years, relevant initiatives were developed to improve the quality of care for pregnant women and access to childbirth care in Brazil, such as the priority actions to expand prenatal coverage and better link between outpatient and outpatient care services described in Prenatal and Birth Humanization Program (*Programa de Humanização no Pré-Natal e Nascimento*, PHPN).²⁷ Also noteworthy are the strategies proposed by the Stork Network aimed at changing the model of childbirth care through multiprofessional teams, including obstetric nursing, the use of protocols and the monitoring of indicators of services with financing conditioned to reaching goals.¹⁹

Prenatal follow-up until delivery time, including the definition of a referral maternity for at-risk pregnant women, is a key aspect of maternal and child health care.²⁷ In addition, qualification of care, especially in the hospital environment at birth, has already been identified as a priority for reducing child mortality in Brazil.¹⁹ Even in countries with lower mortality rates, a better management of birth care and intrapartum neonatal events has been shown to be effective in reducing neonatal deaths.²⁸

However, the challenge of securing access to the best care practices available to pregnant women, as well as reducing the gap between childbirth care practices and evidence-based recommendations persists in the country.¹⁹ In the case of a study using secondary data, it is important to mention that there are restrictions regarding subregistrations and non-specific registrations in the MIS and LBIS bases, although techniques have been applied to minimize these problems. However, this limits the analyses that can be performed in the study.

CONCLUSIONS

The results of this study indicate a reduction in the avoidable infant mortality rate, but highlighted the importance of the causes related to health care during pregnancy, childbirth and newborns in the municipalities of *Vale do Jequitinhonha*, *Minas Gerais*. In addition, a large proportion of preventable deaths persist in relation to total child deaths, especially in the most vulnerable population.

The occurrence of preventable infant deaths is attributed to problems in access to and quality of care provided by the Brazilian health services, so such surveys are critical for assessing health status in locations recognized for their worst indicators, as well as for developing corrective measures that are focused on priority groups. Further advances in reducing child mortality depend on the consolidation of a better integrated perinatal network at all levels of complexity, as well as improvements in the living conditions of the populations.

REFERENCES

- França EB, Lansky S, Rego MAS, Malta DC, França JS, Teixeira R, et al. Principais causas da mortalidade na infância no Brasil, em 1990 e 2015: estimativas do estudo de Carga Global de Doença. Rev Bras Epidemiol. 2017[cited 2018 Aug 16];20(1):46-60. Available from: http://www.scielo.br/ pdf/rbepid/v20s1/1980-5497-rbepid-20-s1-00046.pdf
- Dias BAS, Santos Neto ET, Andrade MAC. Classificações de evitabilidade dos óbitos infantis: diferentes métodos, diferentes repercussões? Cad Saúde Pública. 2017[cited 2018 Sept 10];33(5):e00125916. Available from: http:// dx.doi.org/10.1590/0102-311x00125916
- Malta DC, Sardinha LMV, Moura L, Lansky S, Leal MC, Szwarcwald CL, et al. Atualização da lista de causas de mortes evitáveis por intervenções do Sistema Único de Saúde do Brasil. Epidemiol Serv Saúde. 2010[cited 2018 Aug 10];19(2):173-6. Available from: http://bdpi.usp.br/bitstream/ handle/BDPI/ 14517/art_MALTA_Atualizacao_da_lista_de_causas_de_ mortes_2010.pdf?sequence=1
- Victora CG, Aquino EML, Leal MC, Monteiro CA, Barros FC, Szwarcwald CL. Maternal and child health in Brazil: progress and challenges. Lancet. 2011[cited 2018 Aug 10];377(9780):1863-76. Available from: https://www. thelancet.com/journals/lancet/article/PIIS0140-6736(11)60138-4/fulltext
- Gonçalves A, Costa MCN, Paim JS, Silva LMV, Braga JU, Barreto M. Social inequalities in neonatal mortality and living condition. Rev Bras Epidemiol. 2013[cited 2018 Sept 10];16(3):682-91. Available from: http://dx.doi .org/10.1590/S1415-790X2013000300012
- Leal MC, Bittencourt SDA, Torres RMC, Niquini RP, Souza Junior PRB. Determinantes do óbito infantil no Vale do Jequitinhonha e nas regiões Norte e Nordeste do Brasil. Rev Saúde Pública. 2017[cited 2018 Aug 16];51:1-9. Available from: http://www.scielo.br/pdf/rsp/v51/pt_0034-8910rsp-S1518-87872017051006391.pdf

- Guimarães AQ. Plano de desenvolvimento para o Vale do Jequitinhonha: desafios e direções prioritárias para o desenvolvimento da região. Belo Horizonte: Fundação João Pinheiro; 2017[cited 2018 Aug 01]. Available from: http://sii.fjp.mg.gov.br/02_Apresenta%C3%A7%C3%A3o_PDVJ.pdf
- Ministério da Saúde (BR). Cadastro Nacional de Estabelecimentos de Saúde. Departamento de Informática do SUS (Datasus). [cited 2018 Dec 05]. Available from: http://www.cnes.datasus.gov.br
- Instituto de Pesquisa Econômica Aplicada. Atlas da vulnerabilidade social nos municípios brasileiros. Brasília: IPEA; 2015[cited 2018 Aug 11]. Available from: http://ivs.ipea.gov.br/images/publicacoes/lvs/publicacao_atlas_ivs.pdf
- Soares GP, Brum JD, Oliveira GM, Klein CH, Silva NA. Mortalidade por todas as causas e por doenças cardiovasculares em três estados do Brasil, 1980 a 2006. Rev Panam Salud Publica. 2010[cited 2018 Sept 02];28(4):258-66. Available from: https://www.scielosp.org/article/rpsp/2010.v28n4/258-266/
- 11. Duncan BB, Stevens A, Iser BP, Malta DC, Silva GA, Schmidt MI. Saúde Brasil 2010: uma análise da situação de saúde e de evidências selecionadas de impacto de ações de vigilância em saúde. Mortalidade por doenças crônicas no Brasil: situação em 2009 e tendências de 1991 a 2009. Brasília: Ministério da Saúde; 2011.
- 12. Szwarcwald CL, Morais Neto OL, Frias PG, Souza Junior PR, Escalante JJ, Lima RB, et al. Saúde Brasil 2010: uma análise da situação de saúde e de evidências selecionadas de impacto de ações de vigilância em saúde. Busca ativa de óbitos e nascimentos no Nordeste e na Amazônia Legal: estimação das coberturas do SIM e do SINASC nos municípios brasileiros. Brasília: Ministério da Saúde; 2011.
- Nascimento SG, Oliveira CM, Sposito V, Ferreira DKS, Bonfim CV. Mortalidade infantil por causas evitáveis em uma cidade do Nordeste do Brasil. Rev Bras Enferm. 2014[cited 2018 Aug 25];67(2):208-12. Available from: http://dx.doi.org/10.5935/0034-7167.20140027
- Lisboa L, Abreu DMX, Lana AMQ, França EB. Mortalidade infantil: principais causas evitáveis na região Centro de Minas Gerais, 1999-2011. Epidemiol Serv Saúde. 2015[cited 2018 Aug 20];24(4):711-20. Available from: http:// www.scielo.br/pdf/ress/v24n4/2237-9622-ress-24-04-00711.pdf
- Liu L, Oza S, Hogan D, Perin J, Rudan I, Lawn JE, et al. Global, regional, and national causes of child mortality in 2000–13, with projections to inform post-2015 priorities: an updated systematic analysis. Lancet. 2015[cited 2018 Dec 05];385(9966):430-40. Available from: https://globalresearchnurses. tghn.org/articles/global-regional-and-national-causes-child-mortality-200013-projections-inform-post-2015-priorities-updated-systematicanalysis/
- Figueiredo PP, Lunardi Filho WD, Lunardi VL, Pimpão FD. Mortalidade infantil e pré-natal: contribuições da clínica à luz de Canguilhem e Foucault. Rev Latino-Am Enferm. 2012[cited 2018 Sept 02];20(1):1-10. Available from: http://dx.doi.org/10.1590/S0104-11692012000100026
- Viellas EF, Domingues RMSM, Dias MAB, Gama SGN, Theme Filha MM, Costa JV, et al. Assistência pré-natal no Brasil. Cad Saúde Pública. 2014[cited 2018 Sept 06];30(Suppl):S85-100. Available from: http://www.scielo.br/pdf/ csp/v30s1/0102-311X-csp-30-s1-0085.pdf

- Nunes JT, Gomes KRO, Rodrigues MTP, Mascarenhas MDM. Qualidade da assistência pré-natal no Brasil: revisão de artigos publicados de 2005 a 2015. Cad Saúde Coletiva. 2016[cited 2018 Sept 02];24(2):252-61. Available from: http://dx.doi.org/10.1590/1414-462X201600020171
- Lansky S, Friche AAL, Silva AAM, Campos D, Bittencourt DAS, Carvalho ML, et al. Pesquisa Nascer no Brasil: perfil da mortalidade neonatal e avaliação da assistência à gestante e ao recém-nascido. Cad Saúde Pública. 2014[cited 2018 Sept 06];30(Suppl):S192-207. Available from: http://www.scielo.br/pdf/ csp/v30s1/0102-311X-csp-30-s1-0192.pdf
- Feng XL, Guo S, Hipgrave D, Zhu J, Zhang L, Song L, et al. China's facility-based birth strategy and neonatal mortality: a population-based epidemiological study. Lancet. 2011[cited 2018 Sept 06];378(9801):1493-500. Available from: https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(11)61096-9/fulltext
- Tura G, Fantahun M, Worku A. The effect of health facility delivery on neonatal mortality: systematic review and meta-analysis. BMC Pregnancy Childbirth. 2013[cited 2018 Sept 06];13(18):1-9. Available from: https://bmcpregnancychildbirth.biomedcentral.com/ articles/10.1186/1471-2393-13-18
- Altman R, Sidney K, Costa A, Vora K, Salazar M. Is institutional delivery protective against neonatal mortality among poor or tribal women? a cohort study from Gujarat, India. Matern Child Health J. 2017[cited 2018 Aug 28];21:1065-72. Available from: https://doi.org/10.1007/s10995-016-2202-y
- Coelho KR. Avaliação do grau de implantação do programa de humanização do parto e nascimento no médio Vale do Jequitinhonha em Minas Gerais [tese]. Belo Horizonte: Universidade Federal de Minas Gerais, Escola de Enfermagem; 2014.
- Almeida WS, Szwarcwald CL. Mortalidade infantil e acesso geográfico ao parto nos municípios brasileiros. Rev Saúde Pública. 2012[cited 2018 Aug 12];46(1):68-76. Available from: http://dx.doi.org/10.1590/S0034-89102012005000003
- Bathia M, Ranjan M, Dixit P, Dwivedi LK. Mind the gap: temporal trends in inequalities in infant and child mortality in India (1992-2016). SSM Popul Health. 2018[cited 2018 Sept 10];9(5):201-9. Available from: https:// www.researchgate.net/publication/325063672_Mind_the_Gap_ Temporal_trends_in_Inequalities_in_infant_and_child_mortality_in_ India_1992-2016
- Shifa GT, Ahmed AA, Yaley AW. Socioeconomic and environmental determinants of under-five mortality in Gamo Gofa Zone, Southern Ethiopia: a matched case control study. BMC Int Health Hum Rights. 2018[cited 2018 Sept 10];18:14. Available from: https://www.ncbi.nlm.nih. gov/pmc/articles/PMC5830345/
- Serruya SJ, Lago TG, Cecatti JG. Avaliação preliminar do programa de humanização no pré-natal e nascimento no Brasil. Rev Bras Ginecol Obstet. 2004[cited 2018 Oct 04];26(7):517-25. Available from: http://dx.doi. org/10.1590/S0100-72032004000700003
- Black RE, Levin C, Walker N, Chou D, Termmerman M. Reproductive, maternal, newborn, and child health: key messages from Disease Control Priorities 3rd Edition. Lancet. 2016[cited 2018 Sept 29];388:2811-24. Available from: https://doi.org/10.1016/S0140-6736(16)00738-8