Independent risk factors associated with infant deaths

Fatores de risco independentes associados a óbitos infantis

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Descritores
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Abstract

Objective: Identifying the independent risk factors associated with infant deaths registered in Brazilian public information systems.

Methods: A cross-sectional study using secondary data recorded in public information systems for eleven years. The association of mortality rates was observed according to death periods using univariate and multivariate regression tests.

Results: The infant mortality rate decreased by 20.7 % in the study period. The list of independent factors associated with infant deaths shows the necessity for measures to increase public actions aimed at the early onset of prenatal care, continuing until the postpartum, puerperal period and in the growth and development of the newborn.

Conclusion: The independent risk factors for infant death were low birth weight, gestation duration of less than 37 weeks, multiple pregnancy, maternal educational level lower than eight years, Apgar score and less than seven antenatal pregnancy.

Resumo

Objetivo: Identificar os fatores de risco independentes associados aos óbitos infantis registrados nos sistemas informatizados públicos brasileiros.

Métodos: Estudo transversal com dados secundários registrados no período de onze anos nos sistemas informatizados públicos. A associação das taxas de mortalidade foi verificada segundo períodos de óbito utilizando-se testes de regressão univariada e multivariada.

Resultados: A mortalidade infantil apresentou redução de 20,7% no período estudado. A lista de fatores independentes associados aos óbitos infantis indica a necessidade de medidas para intensificar as ações públicas visando o início precoce da assistência pré-natal, no pós-parto, acompanhamento no puerpério, e o crescimento e desenvolvimento do recém-nascido.

Conclusão: Os fatores de risco independentes para o óbito infantil foram: baixo peso ao nascer, duração da gestação inferior a 37 semanas, gravidez múltipla, escolaridade materna inferior a oito anos, boletim de Apgar e menos de sete consultas pré-natais.

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Introduction

The infant mortality rate (IMR) is considered one of the leading indicators for the assessment of population health, especially with regard to the quality of care provided to pregnant women and newborns throughout the pre-natal period, the delivery and puerperium. This quality directly affects the prevention of maternal and infant morbidity and mortality.[1]

In Brazil, it was observed a reduction in the infant mortality rate as follows: in 1990, the rate was 47/1000 live births. In 2013, preliminary data show that it was 19.8 / 1000 live births. In 1990, in the state of Paraná, southern Brazil, this ratio was 35/1000 live births. After twenty years, in 2011, the rate decreased to 1.5 / 1,000 live births.[2,3]

Risk factors for infant death can also be related to maternal and newborn variables as well as with assistance variables. Studies show that the greatest risks are consistent with the variables of the newborn, especially low birth weight and prematurity.[4,5]

Although there is evidence of the advances in the studies of infant mortality and the large number of publications that depict the risk factors associated with infant deaths, it is essential to consider the big difference in the sociodemographic profile of the Brazilian population. It is important to develop local studies because, despite the possible similarity of results with studies of large areas, the municipal health planning can only be carried out based on data that consider the peculiarities of the locality.[6]

The objective of this study was to identify the independent risk factors associated with infant deaths registered in Brazilian public information systems.

Methods

A cross-sectional study using secondary data from the Brazilian government computer systems - the Sistema de Informação sobre Nascidos Vivos e sobre Mortalidade do Sistema Único de Saúde (Information System on Live Births and Mortality of the Unified Health System) - with variables on live births and infant deaths of the residents of the municipality of Paranvaí (state of Paraná) in the period between 2000 and 2011.

Data were grouped by three-year periods. The inclusion criterion was analyzing only the data that had all the variables met. The study of association was made between the first and the third three-year periods with the objective of showing if there were differences in associated variables, taking into consideration the evolution of the process of health during the study period.

In the first stage, the databases on live births and deaths for each triennium were integrated in a deterministic way, with the declaration of the number of live births as the common variable.

The infant mortality rate was the dependent variable and the independent variables were divided in newborn, maternal and assistance variables. The newborn variables were gender, birth weight, duration of pregnancy, race, and Apgar score in the first and fifth minutes. Maternal variables were the type of pregnancy (single or multiple), maternal age, level of education, and marital status. The assistance variables were the type of delivery and number of prenatal consultations.

To analyze the association between the independent variables and infant death the Pearson's chi-squared test and the Fisher's exact test were used when indicated, considering the significance level of 5%. The strength of the association was assessed by estimating the crude Odds Ratio. The multivariate logistic regression was used for the joint evaluation of variables associated with death. The significant variables with $p<0.20$ in the univariate analysis were selected for the regression analysis, performed by the stepwise backward method (likelihood ratio). The variables that kept $p \leq 0.05$ after adjustments remained in the multiple regression model. The goodness of fit was assessed using the Hosmer-Lemeshow test.[7] The Epi Info and SPSS 15.0 softwares were used for data analysis.

The study followed national and international standards of ethics in research involving human beings.

Results

The highest number of infant deaths was found in the first and third triennium. Regarding the maternal variables, between the first and the last triennium it was observed a gradual increase of mothers with eight or more years of education and of mothers who live without their partners (Table 1).

Table 1. Infant deaths according to newborn, maternal and assistance variables

Variables	1º. Triennium 53 deaths		2º. Triennium 36 deaths		3º. Triennium 48 deaths		4º. Triennium 42 deaths	
Maternal variables								
Age								
< 20	13	24.5	8	22.2	14	29.2	10	23.8
20-34	35	66.0	20	55.5	27	56.3	24	57.1
≥ 35	5	9.4	8	22.2	07	14.6	8	19.0
Level of education (years)								
Up to 7	35	66.0	11	30.6	13	27.1	13	30.9
8 or more	18	33.9	25	69.4	35	72.9	29	69.0
Marital status								
Living without partner	18	33.9	20	55.6	28	58.3	29	69.0
Living with partner	35	66.0	16	44.4	20	41.7	13	30.9
Type of gestation								
Single	38	71.7	30	83.3	48	100	39	92.8
Multiple	15	28.3	6	16.6	-	-	3	7.1
Newborn variables								
Sex								
Male	28	52.8	19	52.7	23	47.9	21	50.0
Female	25	47.1	17	47.2	25	52.1	21	50.0
Birth weight (g)								
< 2500	33	62.2	25	69.4	29	60.4	31	73.8
≥ 2500	20	37.7	11	30.5	19	39.6	11	26.1
Duration of gestation (weeks)								
< 37	30	56.6	22	61.1	18	37.5	30	71.4
≥ 37	23	43.4	14	38.9	28	58.3	12	28.5
Apgar (1st min)								
< 7	34	64.2	25	69.4	25	52.1	22	52.3
≥ 7	19	35.8	11	30.5	23	47.9	20	47.6
Apgar (5th min)								
< 7	26	49.0	14	38.9	16	33.3	17	40.4
≥ 7	27	50.9	22	61.1	32	66.7	25	59.5
Race/color								
White	46	86.8	35	97.2	45	93.7	35	83.3
Others	07	13.2	01	2.8	03	6.2	07	16.6
Assistance variables								
Type of delivery								
Vaginal	36	67.9	21	58.3	25	52.1	18	42.8
Cesarean	17	32.0	15	41.7	23	47.9	24	57.1
Number of prenatal consultations								
< 7	39	73.6	20	55.5	29	60.4	29	69.0
≥ 7	14	26.4	16	44.4	19	39.6	13	30.9

Source: SINASC/DATASUS (http://tabnet.datasus.gov.br/cgi/sinasc/dados/nov_indice.htm). Results are given in absolute numbers followed by relative numbers to the four three-year periods

The univariate analysis of the first triennium revealed that two of the four studied variables - type of pregnancy and level of education - showed statistically significant association. In the last three-year period the following variables were associated with death: type of pregnancy, maternal age, level of education and marital status (Table 2). However, after multivariate logistic regression, two variables - type of pregnancy and maternal educational level - maintained association with death for both three-year periods (Table 3).

Table 2. Unadjusted risk factors for infant mortality

Variables	2000 – 2002				2009 - 2011			
	Death (n=53)	Live (n=3468)	Crude Oddis Ratio	p-value	Death (n=42)	Live (n=3423)	Crude Oddis Ratio	p-value
Maternal variables								
Age								
10-19	13	633	1.56	0.1735	10	533	2.04	0.0359
20-34	35	2653	1.00		24	2612	1.00	
≥35	05	182	2.08		08	278	3.13	
Level of education (years)								
Up to 7	35	1476	2.62	0,0006	13	504	2.60	0.0033
8 or more	18	1992	1.00		29	2919	1.00	
Marital status								
Living without partner	16	1080	0.96	0.8817	29	1318	3.56	< 0.0001
Living with partner	37	2388	1.00		13	2105	1.00	
Type of gestation								
Single	38	3398	1.00	< 0.0001	39	3381	1.00	< 0.0001
Multiple	15	70	19.16		03	42	6.83	
Newborn variables								
Sex								
Male	29	1680	1.29	0.3644	21	1665	1.06	0.8610
Female	24	1788	1.00		21	1758	1.00	
Birth weight (g)								
< 2500	34	366	15.17	< 0.0001	31	331	26.33	< 0.0001
≥ 2500	19	3102	1.00		11	3092	1.00	
Duration of gestation (weeks)								
≤ 36	30	332	12.32	< 0.0001	30	163	50.00	< 0.0001
≥ 37	23	3136	1.00		12	3260	1.00	
Apgar (1st min)								
< 7	34	171	34.50	< 0.0001	22	127	28.55	< 0.0001
≥ 7	19	3297	1.00		20	3296	1.00	
Apgar (5th min)								
< 7	26	25	132.6	< 0.0001	18	18	136.20	< 0.0001
≥ 7	27	3443	1.00		25	3405	1.00	
Race								
White	46	3130	1.00	0.4002	35	3243	1.00	0.0011
Others	07	338	1.41		07	180	3.60	
Assistance variables								
Type of delivery								
Vaginal	36	1724	2.14	0.0084	18	484	4.55	< 0.0001
Cesarean	17	1744	1.00		24	2939	1.00	
No. of prenatal consultations								
< 7	39	1461	3.83	< 0.0001	29	994	5.45	< 0.0001
≥ 7	14	2007	1.00		13	2429	1.00	

Source: SINASC/DATASUS (http://tabnet.datasus.gov.br/cgi/sinasc/dados/nov_indice.htm)

Table 3. Logistic regression analysis of factors associated with infant mortality

Variable	2000 - 2002				2009-2011			
	Death (n=53)	Live (n=3468)	Adjusted Oddis Ratio	p-value	Death (n=42)	Live (n=3423)	Adjusted Oddis Ratio	p-value
Maternal variables								
Level of education (years)								
Up to 7	35	1476	2.73	< 0.0001	13	504	2.98	< 0.0001
8 or more	18	1992	1.00		29	2919	1.00	
Type of gestation								
Single	38	3398	1.00	<0.0001	39	3381	1.00	<0.0001
Multiple	15	70	11.34		03	42	6.83	
Newborn variables								
Birth weight (g)								
< 2500	34	366	17.76	<0.0001	31	331	31.44	<0.0001
≥ 2500	19	3102	1.00		11	3092	1.00	
Duration of gestation (weeks)								
≤ 36	30	332	12.32	<0.0001	30	163	11.08	< 00001
37 to 41	23	3136	1.00		12	3260	1.00	
Apgar (1st min)								
0 to 6	34	171	8.88	<0.0001	22	127	6.87	<0.0001
7 to 10	19	3297	1.00		20	3296	1.00	
Apgar (5th min)								
0 to 6	26	25	18.98	<0.0001	18	18	25.67	<0.0001
7 to 10	27	3443	1.00		25	3405	1.00	
Assistance variables								
No. of prenatal consultations								
0 to 6	39	1461	1.86	< 0.0001	29	994	2.45	< 0.0001
≥ 7	14	2007	1.00		13	2429	1.00	

Source: SINASC/DATASUS (http://tabnet.datasus.gov.br/cgi/sinasc/dados/nov_indice.htm). In the regression analysis performed by the backward stepwise method (likelihood ratio), the variables that kept the value of $p \leq 0.05$ after adjustment remained in the multiple regression model. The goodness of fit was assessed using the Hosmer – Lemeshow test

Two variables of the newborn - low birth weight and pregnancy duration of less than 37 weeks - remained above 50% in almost every triennium. Particularly in the last triennium, it is noteworthy that these two variables represent 73.8 and 71.4% of infant deaths, respectively. Concomitant to this, the analysis of the type of delivery indicates that in this same three-year period 57.1% of deliveries were of the cesarean kind, as shown in table 1.

The birth weight, length of gestation and Apgar score at one and five minutes were significant for the two triennial periods subjected to univariate analysis. The race/color variable showed significance only in the last triennium. In table 3, the multivariate logistic regression shows continued association of infant death with birth weight, length of gestation and Apgar score in the first and fifth minutes. It is noteworthy that the risk of death increased from the first to the third triennium for infants weighing less than 2,500 grams and with Apgar below seven in the fifth minute.

As shown in table 1, there was a gradual increase in the cesarean delivery throughout the triennial periods in the assistance variable. In the univariate analysis presented in table 2, there was association for the number of prenatal visits and the type of delivery.

The chi-square test for association of Pearson and Fisher exact test were used when indicated, considering the significance level of 5%.

Only the number below seven prenatal visits maintained the association with infant death in

both triennial periods when subjected to logistic regression, as shown in table 3.

Discussion

Studies that use secondary data – like the present study - may be influenced by factors such as the quality of reviewed information, especially those related to the non-fulfillment of some variables. Another limitation is the restriction of available variables, which makes it impossible to analyze the following factors: social class, ruptured membranes, length of labor, interventions during labor, among others.

The results show that although well studied, the factors associated with child mortality differ according to regional characteristics, which justifies the importance of localized analyzes for a strategic planning carried out by local health officers and coordinator nurses of health care teams.

Infant mortality in the city of Paranavaí (state of Paraná) decreased by 20.7% between the first and the last triennium, a similar result to the one found in another study in the same state.[8]

As observed in other studies, birth weight and prematurity were risk factors highly associated with infant mortality.[4,8] Studies have reported that low birth weight is strongly associated with infant death in the neonatal period.[9,10] Also, both the low weight and prematurity reflect socioeconomic and maternal morbidity conditions that are not favorable for the development of the fetus. A study carried out in a region of the state of Paraná revealed that urinary tract infections were the main cause of premature labor, which, in turn, can lead to low birth weight.[11]

In the last studied triennium, low birth weight and prematurity were significant factors for infant mortality, with increased risk in relation to the first triennium. Concomitant to this, in the last three-year period there has also been an increase in the percentage of cesarean deliveries. This may also be related with the two aforementioned variables because of the scheduled surgical procedure and the occurrence of delivery before the due date. However, the cesarean section did not appear as a risk factor for infant death in the association analysis. Unlike other studies, the normal delivery lost significance in the multivariate logistic regression.[5,12] It is relevant to mention that throughout the study period, the municipality showed the percentage of cesarean section far above the acceptable by the World Health Organization, which recommends that this type of delivery should not exceed 15% of the total.[13]

The protective effect of the cesarean section found in other studies may be related to other factors such as better delivery care and maternal socioeconomic status.[5,12] The risk effect of normal delivery on its turn, may be related to the time of rupture of membranes which, when not occurring naturally, is done by most obstetricians in order to speed up labor. In a recent study on deaths of neonates due to healthcare-related infections, the data revealed that the time of ruptured membranes was more than 24 hours in 10% of deaths.[14]

In agreement with results of other studies, a maternal educational level lower than eight years was an important factor to infant mortality in the two periods.[8,12] Maternal educational level is considered a marker of socioeconomic status, besides being related to the cultural and behavioral profile, which are inextricably linked to health care, both maternal and of the newborn.[4]

Multiple pregnancy was also associated with infant death, similar to the findings of other studies.[12,14] It is noteworthy the need for these pregnant women to be early identified and receive special attention throughout prenatal care, delivery and postpartum because this type of pregnancy often leads to premature labor, which consequently leads to low birth weight, both strong determinants of infant death.[4]

Maternal age showed association in the univariate analysis in the last triennium. However, in the multivariate logistic regression this variable lost significance, confirming the results of other studies.[14,15] Although without independent association with infant death, it is noteworthy that the studied municipality did not present a reduction in the percentage of teenage mothers throughout the study

period. This demonstrates the need for sexual and reproductive health programs focusing on family planning and meeting the contraceptive needs, thus reducing the vulnerability of adolescents. The risk of death for children of mothers aged under 20 years may often be related to the delay in assuming pregnancy and, therefore, beginning prenatal care, which once again strengthens the vulnerability of adolescent mothers, justifying this age group to be at intermediate risk.[16]

Between the first and the last triennium, the present study showed increased risk of death for children of mothers who had less than seven prenatal consultations, corroborating the findings of other studies.[4,12] The quality of such consultations and early prenatal care early in pregnancy are also important. Furthermore, it is noteworthy the fact that during the consultations the topics related to the context of women's lives should be discussed because it can negatively interfere in pregnancy, as is the case of working hours, moral harassment, domestic violence, economic dependence, among other factors that may limit care practices and negatively act on the health of the mother-child binomial.[17]

The results of this study also showed the Apgar score below seven in the first and fifth minutes as a risk factor for infant mortality. The Apgar score is used to measure the vitality of the newborn and other studies show its strong association with infant death.[4,14] Apgar scores in the fifth minute were adequate in most newborns, however, deaths also occurred, suggesting that other factors have contributed to the risk increase between the first and the last triennium.

Among the characteristics associated with infant death in this study, the highlights are those related to birth weight below 2,500 grams, Apgar score less than seven at one and five minutes and length of gestation. Such results were also found in other studies.[18-20]

All the independent risk variables in the first triennium remained risk variables in the end of the period. Even with the reduced percentage of infant deaths to mothers with low educational level - from 66% in the first triennium to 30.9% in the third triennium - this variable continued to determine infant death with almost unchanged OR during the decade. This highlights the need for consolidation of public policies directed to pregnant women and referral of high-risk pregnancies.

Tracking the growth and development of children in the first year of life is the duty of the health-care team. This includes nurses, who are responsible for stratifying the risks of illness and death during this phase, considered as the most vulnerable, thus prioritizing the quality care.[16]

Even when classified as no risk, both pregnant women and children should attend nursing consultations that aim to achieve a care model that is adequate to the health conditions and needs of the population. Another suggestion is that the city intensifies public actions for the early onset of prenatal care, continuing to the postpartum period until the growth and development of the newborn.

Conclusion

The independent risk factors for infant death were low birth weight, gestation duration of less than 37 weeks, multiple pregnancy, maternal educational level lower than eight years, Apgar score and less than seven prenatal consultations.

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Collaborations

Silva AL and Mathias TAF contributed to the project design, research analysis, data interpretation, drafting the article, critical revision of the important intellectual content and final approval of the version to be published.

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