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Breastfeeding during the first hour of life and neonatal mortality☆

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KEYWORDS
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Abstract

Objective: To analyze the correlation between breastfeeding in the first hour of life with neonatal mortality rates.
Methods: The present study used secondary data from 67 countries, obtained from the Demographic and Health Surveys. Initially, for data analysis, Spearman Correlation (95% CI) and Kernel graphical analysis were employed, followed by a Negative Binomial Poisson regression model, adjusted for potential confounders.
Results: Breastfeeding within the first hour of life was negatively correlated with neonatal mortality (Spearman's Rho = −0.245, p = 0.046), and this correlation was stronger among countries with more than 29 neonatal deaths per 1000 newborns (Spearman's Rho = −0.327, p = 0.048). According to the statistical model, countries with the lowest breastfeeding tertiles had 24% higher neonatal mortality rates (Rate ratio = 1.24, 95% CI = 1.07-1.44, p < 0.05), even when adjusted for potential confounders.
Conclusion: The protective effect of breastfeeding during the first hour of life on neonatal mortality in this ecological study is consistent with findings from previous observational studies, indicating the importance of adopting breastfeeding within the first hour as a routine neonatal care practice.

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PALAVRAS-CHAVE
Saúde materno-infantil;
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Medidas em epidemiologia;
Lactente

A amamentação na primeira hora de vida e mortalidade neonatal

Resumo
Objetivo: Analisar a correlação entre o percentual de amamentação na primeira hora de vida e as taxas de mortalidade neonatal.
Métodos: Foram utilizados dados secundários de 67 países obtidos das pesquisas realizadas com a metodologia do *Demographic and Health Surveys*. Inicialmente, para a análise dos dados, foram empregadas a Correlação de Spearman (IC 95%) e a análise gráfica com modificação de Kernel, seguidas de regressão de Poisson Binomial Negativa, ajustando para possíveis fatores de confundimento.
Resultados: O percentual de aleitamento materno na primeira hora de vida esteve negativamente associado com as taxas de mortalidade neonatal (Rho = −0,245, p = 0,046), e esta correlação foi mais forte entre os países com mortalidade neonatal superior a 29 mortes/1.000 nascidos vivos (Rho = −0,327, p = 0,048). Os países com os menores tercis de aleitamento materno na primeira hora de vida tiveram uma taxa 24% maior de mortalidade neonatal (razão de taxa = 1,24, IC 95% = 1,07-1,44), mesmo ajustando para fatores de confundimento.
Conclusão: O efeito protetor da amamentação na primeira hora de vida sobre a mortalidade neonatal encontrado nesse estudo ecológico é consistente com o de estudos observacionais, e aponta para a importância de se adotar a amamentação na primeira hora de vida como prática de atenção neonatal.

Introduction

The World Health Organization (WHO) recommends placing babies in skin-to-skin contact with their mothers immediately after birth for at least 1 hour and helping mothers to recognize when their babies are ready to breastfeed. To help mothers initiate breastfeeding during this sensitive period in which mothers and newborns are alert, corresponds to step 4 of the Baby-Friendly Hospital Initiative (BFHI).[1] This is a practice that can reduce neonatal mortality by 22%,[2] and the more the initiation of breastfeeding is delayed, the greater the odds of neonatal mortality caused by infections.[3]

The protective effect of breastfeeding in the first hour of life may be related to the following mechanisms: intestinal colonization by saprophytic bacteria found in maternal milk,[4] the property of breast milk of reducing intestinal colonization by gram-negative bacteria[5] and maternal adaptive ability to produce bioactive immune factors suitable for the newborn, which are present in colostrum according to gestational age.[6] One of these factors is Immunoglobulin-A, which is found in higher concentrations in colostrum when compared to mature milk.[7]

Each year, more than 4 million babies die in the first 27 days of life (neonatal period), and almost all of these deaths occur in poorer countries.[8] In this context, the promotion of breastfeeding is one of the strategies of greater cost-effectiveness for improving child health,[9] which highlights the importance of the adoption of breastfeeding within the first hour of life as a hospital routine. The present study aimed to assess the correlation between breastfeeding in the first hour of life and the rates of neonatal mortality in countries whose data are available in the Demographic and Health Surveys (DHS).

Methods

To perform this ecological study, secondary data on the proportion of children breastfed in the first hour of life and neonatal mortality rates were used (number of deaths of children under 28 days of life per 1,000 live births) in 67 countries that performed at least 1 national survey according to the DHS guidelines. Secondary data are publicly available and were obtained through the MEASURE DHS STAT compiler website,[10] using data from the last research available. Besides these data, we obtained information about the percentage of deliveries in health facilities and the percentage of people with secondary education or higher.

The DHS is a project funded by the US Agency for International Development (USAID) and by the participating countries. Since 1984 more than 260 surveys have been conducted in 90 countries. The samples from each country are nationally representative, and data are collected *in loco* about maternal and child health and many other issues, such as HIV, nutrition and fertility, in a standardized way recognized by the international community. In Brazil, the Brazilian Health Ministry runs the DHS, which is called National Demographic and Health Survey for Children and Women [Pesquisa Nacional de Demografia e Saúde da Criança e da Mulher (PNDS)], with editions held in 1986, 1996 and 2006.[11]

Countries that had data on the rate of neonatal mortality and breastfeeding in the first hour of life were: Albania, Armenia, Azerbaijan, Bangladesh, Benin, Bolivia, Brazil, Burkina Faso, Cambodia, Cameroon, Cape Verde, Chad, Colombia, Comoros, Congo (Brazzaville), Democratic Republic of Congo, Ivory Coast, Dominican Republic, Ecuador, Egypt, Eritrea, Ethiopia, Gabon, Ghana, Guinea, Guyana, Haiti, Honduras, India, Indonesia, Jordan, Kazakhstan, Kenya, Kyrgyz Republic, Lesotho, Madagascar, Malawi, Maldives, Mali, Mauritania, Moldova, Morocco, Mozambique, Namibia, Nepal, Niger, Nigeria, Pakistan, Peru, Philippines, Rwanda, São Tomé and Príncipe, Sierra Leone, South Africa, Swaziland, Tanzania, Timor-Leste, Togo, Turkey, Turkmenistan, Uganda, Ukraine, Uzbekistan, Vietnam, Yemen, Zambia and Zimbabwe.

Initially, we used in the data analysis the Spearman correlation between the percentage of breastfeeding within the first hour of life and neonatal mortality rates, considering the 95% confidence interval (95% CI).

Then, a scatterplot was generated, and a linear model was estimated, considering the rate of neonatal mortality as outcome and breastfeeding in the first hour as exposure. This same model was drawn on the scatterplot.

Considering that neonatal mortality rates may not follow a normal distribution (Gaussian), a Kernel graph was generated, with smoothing density.[12]

Moreover, countries were divided into tertiles of percentage of breastfeeding within the first hour of life, including in the first tertile countries with lower percentages. The difference in variance of neonatal mortality medians among tertiles was assessed using the Kruskal-Wallis nonparametric test.[13]

Further, a model with log-linear distribution was run (negative binomial), using the rate of neonatal mortality as outcome and the percentage of breastfeeding within the first hour of life as exposure, adjusting for the percentage of deliveries in health facilities and the percentage of people with secondary education or higher in each of the countries studied. At this stage, all variables were considered simultaneously in the model.[14,15]

Statistical analyses were performed in the R program (version 2.9.2). Because this was a study using secondary databases, aggregated by country, and there was no possibility of identifying individuals according to Resolution 196/96, the present study was not submitted to the Research Ethics Committee to assess risks for humans.

Results

The present study found a relatively weak and negative correlation, but statistically significant [Spearman's rank correlation coefficient (Rho) = −0.245, p = 0.046], between the percentage of breastfeeding within the first hour of life and neonatal mortality rates in the 67 countries studied. The linear model showed a best fit (R^2) of 0.062 (Fig. 1).

When analyzing the scatter plots with Kernel's smoothing (Fig. 2), it was observed that in countries with neonatal mortality rates higher than 29 per 1,000 live births, the correlation with breastfeeding in the first hour of life seemed stronger (Fig. 3).

From this observation, a new correlation was estimated with the 37 countries with neonatal mortality rates higher than 29/1,000 live births, which increased the correlation (Rho = −0.327, p = 0.048) and the fit of the linear model (R^2 = 0.104).

As for confounding variables, the correlation of the neonatal mortality rates was negative and strong in relation to the percentage of deliveries in health facilities in countries (Rho = −0.660, p < 0.001) and in relation to the percentage of people with secondary education or higher (Rho = −0.595, p < 0.001).

Among the 37 countries with higher mortality rates (higher than 29 deaths/1,000 live births), those included in the lowest percentage tertile of breastfeeding in the

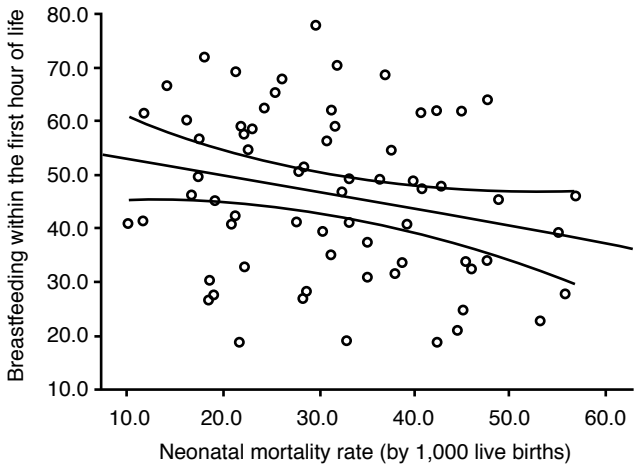

Figure 1 Correlation between the percentage of breastfeeding within the first hour of life and neonatal morality rates in 67 countries (Rho = −0.245)

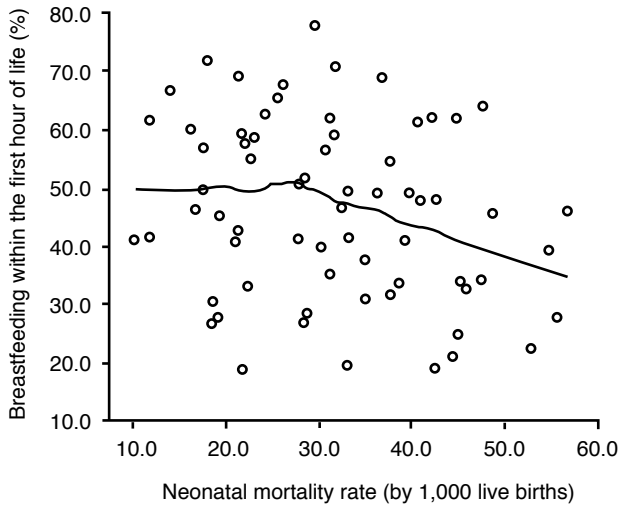

Figure 2 Smoothed density (Kernel) of the correlation between the percentage of breastfeeding withing the first hour of life and neonatal mortality rates in 67 countries.

Figure 3 Correlation between the percentage of breastfeeding withing the first hour of life and neonatal mortality rates in 37 countries with neonatal mortality rates higher than 29 deaths/1,000 live births (Rho = −0.327).

first hour of life had a mean of 43.64 neonatal deaths per 1,000 live births (95% CI = 39.34-47.94). The second tertile presented a mean of 40.42 deaths (95% CI = 34.71-46.12), and the countries included in the tertile with the highest percentage of breastfeeding within the first hour of life had an average rate of 36.50 deaths (95% CI = 32.96-40.04). Variance analysis of medians between the tertiles (univariate Kruskal-Wallis) was marginally significant (p = 0.062). However, considering the negative binomial model (multivariate analysis adjusted for confounding factors), the countries with the lowest tertiles of breastfeeding within the first hour of life had an statistically higher neonatal mortality rate, even after adjusting for the percentage of deliveries in health facilities and the percentage of people with secondary education level or higher, both statistically significant (Table 1).

Discussion

The protective effect of breastfeeding in the first hour of life on the neonatal mortality rates among countries participating in the DHS found in this study was similar, in magnitude, to the effect found by observational studies.[3,4] However, since this is an ecological study, it was not possible to assert a causal relationship between the factors studied. Breastfeeding in the first hour of life is potentially beneficial for all children in all countries. However, its benefits in reducing neonatal mortality appear to be greater among countries with higher rates of neonatal mortality, which may be explained by the fact that these countries, possibly, have worse conditions of assistance during delivery and birth.

Reducing child mortality is one of the goals included in the Millennium Development Goals proposed by the WHO (goal number 4), and neonatal mortality is an important component, because it corresponded to 41% (3.57 millions deaths) of all deaths among children under 5 years old (8.79 million deaths) in the year 2008. The most common causes of neonatal death were: complications of prematurity (12%), birth asphyxia (9%), sepsis (6%) and pneumonia (4%).[16]

The findings of this study can be compared with large observational studies. A study conducted in Ghana, with around 11,000 children, concluded that 22% of neonatal deaths could be prevented if all children had been breastfed in the first hour of life, even when the analysis excluded children with high risk of neonatal mortality (preterm infants, those with congenital anomalies and complications during labor) and those who died in the first week of life.[2]

However, when considering only neonatal deaths from infectious diseases, the difference between breastfeeding in the first hour of life and on the first day of life does not seem to be statistically significant [odds ratio (OR) = 1.47; 95% CI = 0.65-3.30], although both are associated with a reduction in neonatal deaths due to infectious causes (OR = 2.61; 95% CI = 1.68-4.04).[3] The lack of statistical significance between breastfeeding in the first hour and the first day of life in the study of Edmond et al.[3] may be a

Table 1 Ratio of neonatal mortality rates according to the percentage of breastfeeding within the first hour of life, adjusted for the percentage of births in health facilities and education level in 67 countries.*

Variables	Rate ratio (95% CI)
Breastfeeding in the first hour of life	
1st tertile (high)	1.00
2nd tertile (intermediate)	1.06 (0.92-1.24)
3rd tertile (low)	1.24 (1.07-1.44)
Percentage of births in health facilities	
1st tertile (high)	1.00
2nd tertile (intermediate)	1.31 (1.08-1.58)
3rd tertile (low)	1.42 (1.17-1.74)
Percentage of people with secondary education or higher	
1st tertile (high)	1.00
2nd tertile (intermediate)	1.05 (0.87-1.27)
3rd tertile (low)	1.41 (1.15-1.72)

95% CI, 95% confidence interval.
*Negative binomial model.

result of insufficient statistical power to detect differences between these two groups of newborns, since the outcome is relatively rare. This assumption is reinforced by the increased odds of neonatal death in the group breastfed on the first day, compared to the group breastfed in the first hour (OR = 1.47), but whose CI was not sufficient to differentiate the two groups (95% CI = 0.65-3.30).

Garcia et al. observed that the late breastfeeding initiation (over 24 hours) was related to a 78% increase in the risk of neonatal mortality in India, and this effect remained even after the model was adjusted for other variables, such as birth weight and prematurity.[17] A similar study was conducted with more than 22,000 children in Nepal, and neonatal mortality risk increased by 41% when breastfeeding occurred after the first 24 hours of life (relative risk = 1.41; 95% CI = 1.08-1.86), even after adjustment for confounders.[18]

Among the mechanisms that may explain the protection that breastfeeding in the first hour provides to reducing neonatal mortality, those with greater biological plausibility are related to immunological components and probiotics of breast milk, which fulfill an active role in the immunity of the newborn.[4-7]

The infant's intestine is colonized by the same lactic bacteria and enterobacteriaceae found in breast milk,[4] which may reduce the intestinal colonization by gram-negative bacteria among newborns admitted to a neonatal intensive care unit.[5]

Breastfeeding mothers have an innate capacity to produce immunological factors according to the characteristics of newborns. These factors are excreted in breast milk, which is observed, for instance, in the colostrum of mothers with preterm babies, which is richer in interleukins and growth factors (TGFß1) than the colostrum of mothers of full-term newborns.[6]

Furthermore, mean concentrations of Immunoglobulin-A and anti Enteropathogenic Escherichia coli and Shigella flexneri are significantly higher in colostrum when compared to mature milk.[7]

Since it is an ecological study, in which there is no information about individuals, the percentage of breastfeeding within the first hour of life may, in some contexts, represent the set of hospital practices related to neonatal care, for instance, the BFHI. A study conducted in Brazil with more than 10,000 children, found that breastfeeding in the first hour of life is determined essentially by the maternity hospital where the delivery occurred, and individual factors, such as age, parity, and maternal education, did not play a significant role.[19]

Limitations of ecological studies are well established in the literature, and it is important that the inference biases are minimized in studies that use secondary databases. However, such studies, when complemented by observational studies controlled for confounding factors, can help decision makers in public health.[20] Ecological studies are a low cost and rapid implementation alternative to establish correlations between exposures and outcomes of interest and to evaluate the effectiveness of actions related to health.[21]

It is important to highlight the way the results are interpreted, as not to incur in the error of ecological fallacy: the correlation between breastfeeding in the first hour of life and neonatal mortality was observed between countries and not between people.[22]

A limitation of this study was not having considered other potentially confounding factors related to neonatal mortality, such as low birth weight, poverty, labor complications,[8] demographic factors,[3] introduction of infant formulas and foods,[2] besides those related to breastfeeding in the first hour of life, such as the proportion of cesarean births.[17]

These limitations, however, were partially considered when variables related to the population that could be correlated with decreased risk or chance of neonatal mortality were included in the statistical model, such as delivering in a hospital[23] and the education level of the population, which was included as a proxy variable of the socioeconomic level (and poverty) of a population.[24]

The implementation of policies and pro-breastfeeding routines can change the profile of breastfeeding within the first hour of life. Breastfeeding and contact with colostrum are among the actions with better cost-effectiveness for reducing neonatal infections, along with pre-natal care, delivery in a safe and clean place, and anti-tetanus vaccination. However, these actions require effective maternal and child health programs to be implemented.[25]

Therefore, breastfeeding in the first hour of life is recognized by the WHO as an important component in the promotion, protection, and support of breastfeeding, and should be implemented as a routine hospital practice in all countries in order to reduce neonatal mortality and achieve the goal number 4 of the Millennium Development Goals.

Conflicts of interest

The authors have no conflicts of interest to declare.

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References

1. World Health Organization, UNICEF. Baby-friendly Hospital Initiative: Revised, updated, and expanded for integrated care. Geneva: World Health Organization; 2009.
2. Edmond KM, Zandoh C, Quigley MA, Amenga-Etego S, Owusu-Agyei S, Kirkwood BR. Delayed breastfeeding initiation increases risk of neonatal mortality. Pediatrics. 2006;117: e380-6.
3. Edmond KM, Kirkwood BR, Amenga-Etego S, Owusu-Agyei S, Hurt LS. Effect of early infant feeding practices on infection-specific neonatal mortality: an investigation of the causal links with observational data from rural Ghana. Am J Clin Nutr. 2007;86:1126-31.
4. Albesharat R, Ehrmann MA, Korakli M, Yazaji S, Vogel RF. Phenotypic and genotypic analyses of lactic acid bacteria in local fermented food, breast milk and faeces of mothers and their babies. Syst Appl Microbiol. 2011;34:148-55.

5. Parm U, Metsvaht T, Sepp E, Ilmoja ML, Pisarev H, Pauskar M, et al. Risk factors associated with gut and nasopharyngeal colonization by common Gram-negative species and yeasts in neonatal intensive care units patients. Early Hum Dev. 2011; 87:391-9.
6. Castellote C, Casillas R, Ramírez-Santana C, Pérez-Cano FJ, Castell M, Moretones MG, et al. Premature delivery influences the immunological composition of colostrums and transitional and mature human milk. J Nutr. 2011;141:1181-7.
7. Araújo ED, Carbonare SB, de Araújo MC, Palmeira P, Amaral JA, Sales VS. Total and specific IgA in colostrum and milk of mothers of Natal –Rio Grande do Norte, Brasil. Acta Cir Bras. 2005;20:178-84.
8. Lawn JE, Cousens S, Zupan J; Lancet Neonatal Survival Steering Team. 4 million neonatal deaths: when? Where? Why? Lancet. 2005;365:891-900.
9. Horton S, Sanghvi T, Phillips M, Fiedler J, Perez-Escamilla R, Lutter C, et al. Breastfeeding promotion and priority setting in health. Health Policy Plan. 1996;11:156-68.
10. MEASURE DHS STATcompiler [accessed 21 Nov 2011]. Available from: http://www.statcompiler.com
11. Brasil. Ministério da Saúde. Pesquisa Nacional de Demografia e Saúde da Criança e da Mulher (PNDS) [accessed 12 Sep 2012]. Available from: http://bvsms.saude.gov.br/bvs/pnds/index.php
12. Sheather SJ, Jones MC. A reliable data-based bandwidth selection method for Kernel Density Estimation. J R Stat Soc Series B Stat Methodol. 1991;53:683-90.
13. Breslow N. A generalized Kruskal-Wallis test for comparing K samples subject to unequal patterns of censorship. Biometrika. 1970;57:579-94.
14. Rodríguez G. Generalized linear models. Lecture notes [accessed 1 May 2010]. Available from: http://data.princeton.edu/wws509/notes/
15. Fox J. An R and S-Plus Companion to Applied Regression. Thousand Oaks, CA: Sage Publications; 2002.
16. Black RE, Cousens S, Johnson HL, Lawn JE, Rudan I, Bassani DG, et al. Global, regional, and national causes of child mortality in 2008: a systematic analysis. Lancet. 2010;375:1969-87.
17. Garcia CR, Mullany LC, Rahmathullah L, Katz J, Thulasiraj RD, Sheeladevi S, et al. Breast-feeding initiation time and neonatal mortality risk among newborns in South India. J Perinatol. 2011;31:397-403.
18. Mullany LC, Katz J, Li YM, Khatry SK, LeClerq SC, Darmstadt GL, et al. Breast-feeding patterns, time to initiation, and mortality risk among newborns in southern Nepal. J Nutr. 2008; 138:599-603.
19. Boccolini CS, Carvalho ML, Oliveira MI, Vasconcellos AG. Factors associated with breastfeeding in the first hour of life. Rev Saúde Pública. 2011;45:69-78.
20. Pérez-Escamilla R, Vianna RP. Breastfeeding and infant pneumonia in Brazil: the value of electronic surveillance information systems. J Pediatr (Rio J). 2011;87:371-2.
21. Boccolini CS, Carvalho ML, Oliveira MI, Boccolini Pde M. Breastfeeding can prevent hospitalization for pneumonia among children under 1 year old. J Pediatr (Rio J). 2011;87:399-404.
22. Schwartz S. The fallacy of the ecological fallacy: the potential misuse of a concept and the consequences. Am J Public Health. 1994;84:819-24.
23. Victora CG, Aquino EM, do Carmo Leal M, Monteiro CA, Barros FC, Szwarcwald CL. Maternal and child health in Brazil: progress and challenges. Lancet. 2011;377:1863-76.
24. Adler NE, Boyce T, Chesney MA, Cohen S, Folkman S, Kahn RL, et al. Socioeconomic status and health. The challenge of the gradient. Am Psychol. 1994;49:15-24.
25. Huffman SL, Zehner ER, Victora C. Can improvements in breast-feeding practices reduce neonatal mortality in developing countries? Midwifery. 2001;17:80-92.