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Original Article

A multilevel model for the study of breastfeeding determinants in Brazil

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Abstract

The benefits of breastfeeding for the children's health have been highlighted in many studies. The innovative aspect of the present study lies in its use of a multilevel model, a technique that has rarely been applied to studies on breastfeeding. The data reported were collected from a larger study, the Family Budget Survey-Pesquisa de Orçamentos Familiares, carried out between 2002 and 2003 in Brazil that involved a sample of 48 470 households. A representative national sample of 1477 infants aged 0–6 months was used. The statistical analysis was performed using a multilevel model, with two levels grouped by region. In Brazil, breastfeeding prevalence was 58%. The factors that bore a negative influence on breastfeeding were over four residents living in the same household [odds ratio (OR) = 0.68, 90% confidence interval (CI) = 0.51–0.89] and mothers aged 30 years or more (OR = 0.68, 90% CI = 0.53–0.89). The factors that positively influenced breastfeeding were the following: higher socio-economic levels (OR = 1.37, 90% CI = 1.01–1.88), families with over two infants under 5 years (OR = 1.25, 90% CI = 1.00–1.58) and being a resident in rural areas (OR = 1.25, 90% CI = 1.00–1.58). Although majority of the mothers was aware of the value of maternal milk and breastfed their babies, the prevalence of breastfeeding remains lower than the rate advised by the World Health Organization, and the number of residents living in the same household along with mothers aged 30 years or older were both factors associated with early cessation of infant breastfeeding before 6 months.

Keywords: breastfeeding, prevalence, determinants, hierarchical (multilevel) analysis.

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Introduction

Monitoring child nutrition is fundamental in order to assess the state of child health in a given country (Monteiro *et al*. 1993). Specialists worldwide recommend the practice of breastfeeding because it provides a superior source of nutrients for infants, an effective form of protection against illness and the expression of affective closeness between mother and child (Ergenekon-Ozelci *et al*. 2006). Breastfeeding is defined as giving breast milk to children (whether directly from the breast or pumped and ingested later), independently of the ingestion of solid foods, semi-solid foods or liquids (including artificial milk) (Ministério da Saúde 2002). The World Health Organization recommends breast milk for infants, particularly up to the age of 6 months (WHO 1991), thus explaining the rationale for the research carried out specifically within this age group.

Since the 1980s, several strategies have been established to increase breastfeeding prevalence in Brazil. According to data from national studies, breastfeeding has increased considerably in all regions of the country. In 1975, 33% of infants aged 0–6 months were breastfed. By 1989, this rate had increased to 49% (Venâncio & Monteiro 1998).

A number of direct and indirect variables are associated with breastfeeding. For instance, an important factor to consider is the age of the mother: older mothers are more likely to breastfeed their children than younger mothers (González *et al*. 2002). The mother's ethnic group is also linked to breastfeeding: in Brazil, white mothers breastfeed their children less than black or mixed-race mothers (Rea 1994). Social factors such as the level of the mother's education and income are also related to breastfeeding rates: mothers with a lower level of education and income breastfeed their children more than mothers with a higher level of education and income (Bentley *et al*. 2003; Haas *et al*. 2006; Romero *et al*. 2006; Yeoh *et al*. 2007). However, the trend is currently changing: the number of better-educated women with higher incomes and easier access to information who breastfeed their children is on the increase. The trend in Brazil for less well-educated mothers to breastfeed is not mirrored in the UK or Western Europe, where breastfeeding is associated with higher levels of education. The area of residence, rural or urban, is also correlated to breastfeeding (Marques *et al*. 2001; Batista Filho & Rissin 2003; Kronborg & Vaeth 2004). According to a survey carried out in Latin America and the Caribbean, women residing in rural areas breastfeed more than those residing in urban areas (Pérez-Escamilla 2003).

There is a high level of heterogeneity in the literature as regards variables associated to breastfeeding, disfavouring or stimulating it. Levels depend on the methodologies applied, e.g. the size of the sample, the location of the study and data collection. In Brazil, this heterogeneity is observed because of the above factors, largely owing to the cultural differences among geographical regions. However, few national studies have analysed this issue.

Knowledge regarding regional breastfeeding trends and determinants is fundamental in order to assess breastfeeding promotion and support strategies and introduce proposed changes and adjustments. To date, only global studies concerning breastfeeding determinants have been carried out, which have not focused on patterns of dependence or correlation among individuals from a particular region. Dependence between observations means that the use of traditional regression models for the analysis of breastfeeding determinants is unsuitable for studying the different regions. Recent research has suggested new methodological approaches, such as the use of multilevel models for the epidemiological designs of this type (Leyland & Goldstein 2007).

Therefore, this study aimed to estimate the current breastfeeding prevalence in Brazil and its regions, to identify the determinants for breastfeeding, and to study their individual and contextual factors on the prevalence of breastfeeding in children aged up to 6 months.

Key messages

- The prevalence of breastfeeding in Brazil was 58%. The northern region of the country has the highest prevalence with 63%, while the lowest was found in the southeastern region with 51%.
- The factors unfavourable to breastfeeding in this sample were mothers aged over 30 years and over four persons in the same household. The factors favourable to breastfeeding were having more than two infants less than 5 years in the same household, higher income and dwelling in rural areas of the country.
- This study demonstrated low variability of the determinants of breastfeeding among Brazil's large regions. Further studies are needed to examine why the practice of breastfeeding, although frequent throughout the country, remains lower than levels advised by the World Health Organization, despite the pro-breastfeeding policies adopted in Brazil.

Subjects and methods

Data and study populations

Brazil has a large national representative household-based study with a complex sample selected in multiple stages involving stratification and clustering, such as the Family Budget Survey [Pesquisa de Orçamentos Familiares (POF)], carried out in 2002–2003 by the Brazilian Institute of Geography and Statistics [Instituto Brasileiro de Geografia e Estatística (IBGE)].

The POF involved interviews conducted in a sample of 48 470 households. The geographical stratification ensured the geographical representativeness of the sample by guaranteeing the participation of all parts of the Brazilian territory. The sampling of POF was structured to produce estimates representative of the country as a whole, its major regions (north, north-east, south-east, south and central west) and within both urban and rural settings. A complete overview and further details are described elsewhere (IBGE 2004).

In the questionnaire, sex was registered under four categories: male, female, pregnant and breastfeeding. On this basis, our sample was selected based on all households with children under 6 months, and numbered 1477 children, and assigned the condition of breastfeeding to all children under 6 months whose mothers had reported breastfeeding at the time.

The independent variables in the study were the following: mother's age (<20, 20–25, 26–30 and >30 years), mother's level of education (schooling of up to 4, 5–8 and 9 years or more), the number of residents in the household (1–3, 4–5 and over 6), the number of children in the household under the age of 5 years (1, 2, 3 or more), the ethnic group [white, black, mixed race (i.e. black and white)], the region (north, north-east, south-east, south and central west), the household per capita income (according to income quartiles), day nursery attendance, and the type of area (rural or urban). In this paper, the cut-off points chosen were those commonly used in scientific publications on breastfeeding, allowing results obtained to be compared with those of other studies.

Statistical analysis

Breastfeeding prevalence was estimated for the country as a whole and for the individual regions, calculated by dividing breastfed infants aged 0–6 months by the total number of infants aged 0–6 months, with a 95% confidence interval.

The distribution of breastfeeding determinants in the various regions was analysed by using contingency tables and the chi-square test with a 5% significance level.

A two-level hierarchical model was used to perform the analysis, given the structure of the data that were grouped by region. The two levels were subjects (level 1) and regions (level 2) (Bryk & Raudenbush 1992; Goldstein 1995). The effectiveness of this model is higher than that of other models that do not take into account the hierarchical structure of the data, which is why it has also been used by public-health researchers (Gatsonis *et al*. 1995; Leyland & Boddy 1997; Sixma *et al*. 1998).

The hierarchical model used in the analysis establishes that the dependent variable Y_{ij} follows the binomial distribution $Y_{ij} \sim Binomial(1,\pi_{ij})$ with the conditional variance $var(y_{ij}|\pi_{ij}) = \pi_{ij}(1-\pi_{ij})$ in which y_{ij} is the observed value of the dependent variable and π_{ij} is the probability of not breastfeeding for subject i from region j. Therefore, the binomial model establishes:

$$y_{ij} = \pi_{ij} + e_{0ij}z_{0ij}$$

in which z_{0ij} is the binomial variance, defined by $\pi_{ij}(1-\pi_{ij})$, and e_{0ij} is the level 1 random error. The variance of this random error is equal to that of the unit in the event of a perfect fit to the binomial distribution or may be estimated based on the data to compare the overdispersion or extra-binomial variation of the model. If the variance of e_{0ij} is greater than 1, then there will be an overdispersion in the model, and therefore, an incorrect fit in the data.

The dependent variable may be explained by a series of independent variables represented by $X_1, \ldots, X_p$. With the above conditions, the multilevel logistic regression model may be expressed in the form

$$logit(\pi_{ij}) = \log\left(\frac{\pi_{ij}}{1-\pi_{ij}}\right) = \beta_0 + \beta_1 x_{1ij} + \cdots + \beta_p x_{pij} + u_{0j}$$

in which u_{0j} is the random effect corresponding to the second level, with normal distribution of zero average and variance σ_u^2 (Goldstein 1995).

As the equation of the *logit* model represents the logarithm of the odds presenting the characteristic of interest, the exponential of the coefficients of the regression model may be interpreted in terms of odds ratios (Goldstein 1995; Leyland & Goldstein 2007).

To identify the statistically significant predictor variables, the Wald test is used, with a level of significance of 10% (Greenland 1989; Mickey & Greenland 1989; Leyland & Goldstein 2007).

To estimate the share of variability in breastfeeding by the independent variables, the expression proposed by Snijders & Bosker (2003) was used, which states:

$$R^2 = \frac{\sigma_F^2}{\sigma_F^2 + \sigma_u^2 + \sigma_R^2}$$

The share explained by the variables is σ_F^2 (variance of the predictor values of the model), and the unexplained share is $\sigma_u + \sigma_R^2$. In this unexplained variation, σ_u refers to level two and σ_R^2 refers to level one, fixed at 3.29 (Snijders & Bosker 2003).

The proportion of variability unexplained by the model, $1 - R^2$, may be broken down into two parts. On the one hand, $\frac{\sigma_u^2}{\sigma_F^2 + \sigma_u^2 + \sigma_R^2}$ represents the unexplained variance of level 2. On the other hand, $\frac{\sigma_R^2}{\sigma_F^2 + \sigma_u^2 + \sigma_R^2}$ represents the unexplained variance of level 1.

The SPSS statistical package, version 15 (SPSS Inc., Chicago, IL, USA), was used for the descriptive analysis, while R software, version 2.4.1 (R Foundation for Statistical Computing, Vienna, Austria), was used for the multilevel data analysis. Generalized linear mixed models via penalized quasi-likelihood (glmmPQL) were fitted using the glmmPQL function from the MASS library in R. The study was approved by the Research Ethics Committee of the Faculty of Public Health of the University of São Paulo.

Results

In Brazil, 58% of infants aged 0–6 months were breastfed (Table 1).

Table 1. Breastfeeding prevalence and their respective confidence intervals (CI 95%) in Brazil's macro-regions, 2002–2003

Regions of Brazil	Breastfeeding		
	Infants	Prevalence (%)	95% CI
North	290	63	57–68
North-east	660	59	55–63
South-east	200	51	44–57
South	118	61	52–70
Central west	209	56	49–62
Brazil	1477	58	55–60

A total of 75% of the Brazilian population lived in urban areas. The mean age of mothers was 26 years, with an average of 6 years' education. The average income was $485.00. Fifty-six per cent of the population was classified as mixed race. Forty-four per cent of all households consisted of four or five people. Table 2 depicts the population spread among Brazil's regions.

Table 3 compares the relationship between demographic, social and economic factors, and breastfeeding rates for infants aged 0–6 months to the remaining age groups.

The rate for the maintenance of breastfeeding in infants aged 0–6 months is lower in the case of older mothers and also if there are over four persons in the same household. Children born to mothers aged over 30 years have a 32% higher likelihood of not being breastfed than those born to younger mothers. If there are four or five residents in the same household, then children have a 32% higher likelihood of not being breastfed and a 37% higher likelihood if there are over six persons (Table 3).

The variables income, number of children in the household under the age of 5 years and type of area all significantly influenced breastfeeding. Infants from families with higher incomes are 37% more likely to be breastfed than those belonging to lower income quartiles. Families with over two infants under 5 years were 25% less likely to not breastfeed than families with only one infant. Twenty-five per cent fewer infants living in rural areas of Brazil are not breastfed compared with infants in urban areas (Table 3).

Table 2. Characteristics of the Brazilian population in the different Brazilian regions, 2002–2003

Variables	Macro-regions of Brazil												
	Brazil		North		North-east		South-east		South		Central West		*P**
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	
Area													<0.001
Rural	373	(25.3)	96	(33.1)	177	(26.8)	45	(22.5)	18	(15.3)	37	(17.7)	
Urban	1104	(74.7)	194	(66.9)	483	(73.2)	318	(77.5)	100	(84.7)	172	(82.3)	
Mother's education (years)													<0.001
≤4	481	(34.4)	101	(37.0)	257	(41.3)	58	(30.2)	27	(23.7)	38	(19.5)	
5–8	471	(33.7)	93	(34.1)	189	(30.3)	65	(33.9)	43	(37.7)	81	(41.5)	
≥9	445	(31.9)	79	(28.9)	177	(28.4)	69	(35.9)	44	(38.6)	76	(39.0)	
Children <5 years													<0.001
1	804	(54.4)	132	(45.5)	336	(50.9)	129	(64.5)	93	(78.8)	114	(54.5)	
2	496	(33.6)	113	(39.0)	232	(35.2)	57	(28.5)	20	(16.9)	74	(35.5)	
≥3	177	(12.0)	45	(15.5)	82	(13.9)	14	(7.0)	5	(4.3)	21	(10.0)	
Nursery													<0.001
No	560	(37.9)	119	(41.0)	288	(43.6)	71	(35.5)	35	(29.7)	47	(22.5)	
Yes	917	(62.1)	171	(59.0)	372	(56.4)	129	(64.5)	83	(70.3)	162	(77.5)	
Number of residents													<0.001
1–3	342	(23.2)	49	(16.9)	155	(23.5)	55	(27.5)	34	(28.8)	49	(23.4)	
4–5	659	(44.6)	136	(46.9)	259	(39.2)	95	(47.5)	60	(50.8)	109	(52.2)	
≥6	476	(32.2)	105	(36.2)	246	(37.3)	50	(25.0)	24	(20.4)	51	(24.4)	
Mother's age (years)													<0.001
<20	359	(26.1)	78	(28.7)	166	(26.9)	41	(21.9)	21	(18.8)	53	(27.6)	
20–25	330	(23.9)	65	(24.0)	158	(25.6)	37	(19.8)	21	(18.8)	49	(25.5)	
26–30	324	(23.5)	69	(25.5)	137	(22.2)	51	(27.3)	24	(21.4)	43	(22.4)	
>30	365	(26.5)	59	(21.8)	155	(25.3)	58	(31.0)	46	(41.0)	47	(24.5)	
Income													<0.001
1st quartile	378	(25.6)	64	(22.1)	245	(37.1)	34	(17.0)	6	(5.1)	29	(13.9)	
2nd quartile	406	(27.5)	100	(34.5)	186	(28.2)	43	(21.5)	21	(17.8)	56	(26.8)	
3rd quartile	326	(22.1)	69	(23.7)	111	(16.8)	54	(27.0)	40	(33.9)	52	(24.9)	
4th quartile	367	(24.8)	57	(19.7)	118	(17.9)	69	(34.5)	51	(43.2)	72	(34.4)	
Ethnic group													<0.001
White	563	(38.4)	78	(26.8)	193	(30.3)	105	(52.1)	102	(82.5)	85	(41.5)	
Black	104	(5.5)	12	(2.9)	42	(5.9)	20	(7.8)	14	(5.3)	16	(5.7)	
Mixed race	810	(56.1)	200	(70.3)	399	(63.8)	80	(40.1)	20	(12.2)	111	(52.8)	

*P-values by chi-square test.

The variance of breastfeeding rates explained by the model's variables was 12%. The remaining 88% is the result of the variables that were not considered in this study. The breakdown of the unexplained variance between the levels of analysis demonstrated a variance of 2% in the second level and 98% in the first level, indicating that there is negligible variability among the regions of Brazil. The overdispersion parameters in the analysis showed no evidence of inappropriate data adjustment in this binomial model. Residuals fitted a normal distribution, and there were no outliers or influent points in the data.

Discussion

This study was carefully planned and carried out so as to avoid sampling and information bias. The selected sample was of an appropriate size and representative of the Brazilian population. Data were collected properly. Therefore, the results obtained and presented in this paper accurately reflect breastfeeding practices in Brazil for the studied period. It is crucial to prevent information bias in order to obtain credible results in research. In this study, biases were neutralized or minimized by thoroughly defining the

Table 3. Relation between breastfeeding and demographics, social and economic factors in a multilevel logistic model. Brazil, 2002–2003

	Breastfeeding			
	No (%)	Yes (%)	OR	90% CI
Children <5 years				
1	42.4	57.2	1	–
2	43.7	58.3	1.25	1.00–1.58
3	40.1	59.9	1.26	0.90–1.74
Nursery				
No	40.2	59.8	1	–
Yes	43.0	57.0	0.87	0.71–1.06
Mother's education (years)				
≤4	41.0	59.0	1	–
5–8	39.3	60.7	1.00	0.80–1.26
≥9	35.3	64.7	1.17	0.89–1.55
Number of residents				
1–3	34.2	65.8	1	–
4–5	42.3	57.6	0.68	0.51–0.89
≥6	46.8	53.2	0.63	0.45–0.86
Income				
1st quartile	42.8	57.2	1	–
2nd quartile	43.6	56.4	1.05	0.81–1.37
3rd quartile	40.5	59.5	1.28	0.95–1.72
4th quartile	40.3	59.7	1.37	1.01–1.88
Ethnic group				
White	34.8	65.2	1	–
Black	36.3	63.7	1.02	0.66–1.56
Mixed race	35.2	64.8	1.03	0.84–1.25
Mother's age (years)				
<20	35.4	64.2	1	–
20–25	38.2	61.8	0.85	0.65–1.11
26–30	35.5	64.5	0.95	0.74–1.25
>30	44.6	55.4	0.68	0.53–0.89
Area				
Urban	42.4	57.6	1	–
Rural	40.5	59.5	1.25	1.00–1.58
Levels			Variance	Overdispersion
1	–	–	–	0.998791
2	–	–	0.1227	–

OR, odds ratio; CI, confidence interval.

studied variables, thus guaranteeing the internal validity of the study.

Multilevel analysis is an extension of traditional multivariate regression models. In this sense, all the reported potential confounders were controlled. Maybe there are other unknown key confounders. However, we used those that are most relevant in the scientific literature. As some authors showed, the number of confounders that need to be adjusted for will be limited in order to reduce the risk of overfitting of a multilevel multivariable model (Groenwold *et al*. 2008).

In the last few decades, according to the data from national surveys, breastfeeding prevalence in Brazil has risen. In 1975, 33% of 6-month-old infants were breastfed, compared with 49% in 1989 (Venâncio & Monteiro 1998), 51% in 1996 (BEMFAM/DHS/IBGE/MS/UNICEF 1997) and 58% currently, according to the results of this study. Compared with other countries, breastfeeding prevalence in Brazil is high:

prevalence is 33% in the USA (Ryan *et al*. 2002), 36% in Hong Kong (Lee *et al*. 2007), 24% in Greece (Antoniou *et al*. 2005; Bakoula *et al*. 2007), 58% in Germany (Peters *et al*. 2006), 47% in Russia (Grjibovski *et al*. 2005) and 76% in China (Xu *et al*. 2006).

Breastfeeding prevalence in Brazil is also high when compared with countries in Latin and Central America. Studies carried out in the 1970s and 1980s (Pérez-Escamilla 2003) demonstrated a slight increase in breastfeeding rates in Ecuador, Peru, and Trinidad and Tobago, no change in Mexico, and a decline in Columbia and the Dominican Republic. In the case of Brazil, the highest prevalence was in the northern region at 63%.

The innovative aspect of the present study lies in its use of a multilevel model, a technique that has rarely been applied to studies on breastfeeding. This relatively recent approach is most suited to research involving hierarchical data and for explaining the individual and contextual variables related to the families' and infants' biological and socio-economic backgrounds as breastfeeding determinants.

Four people or more in a single household proved to be an unfavourable factor as regards breastfeeding. This situation could be linked to excessive work burden for the mothers and a consequent decrease in the amount of attention given to the child. These data agree with the results presented in the National Survey of Children's Health which indicates that, where a family is composed of members other than the biological parents, there is a risk of children not being breastfed (Singh *et al*. 2007).

The link between living conditions and breastfeeding practices during the first few months of an infant's life is clear. The results of this study proved that infants aged 0–6 months whose families' income was higher were more likely to be breastfed. It may be assumed that their more privileged economic situation provides these families with easier access to information concerning the benefits of breast milk, which would explain why the more privileged classes value breastfeeding more highly than the lower classes. Factors such as pressure on mothers to return to work, aggressive formula milk marketing campaigns and cultural backgrounds that do not value breastfeeding also increase the likelihood of infants in poorer families being introduced to supplementary baby food at an early age (Victora *et al*. 1992; Rea *et al*. 1997; Vasconcelos *et al*. 2006; Oliveira *et al*. 2007).

Another important factor is maternal age. Older mothers breastfeed their children less. A plausible explanation for this would be their more stable professional situation. Women who are committed to their career might not have the time needed to take care of their babies or lack the dedication breastfeeding requires. A further reason is the mothers' personal decision not to breastfeed. These results agree with those presented in studies carried out in Hong Kong and the USA, where the intention not to breastfeed was more common in older mothers than younger ones (Ryan *et al*. 2002; Leung *et al*. 2003). However, some studies have reported the opposite trend, where older mothers have increased the length of their breastfeeding period (González *et al*. 2002; Hwang *et al*. 2006).

Even amid the current trend towards urbanization, mothers in rural areas are more likely to breastfeed their children in the Latin American and Caribbean region (Trussel *et al*. 1992; Pérez-Escamilla 2003). This may indicate a certain degree of reversal in the anticipated trend of adopting dominant cultural values by the underprivileged strata of the population. However, according to a study carried out by Ludvigsson (2003) in Bolivia, the opposite situation is true; mothers living in rural areas were four times less likely to breastfeed their children than urban mothers.

Our results indicate that families with over two infants under 5 years are more likely to breastfeed their children. One possible explanation for this finding is the fact that multiparous mothers have had previous experience with breastfeeding, or these mothers possessed the habit and perception necessary for the practice of breastfeeding. Another hypothesis is that even if the mother has not breastfed a child, the fact of being more experienced in relation to maternity could encourage the practice of breastfeeding at other times. In a study representative of the national population in Greece involving 2860 parent–child pairs followed for 8–12 months after childbirth, previous experience of breastfeeding by the mother was shown to be significantly associated with a longer

period of breastfeeding (Bakoula *et al*. 2007). According to Kronborg & Vaeth (2004), in a cohort study conducted in 471 Danish mothers who were followed for up to 4 months after delivery, previous experience of breastfeeding was also positively related to breastfeeding rates.

One of the public-health authorities' main objectives is to increase the rate of breastfeeding, especially among groups that are less likely to breastfeed at all and those who are likely to stop prematurely. Counselling programmes about breastfeeding, information campaigns (Venâncio & Monteiro 2006), the development of programmes such as the Baby Friendly Hospital Initiative (Bartington *et al*. 2006), goals such as those set by Healthy People 2010 (CDC – Division of Nutrition, Physical Activity 2007), and the Brazilian trading standard for infant products have all had a positive, significant effect on breastfeeding rates. Successful breastfeeding requires the care of the mother's family, friends and health professionals (Cattaneo *et al*. 2001). Information is crucial to encourage changes in mothers' beliefs and attitudes (Ergenekon-Ozelci *et al*. 2006), and continue the increasing trend in breastfeeding seen over the last decade.

The choice of a multilevel model in this study contributed towards a better understanding of breastfeeding determinants by highlighting the hierarchical relationships among different Brazilian regions as well as the determining factors provided in the clustering levels. A complex system of interrelationships was defined. The results obtained can be valuable for planning effective campaigns in the fields of nutrition and children's health, as well as in more successful monitoring of risk factors linked to breastfeeding.

Some of the variability in breastfeeding not explained by this model could be explained by other individual variants that were not considered in this study. Further research is needed to study individual characteristics. As variability among the regions proved low, it can be assumed that breastfeeding determinants are similar in both regional and national studies.

In any case, the estimation of variability revealed by the independent variables shows that the issue remains under theoretical investigation wherever a logistical regression model is involved. Alternatives suggested by other authors may yield different results but are not yet available in current statistical programmes (Browne *et al*. 2005).

Overall, there is a need for further analysis of the reasons why the return to breastfeeding, although rapidly increasing throughout the world, is not progressing more swiftly in view of the pro-breastfeeding policies adopted by governments worldwide. These findings may be interpreted as indicating that mothers can be helped to fully develop their breastfeeding abilities through improvements in the living conditions of children and their families, and the provision of broader access to essential goods and services.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

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