

**The impact of ever breastfeeding on children ages 12 to 36 months: A secondary data analysis of the standardization study of the Dominican system for evaluating early childhood development**

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## **The impact of ever breastfeeding on children ages 12 to 36 months: A secondary data analysis of the standardization study of the Dominican system for evaluating early childhood development**

Breastfeeding enhances children's survival, making it the best practice globally in child health and nutrition. Extensive research has shown that breastfeeding offers a plethora of benefits to children, including health advantages, physical development, intelligence and cognitive function, behavior, and healthy brain development, when compared to those who are not breastfed (Bar et al., 2016; Brahm & Valdés, 2017; Couto et al., 2020; Herba et al., 2013). Breastfeeding reduces the risk of child mortality and malnutrition, contributes to achieving the expected weight and height—thus developing better physical and psychomotor skills (Ahmed et al., 2023)—, and reduces the risk of obesity and chronic health conditions in adulthood (Pérez-Escamilla et al., 2023).

These benefits are long-term (Binns et al., 2016; Brahm & Valdés, 2017; Colen & Ramey, 2014; Horta et al., 2018) and are attributed to breast milk's unique nutritional composition (Demmelair et al., 2017; Lyons et al., 2020; Paquette et al., 2023)—which strengthens children's immune systems and protects them from gastrointestinal, respiratory, endocrine, and obesity-related diseases (Couto et al., 2020)—and the mother-infant attachment established during breastfeeding (Linde et al., 2020; Pérez-Escamilla et al., 2023). Breastmilk's benefits for infant health and development are enhanced by the nurturing effect of breast suckling (Pérez-Escamilla et al., 2023).

The government of the Dominican Republic has significantly promoted breastfeeding among mothers and their children during early childhood. Through Law 8-95 on Breastfeeding, enacted in 1984, the promotion, teaching, and dissemination of breastfeeding have become a national priority, laying the groundwork for subsequent campaigns and advocating for the rights of breastfeeding mothers under Article 240 of the 1992 Dominican Labor Code and Law 16-92 (Government of the Dominican Republic, 1992) and the 2008 Public Function Law 41-08 (Government of the Dominican Republic, 2008). In 2013, 89.3% of infants were ever breastfed and 6.7% were exclusively breastfed during their first six months (CESDEM & ICF International, 2014), whereas, in 2019, 92.2% ever breastfed and 15.8% did so exclusively during the first six months (ONE & UNICEF, 2022). These prevalence data, which were similar across income groups, educational attainment, and geographical location, indicate a small but positive trend in the increase of these practices over those six years. Longer maternity leave and awareness campaigns to promote breastfeeding may have contributed to this increase. Despite this relative progress, the country still faces significant challenges, such as inadequate information about breastfeeding, limited full-time work arrangements, and the lack of community support (Kristensen-Cabrera et al., 2019). Additionally, the pernicious effect of commercial milk formula manufacturers' marketing practices should not be underestimated (Pérez-Escamilla et al., 2023; Rollins et al., 2016).

In 2022, the National Institute for Early Childhood Comprehensive Care (INAIPI for its acronym in Spanish) implemented the Dominican System for Measuring Early Childhood Development (SIMEDID), a screening tool adapted and validated to the Dominican context (Alonso et al., 2022; Sánchez-Vincitore, 2023) that measures four areas of development: gross-motor, fine-motor, language, and socioemotional development. This tool was standardized in 2023 with children benefiting from INAIPI's services (Sánchez-Vincitore et al., 2023). In SIMEDID's standardization study, children scoring between -1 and -2 standard deviations in

overall development were identified as at risk for mild developmental delay, and those below -2 standard deviations were identified as at risk for severe developmental delay. The study findings indicate that, among children aged 12 to 36 months, 7.9% to 17.0% fell into the mild category and 0% to 2.3% within the severe category (Sánchez-Vincitore et al., 2023).

Building on the foundation laid by the SIMEDID initiative and related studies (Sánchez-Vincitore & Castro, 2022), we set out to explore the role of breastfeeding on early childhood development (ECD) among Dominican children, which has been challenging due to the lack of a surveillance system. This study aims to bridge this knowledge gap by establishing the relationship between breastfeeding and ECD in Dominican children aged 12 to 36 months and assessing the risk of developmental delay by breastfeeding status.

## **Material and methods:**

This study aims to address the effect of breastfeeding on early childhood development of a sample of Dominican children aged 12-36 months who received services at INAIPI and were evaluated during SIMEDID's normalization study. We cross-analyzed that data with INAIPI's Initial Health and Nutrition Assessment Form, which includes information about breastfeeding, among other variables. To determine the breastfeeding impact, the research team: 1) reviewed the participant's institutional registration forms to collect data on breastfeeding and establish associations with the children's development; 2) conducted a series of analyses of covariance (ANCOVA) using ECD scores as dependent variables (overall early childhood development, gross-motor, fine-motor, language, and socio-emotional development), and ever breastfed as the independent variable, with age and sex as covariates.

## **Participants**

From the original standardization study, we collected data from participants meeting the inclusion criteria, which consisted of children between 12 and 36 months of age who had undergone the SIMEDID evaluation and for whom breastfeeding information was available. We conducted a power analysis to determine the appropriate sample size for an Analysis of Covariance (ANCOVA) with a small effect size ( $f = .15$ ), a significance level of  $\alpha = .05$ , and a desired power of .95. We considered one degree of freedom for the numerator, two groups, and two covariates. The total required sample size for this analysis indicates a minimum of 580 participants. We selected 699 children (333 females and 366 males) who met the inclusion criteria, surpassing the minimum requirement.

## **Instruments**

*Dominican Infant Development Measurement System (SIMEDID)*: SIMEDID is a screening tool designed to track child development via a mobile application with a developmental measurement instrument (Alonso et al., 2022; Sánchez-Vincitore, 2023). This instrument allows for the assessment of a child's developmental progress across various developmental areas: gross motor skills (consisting of 33 items), fine motor skills (with 33 items), language and communication (comprising 34 items), and socio-emotional development (including 33 items). Additionally, it provides an overall development score, combining the scores from all these areas (133 items). The list of indicators within the system is organized in ascending order of complexity. Furthermore, the mobile application automatically selects the

specific developmental milestones for observation based on the child's age. Scoring within each developmental area is determined by a count of the number of correct items. As a progressive scale, the application presents only the relevant items that correspond to the child's age, ensuring accuracy, with at least three items falling below the child's expected level of development. Once a participant demonstrates accurate responses below their expected age, the preceding items are automatically scored as accurate. The data collected on the platform are transferred via the internet to INAPI servers.

*INAPI's Initial Health and Nutrition Assessment Form:* This form collects data about the health of children who enter INAPI services, perinatal history, date of birth, sex at birth, nutrition, maternal health history, immunizations, family history, physical examinations, warning signs, and nutrition including ever breastfeeding. The INAPI Health and Nutrition Agents complete the form when the child enters for the first time. For the present study, we focused on these variables: age in days (measured as the count of days since the date of birth), sex at birth (categorized as female or male), and ever breastfeeding.

### **Procedure**

The research team received the anonymized data from the original SIMEDID standardization study. This dataset comprised unique codes that were subsequently integrated with anonymized data from the forms completed by parents when registering for INAPI services, which also contained information regarding breastfeeding.

### **Ethical considerations**

The original standardization study, from which we obtained data for this secondary analysis, received approval from the Ethics Committee of Universidad Iberoamericana (CEI2021-3). This ensured the safety, confidentiality, and well-being of study participants. Parents or caregivers provided consent by signing a consent form, allowing INAPI to assess their children's development and use these data for research purposes.

### **Data analysis plan**

Before assessing the relationship between breastfeeding and early childhood development, we examined the effect of age and sex at birth on childhood development. This initial examination was necessary since, given the progressive nature of the measurement instrument, older participants have higher scores. Furthermore, research has shown that female children typically outperform males in certain development areas (Sánchez-Vincitore & Castro, 2022). We conducted a series of analyses of variance (ANOVA) in which the dependent variable was early childhood development and the independent variables age in days (for the first series of ANOVA) and sex at birth (for the second series ANOVA).

To determine the relationship between ever breastfeeding and ECD, we conducted successive ANCOVA analyses with the dependent variables (overall development, gross motor skills, fine motor skills, language and communication, and socio-emotional development), fixed factor ever breastfeeding, and covariates age in days and sex at birth.

To analyze the relative risk (RR) of developmental delay by breastfeeding status, participants were categorized into two groups based on their developmental scores: those with scores below -1 standard deviation within their age group were categorized into the developmental delay group, and those with scores above this threshold were placed in the other

group. Subsequently, we computed the relative risk of being in the developmental delay group according to breastfeeding status using this formula:

$$RR = \frac{\text{Risk of developmental delay in never breastfed children}}{\text{Risk of developmental delay in ever breastfed children}}$$

**Results:**

Among our sample of 699 participants, 580 were ever breastfed (83.0%) and 119 were not (17.0%). We found that females were ever breastfed more frequently than males, but the differences were not statistically significant (85.9% vs. 80.3%,  $\chi^2(1) = 3.430, p = 0.64$ , continuity correction applied).

To understand the effects of age and sex in childhood development, we conducted a series of analyses of variance (ANOVA) tests in which the dependent variable was early childhood development, and the independent variables were age in days (for the first series of ANOVA) and sex at birth (for the second series ANOVA). We found that age in days and sex at birth were significant predictors of ECD, as shown in **Table 1**. Female children outperformed males in all the development dimensions except for gross motor.

**Table 1.** Effect of age in days and sex at birth on developmental level by dimension (analysis of variance), among children ages 12 to 36 months, Dominican Republic, 2022

Dimension (DV)	Age in days (IV)	Sex at birth (IV)
<b>Overall development</b>	$F(448,698) = 2.935^{***}$	$F(1,698) = 12.141^{**}$
<b>Gross Motor</b>	$F(448,698) = 2.221^{***}$	$F(1,698) = 3.380$
<b>Fine Motor</b>	$F(448,698) = 2.749^{***}$	$F(1,698) = 18.503^{***}$
<b>Language</b>	$F(448,698) = 2.041^{***}$	$F(1,698) = 11.895^{**}$
<b>Socioemotional</b>	$F(448,698) = 2.104^{***}$	$F(1,698) = 7.774^{**}$

Notes:  $**p < 0.01$ ;  $***p < 0.001$ ; DV: Dependent variable; IV: Independent variable.  
For sex at birth, female participants outperformed male participants in significant results.

To determine the relationship between ever breastfed and ECD, we conducted successive ANCOVA tests with the overall development and its dimensions as the dependent variables, breastfeeding as the fixed factor, and age in days and sex at birth as covariates. As shown in **Table 2**, the ANCOVA showed that ever breastfed children outperformed those who never breastfed in the overall development score ( $F(1,698) = 5.80, p < .05$ ), fine motor ( $F(1,698) = 5.61, p < .05$ ), and language ( $F(1,698) = 4.45, p < .05$ ).

**Table 2.** Development differences by breastfeeding status, adjusted by age in days and sex at birth (analysis of covariance) among children ages 12 to 36 months, Dominican Republic, 2022

Dimension	ANCOVA Breastfeeding	Estimated marginal mean (no breastfeeding)	Estimated marginal mean (breastfeeding)	$\eta^2$
<b>Overall development</b>	F(1,698) = 5.80*	88.31	91.30	.004
<b>Gross Motor</b>	F(1,698) = 3.05	22.98	23.67	-
<b>Fine Motor</b>	F(1,698) = 5.61*	22.23	23.00	.008
<b>Language</b>	F(1,698) = 4.45*	18.66	19.70	.006
<b>Socioemotional</b>	F(1,698) = 1.79	24.45	24.92	-

Note: \*p<0.05.

To determine the relative risk of developmental delay by breastfeeding status, we assessed if the presence of breastfeeding was associated with developmental delay. **Table 3** shows that the never breastfed group had a greater risk of developmental delay across all dimensions, with the highest relative risk observed in fine motor development (RR = 2.06). These data show that not being breastfed more than doubles the risk of fine motor development delay and increases the risk of socioemotional, language, and gross motor delay.

**Table 3.** Relative risk of developmental delay by breastfeeding status, by dimensions, among children ages 12 to 36 months, Dominican Republic, 2022

Dimension	Risk in not breastfed children	Risk in breastfed children	Relative Risk (RR)
<b>Overall development</b>	0.176	0.121	<b>1.46</b>
<b>Gross Motor</b>	0.168	0.126	<b>1.34</b>
<b>Fine Motor</b>	0.185	0.090	<b>2.06</b>
<b>Language</b>	0.185	0.136	<b>1.36</b>
<b>Socioemotional</b>	0.210	0.112	<b>1.87</b>

## Discussion:

This study aimed to investigate the relationship between breastfeeding and early childhood development by analyzing developmental data for Dominican children aged 12 to 36 months. Our findings indicate that, after accounting for age and sex at birth, children who were ever breastfed exhibited significantly better overall developmental outcomes than those who were not. These results are in line with previous literature that shows the benefits of breastfeeding on development (Bar et al., 2016; Brahm & Valdés, 2017; Couto et al., 2020; Herba et al., 2013; McGowan & Bland, 2023).

In our study, the differences between children ever and never breastfed were particularly evident in language development and fine motor skills, results that are in line with previous studies. A literature review found that breastfed children outperform non-breastfed children in language skills and that breastfeeding had a protective effect against language disorders (Smith,

2015). This could be explained by the non-nutritive aspects of breastfeeding, which has been associated with a positive psychological impact that fosters the infant's secure attachment to their mother through various mechanisms: skin-to-skin contact, direct sensory feedback, regular and sensitive interactions, and release of oxytocin and prolactin hormones that enhance maternal caregiving through heightened emotional attunement and increased empathy towards the infant (Linde et al., 2020). In addition, there is evidence that children breastfed for less than four months perform significantly worse in fine motor tasks than children breastfed for a longer period (Oddy et al., 2011). Our study also found that children who were never breastfed have higher risks of developmental delay in all development dimensions compared to those who were ever breastfed. This indicates that breastfeeding may provide a protective effect, as seen in the literature (Oddy et al., 2011).

This study further confirms the validity of SIMEDID by demonstrating its capacity to evidence established factors associated with childhood development—a confirmation echoed in our findings. As expected, older children achieved higher scores compared to younger children. Additionally, across most developmental domains, female children displayed better performance than their male counterparts (Sánchez-Vincitore & Castro, 2022).

The present study has some limitations that should be considered for its interpretation. The breastfeeding data analyzed were limited to the child being ever breastfed—at the time of the study, no information was available on the time of initiation, duration, or exclusivity of breastfeeding. This lack of fine-grain detail may account for the small effect size, as various studies suggest that the longer the duration of breastfeeding, the more positive impact on children's development. Exclusive breastfeeding for the first 6 months and continued complementary feeding until 2 years of age is a protective factor that reduces the chances of attention deficits, autism spectrum disorder, and other behavioral disturbances throughout early childhood (Brahm & Valdés, 2017). Other authors support the benefits of exclusive breastfeeding for cognitive skills related to learning, decision-making, reasoning, visual and auditory memory, literacy, mathematics (Couto et al., 2020), and language skills (Salinas et al., 2022).

Another limitation is that the study did not consider other psychosocial and sociodemographic factors, above and beyond age and sex, that contribute to both breastfeeding practice and childhood development. Future studies should account for these variables to understand breastfeeding practices better. Moreover, the study sample is extracted from a population of highly vulnerable children. The prevalence of ever breastfeeding found in the sample (83.0%) is much lower than the prevalence found among the lowest income group in the 2019 national household survey (92.6%) (ONE & UNICEF, 2022). This difference could be explained by the existence of core structural hurdles that deter the establishment of a conducive breastfeeding atmosphere, such as gender inequality, urbanization, labor markets that fail to support women's reproductive and caregiving roles, and inadequate healthcare, including the overmedicalization of childbirth (Pérez-Escamilla et al., 2023). The fact that 62.9% of births in the Dominican Republic are by cesarean attests to this form of medicalization (ONE & UNICEF, 2022), and the inadequate healthcare during childbirth in public health facilities in the country has been extensively documented (Castro, 2019; Castro, 2024; Castro & Savage, 2019; Preaux & Castro, 2023).

While the prevalence of breastfeeding within our sample was lower than the national rates, INAIPI has initiatives that actively promote breastfeeding through tailored programs involving home visits, parental training, and installing breastfeeding rooms at INAIPI facilities.

As SIMEDID becomes the primary tool for developmental monitoring at INAIPI and gradually becomes integrated with other INAIPI databases and higher-quality data are obtained, cross-analyses between datasets hold the potential to provide a more holistic understanding of the effects of breastfeeding.

Notwithstanding these limitations, the present study contributes to the growing body of evidence supporting the benefits of breastfeeding in promoting early childhood development and preventing developmental delay.

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### **Data availability:**

An OSF repository with raw and anonymized data can be found at <https://osf.io/qpwzj/>.

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