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Association between exclusive breastfeeding and chronic child malnutrition in Ecuador: ENDI analysis 2023-2024

Asociación entre lactancia materna exclusiva y desnutrición crónica infantil en Ecuador: análisis ENDI 2023- 2024

Torres Ordoñez, L.
Universidad Estatal de Milagro (UNEMI), ltorresordonez@unemi.edu.ec
ORCID: https://orcid.org/0000-0002-5971-1451

Cárdenas Dávila, V.
Universidad Estatal de Milagro (UNEMI), cardenasdavilav@unimi.edu.ec
ORCID: https://orcid.org/0009-0000-7393-6289

Calderón Cisneros, J.
Universidad Tecnológica ECOTEC, jcalderoncisnero@ecotec.edu.ec
ORCID: https://orcid.org/0000-0002-8167-8694

Solís Manzano, A.
Universidad Estatal de Milagro (UNEMI), solismanzano@unemi.edu.ec
ORCID: https://orcid.org/0000-0003-0815-7312

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Corresponding Author
cardenasdavilav@unimi.edu.ec
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Abstract

Chronic child undernutrition remains a major public health issue in Ecuador, particularly among rural and vulnerable populations. Exclusive breastfeeding (EBF) during the first six months of life has been identified as a key protective factor. This study aimed to analyze the association between EBF and chronic child undernutrition (CCU) in children under three years of age, using data from the National Child Undernutrition Survey (ENDI 2023–2024). A cross-sectional quantitative design was applied, based on a nationally representative sample. Descriptive analyses, Chi-

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square tests, and binary logistic regression were used to explore associations between variables. Results showed that 17.9% of children presented CCU, and only 47.3% received EBF. Although the bivariate analysis revealed an unexpected association, the multivariate analysis confirmed that EBF is significantly associated with a lower likelihood of CCU (OR: 0.845; p = 0.005). Male sex, older age, and rural residence were also identified as risk factors for CCU. These findings underscore the importance of promoting exclusive breastfeeding as a key strategy in addressing childhood undernutrition in Ecuador.
Keywords: exclusive breastfeeding, chronic undernutrition, Ecuador, child health, ENDI, logistic regression

Resumen

La desnutrición crónica infantil continúa siendo un problema de salud pública en Ecuador, especialmente en poblaciones rurales y vulnerables. La lactancia materna exclusiva (LME) ha sido identificada como un factor protector clave durante los primeros seis meses de vida. Este estudio tuvo como objetivo analizar la asociación entre la LME y la desnutrición crónica infantil (DCI) en niños menores de tres años, utilizando datos de la Encuesta Nacional de Desnutrición Infantil (ENDI 2023–2024). Se realizó un estudio transversal de enfoque cuantitativo, basado en una muestra representativa a nivel nacional. Se aplicaron análisis descriptivos, prueba de Chi-cuadrado y regresión logística binaria para identificar asociaciones entre variables. Los resultados indicaron que el 17,9% de los niños presentó DCI, y solo el 47,3% recibió LME. Aunque el análisis bivariado mostró una asociación inesperada, el análisis multivariado confirmó que la LME se asocia significativamente con una menor probabilidad de DCI (OR: 0,845; p = 0,005). Además, se identificaron otros factores asociados a mayor

riesgo de DCI, como el sexo masculino, mayor edad y residencia rural. Estos hallazgos refuerzan la necesidad de fortalecer las políticas de promoción de la lactancia materna exclusiva en el país.

Palabras clave: desnutrición crónica infantil, lactancia materna exclusiva, Ecuador, salud pública, ENDI, regresión logística.

Introduction

Chronic child malnutrition is one of the main public health challenges worldwide. This problem occurs when children do not receive the nutrients necessary for proper development, which manifests itself in stunted growth, acute malnutrition, and, in some cases, overweight. These conditions negatively affect their overall health, learning ability, and resistance to disease (Child Malnutrition | UNICEF, n.d.).

One of the key factors in preventing child malnutrition is exclusive breastfeeding, as it provides essential nutrients and antibodies that strengthen the baby's immune system, in addition to fostering the mother-child bond (Angula et al., 2024). However, globally, only 38% of infants under six months of age are exclusively breastfed, and it is estimated that the lack of breastfeeding contributes to 11.6% of infant mortality in children under five years of age. In 2011, this represented approximately 804,000 infant deaths (Global Nutrition Targets 2025: Policy Paper on Breastfeeding, n.d.).

In response to this problem, in 2012 the World Health Assembly (WHA) set a target of increasing the rate of exclusive breastfeeding during the first six months of life to at least 50% by 2025, with the aim of improving child health and reducing mortality associated with malnutrition (Breastfeeding and Complementary Feeding - PAHO/WHO, n.d.).

In the case of Ecuador, data from the National Institute of Statistics and Census (INEC) indicate that chronic child malnutrition (CCM) affects 16.4% of children under five, with a higher prevalence in rural areas (20.6%) compared to urban areas (14.0%). The Sierra region is the most affected, with 21.4% of children with CCH, followed by the Amazon region with 20.2% (INEC, 2023). Although the CHD rate has fallen by 12 percentage points over the last seventeen years, from 28.4% in 2006 to 16.4% in 2023, these advances are still insufficient to meet international standards and reflect the complexity of the problem, which is influenced by social, economic, and environmental determinants (CRISFE Foundation, 2022).

One factor that could explain these alarming rates is insufficient exclusive breastfeeding in the first months of life. In Ecuador, the prevalence of exclusive breastfeeding is 53.1% in children under six months of age, with higher rates in rural areas (52.8%) compared to urban areas (48.2%) (Ruano et al., 2023). Although more than half of children are exclusively breastfed, 46.9% are not, which increases their vulnerability to diseases such as anemia and could influence their long-term nutritional status.

Therefore, this study aims to determine whether exclusive breastfeeding acts as a protective factor against chronic child malnutrition in children under three years of age in Ecuador, based on statistical analysis of representative data from the National Child Malnutrition Survey (ENDI).

Methodology

This study was conducted using a quantitative approach, with a cross-sectional, descriptive, and analytical design. The objective was to evaluate the relationship between exclusive breastfeeding and chronic child malnutrition (CCM) in children under three years of age in Ecuador, using data from the National Child Malnutrition Survey (ENDI), Round 2 (2023–2024). As Wang & Cheng (2020) point out, cross-sectional

studies with representative samples allow for the identification of public health associations with external validity, making it possible to relate associations between variables at a given moment, based on the analysis of representative secondary databases at the national level.

Two official databases generated by the National Institute of Statistics and Census (INEC) as part of the ENDI were used. The analysis of national surveys, as recommended by Gahche et al. (2025), is key to evaluating nutritional determinants in heterogeneous populations:

- F1 – Individuals: contains anthropometric, sociodemographic, and household information.

- F2 – Breastfeeding: collects specific details on breastfeeding practices, initial feeding, and conditions related to the mother.

The target population is children under three years of age, excluding the province of Galápagos. From the total ENDI universe (n=93,242), the analysis was limited to cases with complete information on the variables of interest, so specific subsamples were used according to each analysis:

- For the assessment of chronic child malnutrition, 22,331 valid cases with complete anthropometric information were considered.

- For variables on exclusive breastfeeding, 7,376 cases with complete data were used.

- The binary logistic regression model was performed on 7,229 valid cases, after excluding records with missing values in the included covariates. Binary logistic regression was selected to control for confounders, following the recommendations of Khan et al. (2020) in nutritional, epidemiological, and socioeconomic studies.

Data collection was carried out through structured face-to-face interviews between July 2023 and August 2024, using Form 2 of the Family Survey Module (MEF), approved by the Special Commission on Health Statistics.

The dependent variable was chronic child malnutrition (CCM), defined based on the height/age Z score according to the World Health Organization (WHO) child growth standards. Any child whose Z score was less than -2 standard deviations was classified as a case of chronic malnutrition.

The main independent variable was exclusive breastfeeding (breastfeeding_yes/no), coded dichotomously (Yes/No), according to the mother's report on whether the child was fed only breast milk during the first six months of life, without receiving other liquids or foods, except for medications, in accordance with the official WHO definition.

The following control covariates were also included:

- Child age (child_age_group): grouped into ranges (0–5, 6–11, 12–23, 24–35 months).

- Child sex (f1_s1_2): female or male.

- Area of residence (area): urban or rural.

- Mother's educational level (only in the descriptive analysis).

- Mother's work activity and feeding in the first 3 days (only descriptive).

The selection of these covariates was based on the available scientific evidence and the structure of the ENDI database. Factors with the potential to act as confounding variables were chosen, i.e., those that could influence both the probability of receiving exclusive breastfeeding and the risk of developing chronic malnutrition. Variables such as the child's age, sex, and area of residence were considered fundamental because of their

relationship to growth patterns, access to health services, and social determinants of health. Although other variables such as the mother's educational level or the household's socioeconomic status are also relevant, their inclusion was limited to descriptive analysis due to the presence of missing data in the subsample analyzed for regression (Black et al. 2013).

The data were exported from the official INEC platform and analyzed using SPSS version 26 software. Descriptive analyses of frequencies and percentages, Pearson's chi-square tests to explore bivariate associations, and a binary logistic regression model to identify factors associated with IMCI were applied. A statistical significance level of $p < 0.05$ was established.

Results

A descriptive analysis was performed to characterize the sample based on the main variables of the study. Of the 22,331 children with valid data on nutritional status, 17.9% had chronic child malnutrition (CCM), while 82.1% did not have this condition. These results are consistent with CCM figures in middle-income countries, which report similar prevalences (Sagastume et al. 2024).

With regard to exclusive breastfeeding (EBF), 7,376 cases with complete information were analyzed. Of these, 47.3% were exclusively breastfed during the first six months, and 52.7% were not. The EBF rate (47.3%) is consistent with studies in similar contexts (Ford et al., 2025), where socioeconomic factors limit adherence.

Regarding the mothers' work activity, in a subsample with complete data (n = 34,535), 94.6% reported having had only one job in the week prior to the survey, while 5.4% reported having worked in more than one. This information is relevant, as it has been documented that maternal working conditions,

especially working hours and lack of paid leave, can negatively affect the initiation and duration of exclusive breastfeeding (Rollins et al., 2016; Khan et al., 2020).

With regard to feeding in the first three days of life, 12,141 cases with available information were analyzed. Of these, 41.1% of infants received some food or drink in addition to breast milk, while 58.9% were not fed any other liquid or substance besides breast milk. This finding is relevant, as several studies have shown that early introduction of liquids, formulas, or infusions is associated with a lower probability of maintaining exclusive breastfeeding during the first six months, as well as a higher risk of gastrointestinal infections and malnutrition (Barros et al., 2021; Angula et al., 2024).

Regarding the mother's educational level, 30,417 cases with complete information were analyzed. It was observed that 40.8% of mothers had secondary education, 38.8% had basic education, and only 20.4% had higher education. This pattern is consistent with the scientific literature, which has shown an association between higher maternal education and a greater likelihood of initiating and maintaining exclusive breastfeeding. Mothers with higher education tend to have greater access to health information, greater capacity for autonomous decision-making, and greater willingness to follow feeding practices recommended by the World Health Organization (Ford et al., 2025; Rollins et al., 2016). However, it has also been found that, in certain contexts, mothers with higher levels of education tend to return to formal work earlier, which could represent an obstacle to sustaining breastfeeding if they do not have adequate institutional support (Khan et al., 2020).

Bivariate analysis: Association between EBF and CHD

Pearson's chi-square test was applied to explore the association between exclusive breastfeeding and chronic child malnutrition in a subsample of 7,376 valid cases.

Cases were selected using listwise deletion, a method that eliminates records with missing values in the variables of interest (χ^2 goodness of fit for missing data: $p > 0.05$).

Of the 12,141 children registered in the ENDI 2023-2024, 7,376 cases (60.8%) with complete data for the variables exclusive breastfeeding (EBF) and chronic child malnutrition (CCM) were analyzed.

The remaining 4,765 cases (39.2%) were excluded due to missing values. This loss is common in national surveys and does not compromise the representativeness of the sample, as the percentage of valid data exceeds the minimum required for statistical analysis (Wang & Cheng, 2020).

The table shows the relationship between exclusive breastfeeding (EBF) and Table

A statistically significant association was found between exclusive breastfeeding (EBF) and chronic child malnutrition (CCM) ($\chi^2 = 23.460$; $p < 0.001$). However, counterintuitively, children with EBF had a higher prevalence of CMI (23.4%) than those without EBF (18.7%). This apparent contradiction, as pointed out by Gayawan et al. (2023), could be due to uncontrolled confounding variables such as the child's age, rural area of residence, household socioeconomic status, and access to health services, factors that affect both exposure (EBF) and outcome (CHM).

Bivariate analysis using Pearson's chi-square test revealed a statistically significant association between exclusive breastfeeding (EBF) and chronic child malnutrition (CCM) ($\chi^2[2] = 23.460$; $p < 0.001$). This significance was corroborated by the likelihood ratio test ($\chi^2[2] = 23.722$; $p < 0.001$), confirming the robustness of the results. Compliance with the assumptions was

demonstrated by the absence of expected frequencies below 5 in any cell (minimum expected value = 60.59).

The results of the symmetric measures show identical values for Phi (**φ** = 0.056) and Cramer's V (V = 0.056), both with statistical significance ($p < 0.001$). This indicates that:

1. The association between exclusive breastfeeding and chronic child malnutrition is statistically significant ($p < 0.001$), but weak in magnitude (values close to 0).

2. The weakness of this association suggests that:

· Exclusive breastfeeding explains only a small proportion of the variability in chronic malnutrition

· Other factors not measured in this analysis could be influencing the relationship

· Multivariate analyses are necessary to control for possible confounding variables

3. The consistency between both measures (Phi and Cramer's V) confirms the robustness of these findings.

The cross-tabulation analysis revealed relevant findings on the relationship between exclusive breastfeeding (EBF) and chronic child malnutrition (CCM) in the sample studied (n=7,376). The results showed that:

1. Case distribution:

· 41.2% of children did not receive EBF (n=3,040)

· 58.8% did receive EBF (n=4,336)

2. Prevalence of CMI:

· In the group without EBF: 18.7% had CMI (568 cases)

· In the group with EBF: 23.4% had CMI (1,014 cases)

· Total prevalence: 21.4% (1,582 cases)

3. Main finding: A higher prevalence of DCI was observed in children who received LME (23.4%) compared to those who did not (18.7%). This difference was statistically significant (χ^2=23.460; p<0.001).

4. Interpretation:

The apparent contradiction (higher IMCI in children with EBF) could be explained by:

· Uncontrolled contextual factors (e.g., greater practice of EBF in rural areas with nutritional deficiencies)

· Possible bias in reporting the duration of EBF

· Confounding variables such as the child's age or the quality of complementary feeding

5. Limitations:

· 2% missing data in both EBF categories

· Cross-sectional nature of the study, which does not allow causality to be established

· These results highlight the need for multivariate analyses to control for the possible confounding factors identified.

Multivariate analysis: Binary logistic regression

A binary logistic regression model was applied to estimate the association between LME and DCI, adjusting for age, sex, and area of residence. The model was statistically significant (χ^2 = 209.735; gl = 6; p < 0.001) and had a Nagelkerke R^2 of 0.044. The Hosmer-Lemeshow test (p = 0.001) indicated an adequate fit.

The findings of this study confirm that exclusive breastfeeding (EBF) during the first six months of life is significantly associated with a lower probability of chronic child malnutrition (CCM) in children under three years of age. Although the bivariate analysis initially showed a contradictory relationship—a higher proportion of CWD in children with EBF—this effect was corrected when adjusting for confounding variables such as age, sex, and area of residence. These results reflect that exclusive breastfeeding reduces the risk of chronic child malnutrition even after controlling for confounders (Garina et al. 2024). This highlights the importance of considering sociodemographic factors when assessing nutritional determinants. WHO (2021)

An important sociodemographic factor is rural area, which can significantly influence nutritional determinants and therefore requires special attention. As suggested by Sharma et al. (2024), rural area acts as a confounder by being linked to both lower access to health care and cultural breastfeeding practices

This finding is consistent with previous studies that highlight the nutritional, immunological, and developmental benefits of EBF. Research such as that by Barros et al. (2021) has shown that EBF reduces the risk of infections, improves linear growth, and prevents severe forms of malnutrition. Victora et al. (2008) Likewise, international organizations such as the WHO and UNICEF promote its practice as one of the most effective strategies for preventing malnutrition and improving child survival. EBF not only improves nutritional status but also strengthens immunity (Musallam et al., 2025), which explains its protective role.

A relevant limitation is the possible memory bias in maternal reports on EBF, which could affect the accuracy of the data. To mitigate this, the ENDI used structured interviews and cross-validation with health records when possible.

The pattern observed in the bivariate analysis can be explained by structural factors not included in the model, such as socioeconomic status or access to health services. For example, mothers in rural areas or with lower levels of education may practice LME correctly, but their children may still be exposed to adverse environmental conditions that affect their growth.

It should also be considered that the use of secondary databases implies a dependence on the quality and completeness of the available records. Despite this, the large sample size and nationally representative design strengthen the validity of the findings.

The results support the need to strengthen policies promoting EBF in Ecuador, especially in rural areas and among male children, groups where IMCI was more prevalent. This evidence supports interventions such as: (1) training health professionals in EBF techniques, (2) nutritional monitoring during weaning, and (3) community campaigns adapted to the rural context, in line with WHO goals (2022).

Conclusions

The results of this study confirm that exclusive breastfeeding during the first six months of life is associated with a lower probability of chronic child malnutrition in children under three years of age in Ecuador. As proposed by Kuntjorowati et al. (2024), interventions in rural areas should combine nutrition education and access to health services. Although initially the relationship between the two variables did not appear to be favorable, multivariate analysis showed that, when controlling for factors such as age, sex, and area of residence, exclusive breastfeeding acts as a protective factor against malnutrition.

In addition, it was found that chronic malnutrition most frequently affects older children, males, and those living in rural areas, reflecting social inequalities that still persist and must be considered in public policies.

These findings support the importance of continuing to promote exclusive breastfeeding as a fundamental strategy for the prevention of child malnutrition. Reducing chronic child malnutrition (CCM) requires comprehensive multisectoral strategies, as demonstrated by economic evaluation studies in low- and middle-income countries (Baek et al., 2022). They also highlight the need to strengthen programs and policies that ensure adequate nutrition from the first months of life, especially in vulnerable populations.

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