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Addressing nutritional inequities in vulnerable Colombian communities: an analysis from socioeconomic, cultural, and healthcare challenges

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Abstract

Background Malnutrition remains a significant public health challenge in low-middle-income countries, particularly in rural and ethnic communities where structural inequalities exacerbate health disparities. This study aimed to examine the socioeconomic, cultural, and healthcare factors influencing malnutrition in children under two years old in three vulnerable regions of Colombia: Guajira, Cesar, and Chocó.

Methods A mixed-methods approach was utilized, combining quantitative analysis with qualitative interviews exploring cultural practices and healthcare access. Data was collected from clinical records of 269 children under two years diagnosed with severe and moderate acute malnutrition, data were stratified by region, ethnicity, and maternal education levels. The socioeconomical analysis includes a geographical analysis according to the location of the households.

Results Socioeconomical disparities, with over 52% of households living on less than \$125 USD per month, limited access to complementary foods, and high food insecurity characterized by families eating only once or twice a day. Prolonged exclusive breastfeeding over six months was observed in 10.7% of cases, influenced by cultural beliefs and food insecurity. Health complications, such as diarrhea and respiratory infections, were the most prevalent, where systemic barriers to healthcare access were most evident.

Discussion These findings align with global evidence from the WHO Global Nutrition-Report, which highlights the critical role of poverty, food insecurity, and inequitable healthcare access in perpetuating malnutrition. The study underscores the urgent need for culturally sensitive interventions, social protection programs, and infrastructural investments to address these disparities. By integrating local cultural contexts with evidence-based strategies, targeted-policies can improve maternal and child nutrition outcomes in Colombia's most vulnerable regions.

Keywords Breastfeeding, Malnutrition, Childhood malnourishment, Undernourished, Inequalities, Health services

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Introduction

The world is still engaged in the analysis to understand and reduce the inequities affecting the social and economic development of humanity. Currently, it is documented that poverty reduction has experienced its worst setback in decades, following almost a quarter of a century of sustained progress in reducing extreme poverty worldwide [1]. However, there has not been an adequate response; the cumulative effects of the pandemic and its economic repercussions, along with the impacts of armed conflicts and climate change, will exact a high human and economic cost in the long term [1].

Historically, Colombia has faced a crisis that has prevented significant gains in narrowing the gaps for poverty reduction. According to World Bank data, pre-pandemic rates of poverty and inequality in the country were on the rise. Official monetary poverty increased from 34.7% in 2018 to 35.7% in 2019, and the official Gini index also rose, reaching 52.7 in 2019 (compared to an average of 46.7 in the Andean region and 44.3 in the Southern Cone in 2019). As household incomes plummeted, other dimensions of well-being, especially food security, access to health services, and quality education, worsened [2].

Colombia becomes a focal point for the analysis of inequities, as, in addition to the post-pandemic consequences, it continues to be one of the most unequal countries in the world and the second in Latin America [3]. By 2021, the National Administrative Department of Statistics (DANE) indicated that monetary poverty in the country was 3.2% points lower than that recorded in 2020, when it was 42.5%. However, in rural and dispersed population centers, monetary poverty increased by 1.7% points, rising from 42.9% in 2020 to 44.6% in 2021 [4]. This situation brings about a significant increase in the deterioration of the health of the population in rural, dispersed, and ethnic belonging areas, with malnutrition being one of the problems that most reflect inequalities and inequities.

In the face of acute malnutrition, understood as weight deficit in relation to height below 2 standard deviations [5], in children under 5 years old, this issue persists in Colombia. Historically, two of the departments in Colombia most affected by this situation are Chocó, where the Afro-descendant and indigenous population predominates, and La Guajira, where mainly indigenous population resides. In addition to their high levels of poverty, they face difficulties in accessing health services, education, housing, infrastructure, and challenges inherent to their location and geographical characteristics, as well as being areas marked by armed conflict, further emphasizing poverty [6].

From 2017 to 2019, there was an increasing trend in the prevalence of acute malnutrition. In 2020, a significant decrease occurred due to the COVID-19 health

emergency, which led to a decrease in the attendance of health services for minors, impacting the notification volume of the event. In 2021 and 2022, there is again an increase in notification, with a total of 16,009 cases of moderate and severe acute malnutrition in the country, of which 2,569 (16%) correspond to the indigenous population; 1,311 cases in La Guajira and 442 in Chocó [7].

The proposed project aims to analyze the inequalities stemming from geographical and social characteristics contributing to malnutrition based on information from health and social services, families and health care workers in the departments of La Guajira, César and Chocó as remote and conflict-ridden areas in Colombia, with a particular emphasis on the process of addressing moderate and severe acute malnutrition (MSAM) cases in healthcare.

Methodology

An explanatory sequential mixed methods design with both quantitative and qualitative components was conducted in the departments of Chocó, La Guajira, and Cesar, Colombia. These territories have some of the highest rates of malnourished children under 2 years in the country and are also characterized by significant indigenous community presence, additionally these places are in a challenging context related to the armed conflict, environmental and social inequalities.

The study design was implemented following three subsequent phases:

Quantitative phase: A retrospective analysis was conducted using information of secondary sources such as medical records for all children aged 0 to 24 months diagnosed with moderate or severe acute malnutrition who received care at health care institutions (Instituciones Prestadoras de Salud, IPS) and nutritional recovery centers (Centros de Recuperación Nutricional, CRN) between 2020 and 2021, without exclusions.

Qualitative phase: During this phase in-depth interviews (see Interview Guide, Supplementary Material 1) were conducted with mothers and healthcare professionals, including pediatricians, general practitioners, nutritionists, and nurses who were directly involved in the care of malnourished children at CRN and IPS facilities in the selected departments. The format was designed to achieve a balance between structured and exploratory inquiry.

Participants were recruited using a snowball sampling technique, a widely accepted approach in qualitative research for identifying key informants within a specific community or professional network. To ensure comprehensive data collection and cultural sensitivity, local translators fluent in each indigenous language were engaged throughout the interview process to facilitate

communication with mothers and caregivers from the respective communities.

The translation process was conducted in real-time, with interpreters conveying both the questions from the researchers and the responses from the participants while maintaining fidelity to the original meaning and cultural context.

All interviews were audio-recorded, literally transcribed, and subjected to thematic analysis to identify recurrent patterns and underlying contextual factors that could further explain the quantitative findings.

Geographic and social inequities characterization A malnutrition mapping was conducted in the study areas using data from demographic and address information from families and care centers in each territory. Additionally, open data and Google Earth tools were used to gather information on available roads and rivers in different territories. The digitization of conflict zones was carried out using the diary and maps from the “Geopolitics of Dispossession” study.

Data analysis

For the quantitative component, a univariate and bivariate descriptive analysis is carried out; for the continuous variables, the calculation of mean, minimum, and maximum measures of central tendency is performed, and dispersion (standard deviations); categorical variables are expressed in proportions. The data analysis is performed with the statistical analysis software STATA V18.

A reflective thematic qualitative analysis [8] was defined, following the subsequent phases: data familiarization involved reading and rereading the entire dataset for getting acquainted with it; initial code generation where codes, the fundamental components of what later becomes themes, were generated. The coding process was carried out to produce concise, abbreviated, descriptive, or interpretative labels for pieces of information relevant to the research questions. Theme generation involved reviewing and analyzing the coded data to combine different codes according to shared meanings to form themes or subthemes. Definition and naming of the theme: each individual theme and subtheme was expressed in relation to both the dataset and the research questions [9]. The qualitative information was systematized and processed through the specialized Atlas Ti software, to organize, analyze and find insights in the interviews and open questions.

An analytical triangulation process was carried out, employing explanatory integration of the quantitative and qualitative results according to the analysis plan and study objectives. The aim was to explain and provide an overview of the underlying behavior behind the quantitative findings [10]. This was achieved through the

qualitative narratives of both mothers of children and health professionals responsible for their care and follow-up to explain trends observed in quantitative results.

Geographical and social analysis

A research question was formulated to guide the analysis, directly tied to the research objective: “What territorial factors contribute to child malnutrition in the study area?”. This question encompasses various geographical elements influencing the study’s theme, leading to several categories for exploration:

1. Urban or Rural Setting: Examining whether the study area is located in an urban or rural setting.
2. Accessibility and Infrastructure: Investigating the accessibility of the study area, including the presence and condition of roads leading to urban areas or the location of care centers.
3. Transportation Networks: Analyzing the availability and condition of accessible roads in the area.
4. Employment Situation: Exploring the level of unemployment in the area, considering its potential impact on malnutrition.
5. Historical Conflicts: Investigating whether the area has a history of historical conflicts, as this could be a significant factor in understanding malnutrition patterns.

The cartography relied on all available files and collected data to map malnutrition in the area and its territorial causes. This process led the group of analysts to verify, analyze, and question the distinctive factors affecting the communities under study regarding malnutrition and how to translate them into the territorial descriptive analysis. Which was represented on a map by territory using the ArcGIS software.

Results

Quantitative data were obtained from medical records, while qualitative data were collected through semi-structured interviews with 11 healthcare professionals and 21 mothers. Table 1 presents a sociodemographic and economic analysis of households’ situations of the children with moderate and severe malnourishment, served in the CRNs and IPSs in the study zone. Children aged 12 to 24 months represented 64.5% of the total sample, while those under six months accounted for only 14.5. In the three departments, most families live in the rural area (61%), Chocó was the most representative region, accounting for 79.6% of the total. The indigenous ethnic group is the main one in the three departments, with the highest prevalence in Choco (69.4%), while Afro-descendant families were exclusively reported in Chocó (29.6%).

Table 1 Sociodemographic and economic characteristics of households in Guajira, Cesar, and Chocó, Colombia

Variable	Guajira (N=99)	Cesar (N=72)	Choco (N=98)	Overall (N=269)
Residence area				
Rural (%)	50.5 (50)	56.9 (41)	79.6 (78)	61.0 (169)
Urban (%)	37.4 (37)	43.1 (31)	20.4 (20)	33.5 (88)
Not available (%)	12.1 (12)	0.0 (0)	0.0 (0)	5.5 (12)
Ethnicity				
Afro-descendant (%)	0.0 (0)	0.0 (0)	29.6 (29)	10.8 (29)
Indigenous (%)	52.5 (52)	51.4 (37)	69.4 (68)	58.4 (157)
Other (%)	29.3 (29)	19.4 (14)	1.0 (1)	16.1 (44)
Not available (%)	18.2 (18)	29.2 (21)	0.0 (0)	14.7 (39)
Mother's Educational Level (%)				
None	14.1 (14)	51.4 (37)	42.9 (42)	34.6 (93)
Primary	25.3 (25)	9.7 (7)	22.4 (22)	20.0 (54)
Secondary	24.2 (24)	8.3 (6)	13.3 (13)	16.5 (43)
Technician/Technologist	1.0 (1)	0.0 (0)	0.0 (0)	0.4 (1)
University	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
Not available	35.4 (35)	30.6 (22)	21.4 (21)	28.6 (78)
Mother's Occupation (%)				
Home	49.5 (49)	69.4 (50)	71.4 (70)	63.6 (169)
Study	0.0 (0)	0.0 (0)	2.0 (2)	0.7 (2)
Work	21.2 (21)	0.0 (0)	5.1 (5)	9.7 (26)
Other	1.0 (1)	0.0 (0)	0.0 (0)	0.4 (1)
Not available	28.3 (28)	30.6 (22)	21.4 (21)	26.3 (71)
Household Size				
Mean (members)	5.6	4.2	4.8	4.9
Median (members)	5	4	5	5
Standard Deviation	1.2	0.9	1.4	1.2
Monthly Household Income (USD, 2021) (%)				
< \$125.59	41.4 (41)	61.1 (44)	56.1 (55)	52.0 (140)
\$125.59-\$251.18	3.0 (3)	6.9 (5)	18.4 (18)	9.3 (26)
\$251.18-\$502.36	0.0 (0)	1.4 (1)	0.0 (0)	0.4 (1)
Not available	55.6 (55)	30.6 (22)	25.5 (25)	38.3 (102)

GHSSS: General Health Social Security System, Colombia

Household income: is expressed in USD for the year 2021, Colombia

SMLV: Salario Mínimo Legal Vigente (Current Legal Minimum Wage) (\$271.16 USD)

Maternal education levels are low, with 34.6% of mothers having no formal education and none reaching university-level education. This is most pronounced in Cesar, where 51.4% of mothers report no education. In all three departments, most mothers are engaged in household activities, with only 9.7% participating in formal employment. Household incomes are limited, with 52% reporting monthly earnings below \$125.59 USD, and an average household size of 4.9 members, being low under the Current Legal Minimum Wage in Colombia for that period (\$271.16 USD).

Table 2 highlights key findings related to the nutritional status and recovery of the children. Regarding breastfeeding, the early (<6 months) introduction of complementary foods shows a high percentage being almost the third part of the children (34.2%), particularly in Cesar (40.4%). Only 26% of children received complementary foods at the recommended age of six months, indicating

suboptimal feeding practices across regions. In turn, prolonged exclusive breastfeeding was evident in the three departments, that is, greater than six months, 14.1% in Guajira, 8.3% in Cesar and 9.2% in Chocó.

On the other hand, Diarrhea was the main health complications associated with malnutrition are the most reported condition. Respiratory infection was the second most frequent complication in Guajira and Choco, 6.1 and 19.4%, respectively, while in Cesar it was skin involvement (26.4%).

Finally, the percentage of mothers who were present during the nutritional recovery process in the institutions differed in the three departments, being similar in Guajira and Cesar but close to the half of the in Choco.

Factor influencing abandoning breastfeeding

Based on the responses of the mothers and professionals the main reason for abandoning breastfeeding reveals

Table 2 Breastfeeding practices, introduction of complementary foods, and health complications in children under two years old

Variable	Guajira (N=99)	Cesar (N=72)	Choco (N=98)	Overall (N=269)
Age of Introduction of Foods Other Than Breast Milk (%)				
Early Introduction (< 6 months)	26.3 (26)	40.4 (29)	38.8 (38)	34.2 (93)
At Six Months	29.3 (29)	19.4 (14)	29.6 (29)	26.0 (72)
Late Introduction (> 6 months)	14.1 (14)	8.3 (6)	9.2 (9)	10.7 (29)
Not Available	30.3 (30)	31.9 (23)	22.4 (22)	29.0 (75)
Health Complications (%)				
Diarrhea	10.1 (10)	45.8 (33)	24.5 (24)	25.8 (67)
Respiratory Infection	6.1 (6)	15.3 (11)	19.4 (19)	13.7 (36)
Severe Anemia	3.0 (3)	2.8 (2)	6.1 (6)	4.1 (11)
Skin Complications	2.0 (2)	26.4 (19)	6.1 (6)	10.1 (27)
Hyperemesis	2.0 (2)	23.6 (17)	3.1 (3)	8.1 (22)
Loss of Appetite	1.0 (1)	18.1 (13)	3.1 (3)	6.0 (17)
State of Lethargy	0.0 (0)	0.0 (0)	7.1 (7)	2.6 (7)
Mothers Accompanying Children During Nutritional Recovery (%)				
Yes	39.9 (40)	40.3 (29)	57.1 (56)	45.4 (125)

Table 3 Categorization of reasons for abandoning breastfeeding

Theme	Subcategories	Examples	Key Contexts
Perceived Child Health Issues	- Breastfeeding as the cause of illness - No alternative food sources available	"Mothers associate breastfeeding with the cause of illness in their children." "Their children were not receiving other types of food."	Particularly noted in Chocó, where younger mothers predominate.
Maternal Health Challenges	- Accelerated weight loss - Fatigue and dependency on the child	"The rapid weight loss of mothers was highlighted." "Mothers reported fatigue from the dependency created by breastfeeding."	More frequently in contexts with limited maternal nutrition.
Cultural and Belief Systems	- Pregnancy and breastfeeding seen as incompatible	"Some mothers believe breastfeeding during pregnancy is not possible." "baby rejects the breast"	Found across different regions but linked to cultural perceptions.
Institutional Influence	- Professional advice to stop breastfeeding	"One mother stopped breastfeeding based on the recommendation of healthcare professionals cause the children not receiving other types of food."	Occurred in institutional settings, reflecting professional influence

an interplay of maternal perceptions, cultural beliefs, and institutional influences. Various mothers associated breastfeeding with their children's illnesses, particularly when no alternative foods were available, highlighting concerns about the exclusive dependency on breast milk. Maternal health challenges, such as accelerated weight loss and physical exhaustion, further contributed to early weaning. Cultural beliefs, such as the perception that breastfeeding during pregnancy is harmful, also played a role in cessation decisions. Institutional factors, including disrupted breastfeeding practices, with some mothers reporting a shift to formula feeding upon entering these facilities. Additionally, inconsistent advice from healthcare professionals led some mothers to stop breastfeeding prematurely, underscoring the need for standardized guidance (Table 3).

How many months have you stopped breastfeeding? At 2 months. But it was a lie because even after weaning, he kept getting sick; he's still getting sick. It wasn't breastfeeding. I told my husband the same. They had told me to wean him, and if it was

because of breastfeeding, my child had recovered; he was already walking. But I don't see any difference. (Mother, E2, 2021).

Factors influencing the nutrition and maintenance of recovery for children after their discharge from services

Regarding indigenous mothers, professionals agree that "for several communities, meals are usually only once or twice a day." (Professional, E2, 2021) and "Mothers are responsible for taking care of the animals, which are the main source of income for the family, even when they report that their primary occupation is taking care of the home" (Professional, E1, 2021). "One of the primary reasons for leaving the institution earlier than planned for treatment is the need to care for other children or family responsibilities at home" (Professional, E2, 2021). On the other hand, most professionals highlighted the lack of access to potable water among families living in rural areas as one of the factors most closely associated with complications such as diarrhea and skin conditions, and even as a cause of malnutrition.

It is important to highlight that from October 2021 to April 2022, in six months 40.6% of professionals were no longer present in the institutions, trained professionals in nutrition recovery and breastfeeding consulting leave the territories for many causes, delegating the continuity of the care process to new professionals who lack the necessary training for attending to children with moderate and severe malnutrition in the context of a predominantly indigenous population.

Other responses highlighted that support for caregivers and children is a process that should continue after discharge. When asked about the type of support they would like to continue receiving from institutions once the recovery process for their daughters and sons is completed, mothers express a desire for ongoing guidance on how to feed their children, fearing a relapse. Additionally, they mention a desire for support in the form of food for their children and collaboration with other entities to generate employment, ensuring economic resources for the nutrition of their children.

"The support, therefore, that they continue to provide me from the Recovery Center with monthly follow-ups for the child, so that he does not relapse into malnutrition again." (Mother, E9, 2022).

"I believe that, for example, in the sense that they are institutions, they can have contracts with other organizations to see how they can support me in finding a job, so that I can have job stability to provide the necessary food for my daughter, or with food packages to give her a balanced diet [...] But I also need to have money, money to be able to buy her food, and for that, it requires a job, it requires a good economy, that is one of the factors that concerns me." (Mother, E10, 2022).

Triangulation

This analysis highlights the intersection of economic, cultural, and systemic factors shaping maternal roles and child recovery outcomes. Quantitatively, 63.6% of mothers report being "dedicated to home," but qualitative findings reveal their significant contributions to household income through informal labor, such as livestock care, which remains underrecognized. Income data shows that 52% of households live on less than \$125 per month, compounded by food scarcity and irregular feeding patterns majority in indigenous communities. Recovery challenges include low maternal presence during treatment (45.4%), often due to competing caregiving responsibilities, and high professional turnover (40.6%), leading to inconsistent guidance and reduced care quality. Early cessation of breastfeeding (34.2% introduced solid foods

before six months) is linked to conflicting advice and cultural beliefs, exacerbating malnutrition risks. Finally, diarrhea (25.8%) and skin conditions (10.1%) during recovery are closely tied to the lack of potable water, underscoring the critical need for integrated recovery strategies that address water access, professional training, and long-term nutritional support through employment and intersectoral collaborations (Table 4).

Geographical and social context

In the department of Chocó, the conditions for conducting agriculture to meet food needs are influenced by natural factors such as high rainfall and soils unsuitable for cultivation. Additionally, there are factors related to public order, represented by harassment, which is carried out by various armed groups against the population. This harassment confines or displaces the population, involving practices such as massacres, the planting of landmines, among others. Aspects of the deprived territorial infrastructure, where rivers are perhaps the most important means of transportation, both for economic exchange and food. The CRNs in Chocó seemingly receive the population from three well-defined regions. One region is exclusively connected by the river (Baudó) in the Upper Baudó, a second region around Istmina, connected by both river (San Juan) and road, and a third region around the CRN centers of Quibdó, also connected by both river and road. Additionally, Greater distance from home to care site correlates with less maternal support during the nutritional recovery process for children in areas with more offspring (Map 1).

In La Guajira, conditions for agri-food processes promoting rural population's food security face natural challenges like a dry, arid, and warm climate, water scarcity, and unsuitable soils. Historical public order issues involve harassment by armed groups. Territorial infrastructure is limited, with key transportation routes connecting Río Hacha to the Venezuela border and Puerto Colombia. Manaure and Río Hacha CRNs primarily serve rural Wayuu communities from Colombia and Venezuela. In the Manaure CRN, there was higher availability of mothers from relatively nearby communities, facilitating transportation and maternal support. It's crucial to note that, compared to Río Hacha, Manaure has the longest child stay in the CRN (Map 2).

In the Cesar department, in Valledupar the capital of the Cesar there is a larger urban population and longer stays, while in Pueblo Bello and in Codazzi center (located in the Sierra Nevada), the attended population is predominantly rural and from different indigenous communities. Likewise, in the areas near La Guajira, there is the highest number of cases related to security issues and harassment (Map 3).

Table 4 Triangulation of quantitative and qualitative data on maternal and child health factors

Aspect	Quantitative findings	Qualitative findings	Triangulated insight
Maternal Occupation	63.6% of mothers reported being "dedicated to home duties."	Many mothers care for livestock and animals, which are essential for family income; however, they categorize this work as part of household duties.	Animal care constitutes economic labor, but it is socially perceived as domestic work, leading to its underrepresentation in the quantitative data
Income Contributions	No direct association was found between animal care and household income. 52% of households reported earning less than \$125 USD per month.	Mothers expressed concerns about securing employment and economic resources to provide a balanced diet for their children. Professionals noted that indigenous communities often eat only once or twice a day, highlighting severe food insecurity.	Informal maternal labor contributes to household income but remains unmeasured, further emphasizing the economic vulnerability of these households. Food scarcity is deeply intertwined with cultural and structural barriers
Maternal Presence During Treatment	45.4% of mothers stayed with children during recovery.	Some mothers left early to care for other children, manage household duties, or tend to livestock.	Maternal absence reflects competing social, familiar and economical responsibilities
Breastfeeding Practices	34.2% of mothers introduced solid foods before six months, while only 10.7% practiced exclusive breastfeeding beyond six months.	Cultural beliefs (e.g., incompatibility with pregnancy, and illness) contribute to premature weaning. Conflicting guidance from professionals often leads to early cessation of breastfeeding, impacting children's health. Indigenous communities often eat only once or twice a day, which may be linked to the late introduction of complementary foods.	In some cases, food insecurity extends breastfeeding duration due to the lack of available complementary foods. Systemic gaps in professional training and inconsistent guidance undermine adherence to recommended breastfeeding practices.
Healthcare Professional Turnover	40.6% of healthcare professionals left their institutions within six months, creating gaps in care continuity.	Mothers reported inconsistent and conflicting advice from healthcare professionals, leading to confusion regarding breastfeeding and child nutrition	High professional turnover disrupts care quality and training consistency, requiring strategies for professional retention and capacity building to improve care for malnourished children.
Post-Recovery Support	No quantitative data available on post-recovery follow-ups.	Mothers expressed the need for continued support, including monthly follow-ups, food assistance, and employment programs to prevent relapses into malnutrition.	Mothers highlighted the need for ongoing support, including employment opportunities, to ensure long-term food security and prevent malnutrition relapses. However, access to such programs remains limited, indicating gaps in post-recovery assistance
Complications in Recovery	Diarrhea affects 25.8% of children during recovery (Table 2); skin conditions reported in 10.1%.	Professionals emphasized the lack of potable water in rural families as a key factor contributing to diarrhea, skin conditions, and even malnutrition.	Limited access to potable water exacerbates health complications, underscoring the need for water access as a critical component of post-recovery support

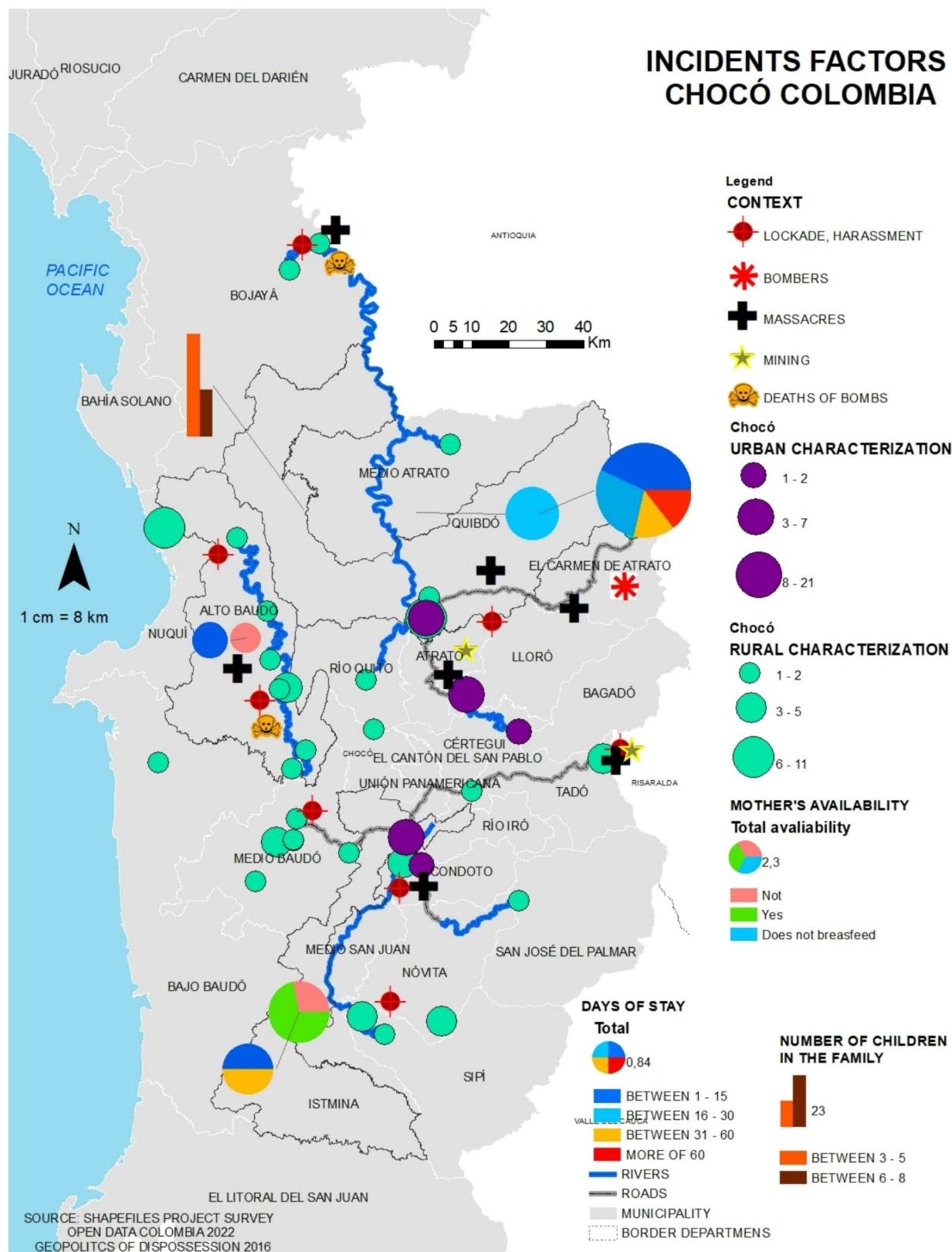
Discussion

The study examines inequalities by analyzing multifaceted factors contributing to moderate and severe malnutrition among children under two years old in Colombia's Guajira, Cesar, and Chocó departments. Key findings include low maternal education levels, suboptimal breastfeeding practices, prevalent health complications, healthcare disparities and significant socio-economic geographical challenges. These elements collectively delay child nutrition and development.

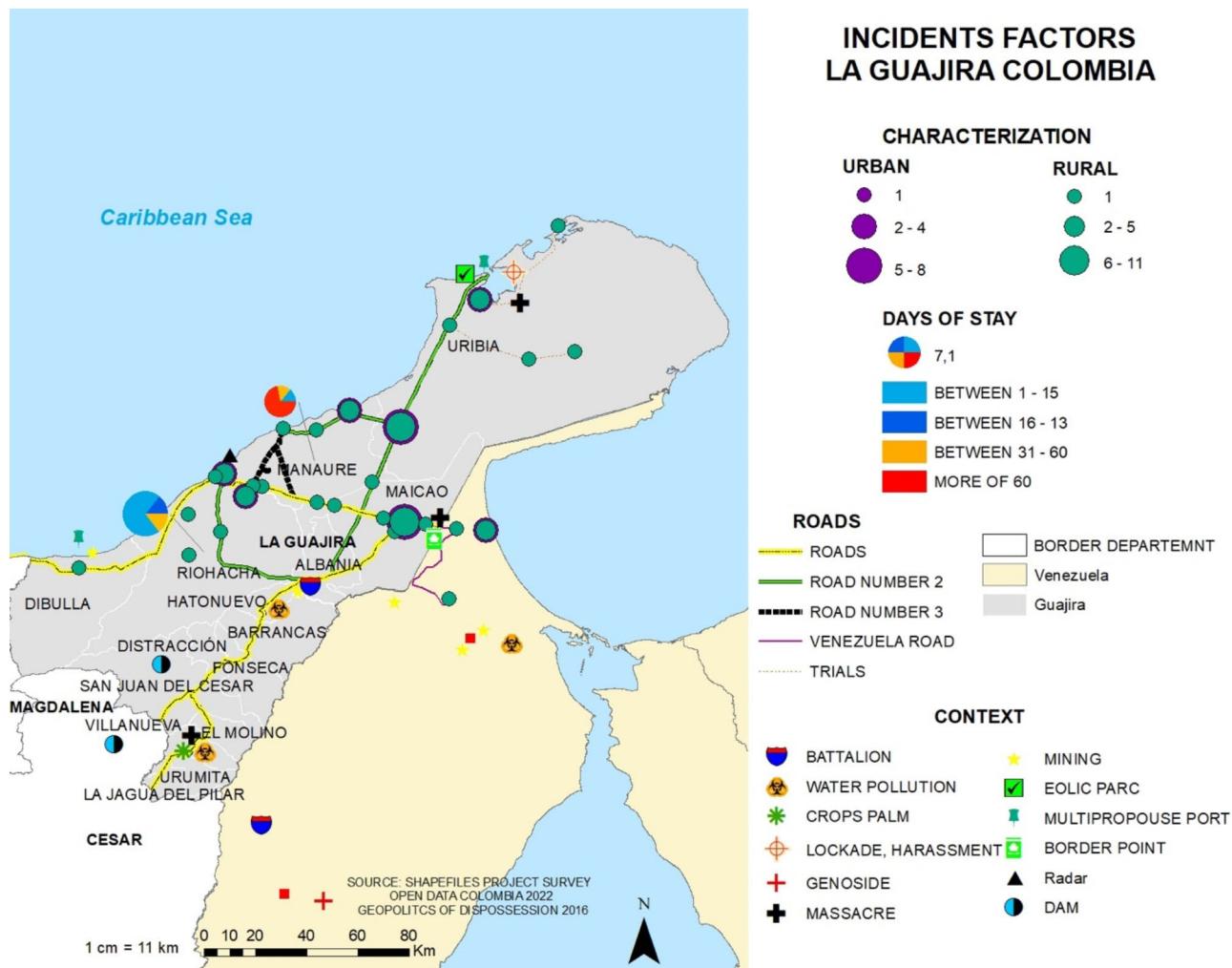
The socioeconomic status of households, measured by income levels, highlights disparities across regions and among ethnic communities living in rural areas of Colombia [11]. This is reflected in the high proportion of households living on less than \$125 USD per month. Considering an average household size of five members, the extreme poverty line in Colombia, as defined by the National Statistics Department (DANE), is \$38.6 USD per person per month [12], which translates to

approximately \$193 USD per household. This threshold is even lower than the global extreme poverty line set by the World Bank at \$1.90 USD per person per day, further underscoring the severe economic vulnerability of these households [13]. This is compounded by limited access to complementary foods and reports of food insecurity, such as families eating only once or twice a day and the prolonged practice of exclusive breastfeeding over six months of age.

These findings align with the WHO Global Nutrition Report, which emphasizes that food insecurity, exacerbated by poverty and inequitable access to affordable, nutritious foods, disproportionately affects vulnerable populations globally, particularly those in low- and middle-income countries. Additionally, the WHO report underscores that the economic constraints faced by such households not only perpetuate malnutrition but also hinder sustainable recovery, further reinforcing the need



Map 1 Incidence factors Chocó, Colombia 2021–2022



Map 2 Incidence factors Guajira, Colombia 2021–2022

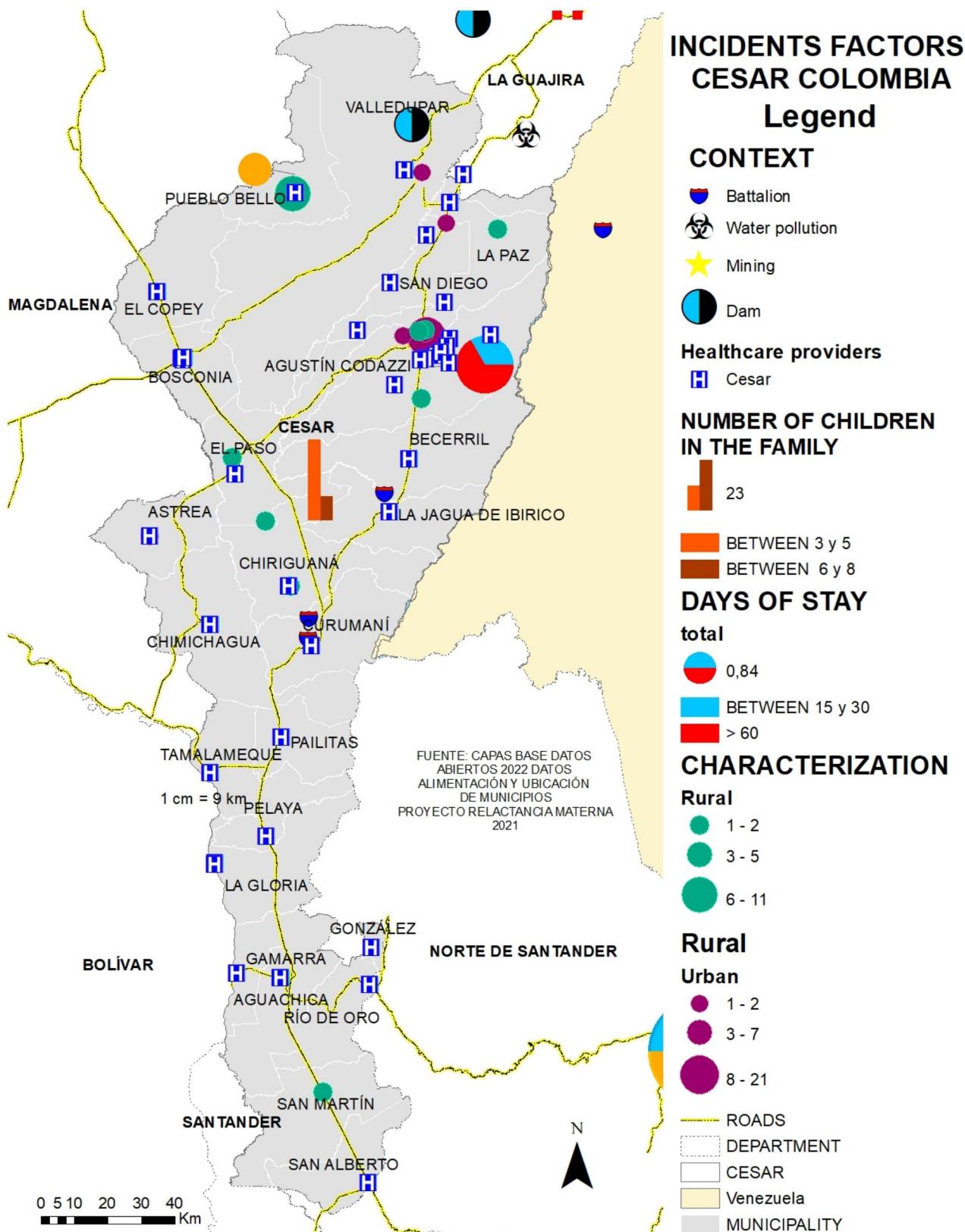
for social protection programs could play a critical role [14].

Likewise, differences between urban and rural settings in terms of access to healthcare and maternal support were analyzed, showing that rural households had less access to services, which contributed to health and nutrition inequities. The percentage of rural households (61% overall, with 79.6% in Chocó) further highlighted geographical barriers to equitable healthcare and nutrition services. The findings are consistent with research developed in Pakistan that shows in rural mothers' access to healthcare and therapeutic programs is hindered by geographical isolation, structural inequalities, poverty, and illiteracy [15].

The healthcare system faces challenges, with professional turnover rates (40.6% leaving within six months) as an indicator of inconsistent access to quality healthcare, disproportionately affecting communities with fewer resources. Conflicting advice from healthcare professionals and gaps in professional training shows systemic

barriers to equitable care. Mothers report receiving inconsistent and sometimes conflicting advice from healthcare providers, resulting in confusion about breastfeeding and child nutrition. High professional turnover disrupts care quality and training consistency, necessitating strategies for professional retention and capacity building to improve care for malnourished children, this is supported by evidence from Brazil, where health system inefficiencies contribute to persistent inequalities in malnutrition [16].

Maternal education levels were used to measure inequities in access to education across the departments, with 51.4% of mothers in Cesar having no formal education compared to other regions. The undervaluation of maternal informal labor (e.g., animal care) was an additional indicator of gender-based and economic inequities. This result agrees with other studies that indicate direct relationships between the duration of breastfeeding and the mother's educational level and low income [17–18]. The educational level of the mother is a variable of particular



Map 3 Incidence factors Cesár, Colombia 2021–2022

interest due to the association that exists between it and the nutritional status of infants and the duration of breastfeeding [19].

Cultural misconceptions about breastfeeding, such as its incompatibility with pregnancy or associations with child illness, emerged as significant barriers. These beliefs resonate with findings from Pakistan, where magico-religious practices dominate maternal health behaviors. In rural Bangladesh, the importance of culturally sensitive health education was emphasized as a strategy to shift harmful practices and promote evidence-based feeding behaviors [20]. Addressing cultural barriers requires engaging local leaders and incorporating traditional practices into health interventions to foster trust and acceptance. This represents a challenge at the training level of the professionals so that they acquired tools to approach these caregivers with techniques adapted to the context, the level of education and language.

Variations in health complications such as diarrhea, respiratory infections, and skin conditions among children across regions highlight inequities in health access, sanitation, and nutrition. The vulnerability of children receiving care increases when exposed to inadequate feeding practices, which are often economically unsustainable. Additionally, the lack of access to drinking water in these territories complicates the proper cleaning of utensils and the control of pathogenic organisms. Combined with improper preparation methods, such as inadequate formula dilution, this poses a significant risk factor for malnutrition [21].

Recognizing these challenges, breast milk remains essential in reducing the duration of these complications [22], provided it is appropriately offered alongside prophylactic therapy as outlined in acute malnutrition management guidelines. This approach includes the provision of therapeutic food and the progressive recovery of natural feeding, either through breastfeeding or adequate complementary feeding [23].

La Guajira, Cesar and Choco are the departments with the highest number of cases of children with MSAM, which is mediated by the social context, food insecurity and the different determinants that have an unfavorable impact on the health of this population [24]. This reality generates the need to promote the training of institutions and human talent in early childhood care [25]. These results are a reflection of the structural conditions that lead boys and girls to the process of acute malnutrition, they are in line with the causes described in the literature [19, 26–28] and must be subject to permanent analysis by territorial entities, therefore it is necessary to strengthen the identification, notification and surveillance processes of these events, as well as the identification and prioritization of families exposed to these risk factors.

In the study population, qualitative findings indicate ongoing challenges in addressing child malnutrition, despite the existence of prevention programs in Colombia, such as the 'Mil Días para Cambiar el Mundo' initiative. Participants reported barriers in access, timely intervention, and follow-up care for malnourished children, particularly in remote rural areas with limited healthcare services. Additionally, concerns were raised regarding gaps in the implementation of national guidelines for malnutrition prevention and management, which may impact the effectiveness of current strategies [29–30].

In the studied departments, accounts from healthcare professionals and caregivers suggest that many children receiving care at Nutritional Recovery Centers (CRN) are referred to food assistance programs after institutional recovery. However, children discharged from healthcare facilities often do not access ongoing nutritional support programs, increasing their vulnerability to relapse into malnutrition.

Findings from this study emphasize the important role of CRNs and IPSs in supporting nutritional recovery. However, participants highlighted the need to strengthen integrated programs that ensure comprehensive prevention, treatment, and follow-up care. Previous research, such as that by Prasad, Gope et al., suggests that implementing Participatory Learning and Action (PLA) methodologies, developed in collaboration with communities, could enhance the effectiveness and sustainability of nutritional interventions [31–32].

This study has certain limitations that should be acknowledged. The quantitative data was obtained from secondary sources, specifically from healthcare institution records, meaning that they only reflect cases that sought and received medical attention. Consequently, these findings cannot be extrapolated to the broader community level, as they exclude children who may have experienced malnutrition but did not access healthcare services. Additionally, while the qualitative phase provided valuable contextual insights, the snowball sampling technique used in selecting participants may have introduced selection bias, as participation depended on referrals within existing networks. Despite these limitations, the study offers important perspectives on child malnutrition within the selected regions, particularly in the context of indigenous communities and vulnerable populations.

A key strength of this study is its comprehensive geographical analysis and its ability to examine inequities through a multidimensional socioeconomic and territorial lens. By integrating quantitative data with qualitative insights, the study provides a nuanced understanding of how economic, social, and geopolitical factors intersect child malnutrition patterns in vulnerable regions. The

triangulation of data contextualizes statistical findings within lived experiences, allowing for a detailed exploration of structural inequalities, territorial disparities, and the impact of conflict zones on healthcare access and food security.

Conclusion

This study demonstrates how structural inequities disproportionately affect ethnic populations in vulnerable regions of Colombia and highlights the profound impact of socioeconomic, cultural, and healthcare inequities on malnutrition in children under two years old. The findings reveal that early abandonment of breastfeeding, food insecurity, limited maternal education, and inconsistent healthcare access significantly contribute to moderate and severe malnutrition.

Regional disparities, explained by the geographical challenges underscore the need for targeted interventions that address cultural beliefs, improve maternal support, and strengthen healthcare systems. The results underline the urgent need for culturally adapted strategies that address the unique challenges these populations face, such as limited education opportunities for mothers, deeply rooted cultural beliefs about breastfeeding, and systemic food insecurity.

To reduce malnutrition rates effectively, it is essential to invest in training healthcare professionals in culturally sensitive communication and context-specific intervention strategies, ensuring that guidance aligns with the cultural and social realities of these communities. Moreover, empowering ethnic populations through education, economic opportunities, and community-driven programs can foster sustainable change. Addressing these inequities requires not only policy adjustments but also collaboration with local leaders to design interventions that resonate with and are embraced by the communities they aim to act. Addressing these multifaceted challenges can foster better health outcomes for children and their families, promoting equality and resilience in underserved regions.

This study highlights the need for further research on informal labor among mothers, particularly regarding income-generating activities that are not officially recognized and their implications for breastfeeding practices and childcare in the context of malnutrition. Given that many mothers engage in unpaid or informal work without financial compensation or social benefits, it is essential to explore whether these economic conditions affect their availability to breastfeed or contribute to early breastfeeding cessation due to competing demands on their time and labor.

Abbreviations

CRN	Centro de Recuperación Nutricional.
ICBF	Instituto Colombiano de Bienestar Familiar.

IPS Institución (es) Prestadora (s) de Servicios de Salud.
 MSAM Severe and Moderate Acute Malnutrition.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12889-025-22694-4>.

Supplementary Material 1

Acknowledgements

We would like to thank the institutions that participated the project, including the Fundación Éxito, the Ministerio de Salud y Protección social, the Instituto Colombiano de Bienestar Familiar, IPS and CRN included.

Author contributions

O.V. led the conception of the study, performed data analysis, drafted the main manuscript text, and approved the final version of the manuscript. J.H., M.L. contributed to the study design, assisted in writing sections of the manuscript, and reviewed and approved the final manuscript. J.D. performed the geographic analyses, created the maps, and contributed to the study design and manuscript writing. All authors read and approved the final version of the manuscript authors read and approved the final version of the manuscript.

Funding

This research was funded by the Éxito Foundation Colombia.

Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

This research project was approved by the Institutional Review Board (IRB) of Fundación Santa Fe de Bogotá (Code Approval CCEI-13044-2021, Acta 08, 05 April 2021). In accordance with the ethical guidelines outlined in Resolution 8430 of 1993, this study is classified as minimal risk because it involves consulting information from medical records and secondary sources. Interviews will also be conducted with personnel supporting the IPS and CRN, as well as with the mothers of the children. Informed consent was obtained from all participants before conducting the interviews and their involvement in the study. All procedures were conducted in compliance with national regulations and ethical guidelines, specifically Resolution 8430 of 1993.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 16 December 2024 / Accepted: 8 April 2025

Published online: 28 April 2025

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