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Dietary Diversity and Nutritional Status in Infants Aged 6 to 23 Months: A Single-Center Observational Study.

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Abstract

Introduction: The first two years of life constitute a critical period for children's nutrition. According to the 2011-2013 National Health and Nutrition Survey, nearly half of children aged 6 to 11 months do not have access to an adequate variety of foods. The objective of the study was to establish the dietary diversity of children aged 6 to 23 months over 5 months, admitted to the Pediatric Clinical and Surgery area of a regional reference public hospital in Cuenca, Ecuador.

Materials and Methods: descriptive study; data collection was conducted using interviews and medical record reviews. Data tabulation and analysis were performed in SPSS 19, employing measures of central tendency and distribution for quantitative variables, and frequencies and percentages for qualitative variables. The sample comprised 171 children aged 6 to 23 months who were hospitalized in the surgery department and pediatric clinic at Vicente Corral Moscoso Hospital.

Results: The study analyzed 171 infants (52% girls), mostly residing in urban areas (58.5%), with caregivers aged 20-35 years and a basic level of education. Pneumonia was the primary reason for admission (42.1%). Nutritional status was critical: 76.7% experienced wasting or severe wasting, whereas only 22.8% had normal weight. Regarding diet, the minimum adequate dietary diversity was 38.6%, which increased significantly with age ($P < 0.001$), reaching 50% after the first year. Dairy products and vitamin A-rich vegetables account for over 80% of consumption, while legumes and nuts are the least frequent. Diet frequency and acceptability also increase proportionally with age ($P < 0.05$), with no significant differences between genders.

Conclusion: Infants exhibit a critical nutritional status, with a high prevalence of wasting. Although dietary diversity, frequency, and diet acceptability reach optimal levels proportionally to age, there are no differences between sexes. Adequate intake of micronutrients is evident, except for legumes and nuts, suggesting that malnutrition persists despite the achieved dietary variety.

Keywords: Dietary Diversity, Nutrition, Minimum Acceptable Diet.

Introduction

Nutrition is the fundamental pillar for strengthening and maintaining children's health, based on the adequate provision of nutrients in terms of quantity, quality, and diversity. Globally, the situation is critical; according to recent data from the United Nations Children's Fund (UNICEF) and the World Health Organization (WHO), it is estimated that 1 in 5 children under 5 years of age has low height for their age, while 12% suffer from wasting and an alarming proportion of one-year-old infants have iron-deficiency anemia [1, 2]. In this scenario, the WHO has urged governments to implement infant and young child feeding policies that promote the timely introduction of appropriate, safe, diverse, and culturally acceptable complementary foods and maintain breastfeeding until two years of age or longer [3].

Scientific evidence from countries with epidemiological profiles similar to Ecuador's, such as Colombia and Peru, maintains that low dietary diversity is the main predictor of the "triple burden" of malnutrition: chronic undernutrition, obesity, and micronutrient deficiencies, with long-term repercussions such as diabetes and food allergies [4, 5]. In the Ecuadorian context, the issue presents profound geographical and ethnic nuances; in provinces such as Chimborazo, undernutrition reaches 44%, far exceeding the national average of 23% reported in the latest National Health and Nutrition Survey (ENSANUT) [6]. This reality suggests that the challenge in Ecuador is not food availability but inequitable access and low levels of nutritional education among families [7].

Dietary diversity, defined as the number of food groups consumed over a specific period, reflects the interaction between children's preferences and caregivers' beliefs. To standardize its assessment, the WHO has established key indicators, updated in 2021, including early initiation of breastfeeding and the minimum dietary diversity (MDD), now based on 8 essential food groups [3, 8]. These indicators enable the assessment of diet quality by examining meat, fruit, vegetable, and cereal consumption, facilitating the identification of at-risk populations and the monitoring of public health interventions [8, 9].

In the city of Cuenca, the urban center of the southern Andean region of Ecuador, child-rearing is influenced by a complex amalgamation of cultural factors, socioeconomic strata, and media pressure. This variability creates a knowledge gap regarding the actual consumption patterns during different growth stages. Under this premise, the present study seeks to answer the following question: What is the dietary diversity among children aged 6 to 23 months admitted to the Pediatric Clinical and Surgery areas of the Vicente Corral Moscoso Hospital? Below, this observational study is detailed, aimed at characterizing the feeding practices of this vulnerable group.

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Materials and methods

Study design

This study is observational and prospective. The design is cross-sectional.

Setting

The present study was conducted in the Department of Pediatrics and Pediatric Surgery at the Vicente Corral Moscoso Regional Hospital, located in Cuenca, Ecuador, under the Ministry of Public Health of Ecuador. The sample is limited to a 5-month collection period from June 1, 2015, to October 30, 2015.

Participants

Infants between 6 and 23 months were included. Mothers or guardians signed the informed consent. Infants who were discharged at the request of parents or guardians before the survey was conducted were excluded.

Study groups

The sample was divided into groups based on the presence of postoperative complications.

Variables

The variables included age, sex, nutritional status, caregiver's occupation, family type, caregiver's age and education level, residence, food intake, dietary diversity, meal frequency, minimum meal frequency, and acceptable minimum diet.

Data sources/measurements

The source was direct. Data was collected through a survey. Nutritional status was classified using the body mass index (BMI) and converted into a continuous quantitative variable: 1. <3DS: Severe wasting. 2. Between -2DS and -3DS: Wasting. 3. Between -2DS and +2DS: Normal. 4. Between +2DS and +3DS: Overweight. 5. >3DS: Obese. The foods consumed were qualitatively classified into the following ranges: 1. Cereals, roots, and tubers. 2. Legumes and nuts. 3. Dairy (milk, yogurt, cheese). 4. Meats (meat, fish, poultry, and liver; organ meats). 5. Eggs. 6. Fruits and vegetables rich in vitamin A. 7. Other fruits and vegetables. Dietary diversity was classified as a nominal qualitative variable into the following categories: adequate (consumption of all groups); minimal (consumption of four groups); and inadequate (consumption of fewer than four groups). The minimum meal-frequency variable was assessed using the food record from the week preceding morbidity. For analysis, the indicator was classified as compliant or non-compliant across three strata: breastfed 6-8 months, 9-23 months, and non-breastfed 6-23 months. The minimum acceptable diet was recorded qualitatively (presence or absence).

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Biases

Observation and selection bias were avoided by applying participant selection criteria. The principal investigator always maintained the data using a guide and records approved in the research protocol to prevent potential interviewer, information, and recall biases. Data collectors on child nutrition were trained for data collection. Two researchers independently analyzed each record in duplicate, and variables were entered into the database after verifying their consistency.

Study Size

The sample was probabilistic. In the City of Cuenca, with a population of 596,000, the pediatric population under 2 years old comprises 1.91% (11,681 children). Using Epi Info (CDC, Atlanta, USA, 2023) with an expected hospitalization frequency of 12.0%, a confidence limit of 5%, and a confidence level of 95%, the sample size was 160 patients.

Quantitative Variables

The results are presented as frequencies and percentages. Variables collected on a scale were not converted into categorical variables.

Statistical analysis

Qualitative variables were analyzed using frequencies and percentages. Proportions were compared using the chi-square test, and means were compared using Student's t-test. The statistical package used was IBM Corp. (2018). IBM SPSS Statistics for Windows, version 26.0. Armonk, NY: IBM Corp.

Results

Participants

A total of 171 children were included in the study, representing 100% of the planned sample size.

Study group description

The family type was mostly nuclear (53.8%). The caregiver's age was 20-35 years in 73.7% of cases. The caregiver's basic education was mostly primary education (56.1%). 64.3% had temporary jobs (Table 1). The description of the group of children is presented in Table 2. Pneumonia (42.1%) and urinary tract infection (8.2%) were the main causes of hospitalization. Nutritional status was severe wasting in 36.3% and wasting in 40.4%. The type of food most consumed by children was from the "Fruits and vegetables rich in Vitamin A" group in 86.5%, meats in 78.4%, and dairy products in 75.4% (Table 2).

Sociodemographic Profile and Nutritional Status

When analyzing the characteristics of the study population, an equitable distribution between men and women is observed across both age groups, with no statistically significant

differences. Regarding origin, although patients from urban areas predominate, a slight increase in rural representation is observed in the 13 to 23 months group (Table 3).

Nutritional Status and Feeding Patterns

The nutritional status reveals a concerning and homogeneous picture among the groups; the majority of infants present some degree of wasting (either moderate or severe), while less than a quarter of the sample maintains a normal nutritional status. This finding underscores the vulnerability of the pediatric patients included in the study, regardless of whether they are in their first or second year of life. Regarding the consumption of food groups, a general trend of greater diversification is observed with increasing age. Children aged 13 to 23 months had higher consumption rates in key categories, such as dairy, meats, and eggs, than infants under 13 months.

Table 1. Description of the study group

Family type	
Nuclear	92 (53.8%)
Expanded nuclear	39 (22.8%)
Expanded single-parent	27 (15.8%)
Single-parent	11 (6.4%)
Others	2 (1.1%)
Caregiver's Age	
Edad óptima (20-35 años)	126 (73.7%)
Elderly (over 35)	27 (15.8%)
Adolescent (under 20 years)	16 (9.4%)
Not recorded	2 (1.2%)
Caregiver's Level	
None	5 (2.9%)
Basic Education	96 (56.1%)
Secondary Education	57 (33.3%)
Higher Education	13 (7.6%)
Caregiver Occupation	
Other/temporary employment	110 (64.3%)
Small merchant	18 (10.5%)
Unemployed	10 (5.8%)
Worker	8 (4.7%)
Artisan and small industrialist	8 (4.7%)
Public employee	6 (3.5%)
Private company employee	4 (2.3%)
Small agricultural worker	4 (2.3%)
Semi-salaried	1 (0.6%)
Independent professional	1 (0.6%)
Manages their own business	1 (0.6%)

Diet quality indicators

The most relevant disparity is observed in dietary quality indicators: 1.) Meal frequency: Older children (13-23 months) showed significantly higher compliance with the minimum meal frequency compared to the 6-12 month group ($P = 0.022$). 2) Dietary diversity: There is a highly significant difference ($p < 0.001$) in dietary adequacy. While half of older children achieve

adequate dietary diversity, only slightly more than a quarter of infants aged 6-12 months do so (Table 3).

Table 2. Reason for admission, nutritional status, type of food.

Reason for Hospitalization	Total n=171
Pneumonia	72 (42.1%)
Urinary tract infection	14 (8.2%)
Acute diarrheal disease	12 (7%)
Cystic fibrosis	9 (5.3%)
Congenital malformation	9 (5.3%)
Soft tissue infection	9 (5.3%)
Convulsive Syndrome	8 (4.7%)
TBI	8 (4.7%)
Burn	7 (4.1%)
Fever of Unknown Origin	7 (4.1%)
Intoxication	7 (4.1%)
Intestinal Obstruction	5 (2.9%)
Malnutrition	4 (2.3%)
Nutritional Status	
Severe wasting (BMI<-3SD)	62 (36.3%)
Wasting (BMI between -2SD and -3SD)	69 (40.4%)
Normal (BMI between +2SD and -2SD)	39 (22.8%)
Overweight (BMI between +2SD and +3SD)	1 (0.6%)
Type of Food	
Fruits and vegetables rich in Vitamin A	148 (86.5%)
Meats	134 (78.4%)
Other fruits and vegetables	132 (77.2%)
Dairy products (milk, yogurt, and cheese)	129 (75.4%)
Eggs	124 (72.5%)
Cereals, roots, and tubers	123 (71.9%)
Legumes and nuts	107 (62.6%)

Table 3. Reason for admission, nutritional status, type of food.

Place of residence	Age Group (months) 6-12 meses n=87	Age Group (months) 13-23 meses n=84	*P*
Males	42 (48.3%)	40 (47.6%)	0.56
Females	45 (51.7%)	44 (52.4%)	
Origin			
Urban area	56 (64.4%)	44 (52.4%)	0.220
Rural area	31 (35.6%)	40 (47.6%)	
Nutritional status			
Severe wasting	32 (36.8%)	30 (35.7%)	0.234
Wasting	36 (41.4%)	33 (39.3%)	
Normal	19 (21.8%)	20 (23.8%)	
Overweight	0 (0%)	1 (1.2%)	
Type of food			
Cereals, roots, and tubers	55 (63.2%)	68 (81.0%)	0.113
Legumes and nuts	45 (51.7%)	62 (73.8%)	
Dairy (milk, yogurt, and cheese)	53 (60.9%)	76 (90.5%)	
Meats	60 (69.0%)	74 (88.1%)	
Eggs	50 (57.5%)	74 (88.1%)	
Fruits and vegetables rich in Vitamin A	70 (80.5%)	78 (92.9%)	

Table 3. Reason for admission, nutritional status, type of food.

Other fruits and vegetables	60 (69.0%)	72 (85.7%)	
Minimum meal frequency			
Yes	52 (59.8%)	64 (76.2%)	0.022
No	35 (40.2%)	20 (23.8%)	
Minimum dietary diversity			
Adequate	24 (27.6%)	42 (50.0%)	
Minimum	39 (44.8%)	37 (44.1%)	<0.001
Inadequate	24 (27.6%)	5 (23.8%)	
Minimum acceptable diet			
Yes	47 (27.6%)	59 (23.8%)	0.24
No	40 (27.6%)	25 (23.8%)	

Discussion

Main findings

The findings of this study reveal a critical situation regarding the nutritional status of the hospitalized pediatric population, where more than 76% of the children showed some degree of wasting, with 36.3% being severe. This nutritional decline occurs alongside a sociodemographic profile of vulnerability, characterized by young caregivers with limited education and temporary employment. Although pneumonia was identified as the main cause of hospitalization, the most important data come from analyzing diet quality: there is a significant gap in dietary diversity by age, with infants aged 6 to 12 months having considerably lower dietary adequacy than children aged 13 to 23 months ($P < 0.001$). These disparities suggest that, despite reports of consumption of key foods such as vitamin A-rich fruits and meats, the minimum required frequency and diversity are not consistently achieved, which could be contributing to the high rates of malnutrition observed in the sample.

Clinical Interpretation

1. The Food Transition Gap

The data reveal a critical vulnerability during the complementary feeding period (6 to 12 months). The notable difference in minimum dietary diversity indicates that younger infants are being restricted from accessing a sufficient variety of food groups, which limits the micronutrient density needed for rapid growth. Clinically, this explains why wasting is common from the early stages: although food volume may be adequate, nutritional quality remains inadequate.

2. The Phenomenon of Persistent Wasting

Although children aged 13 to 23 months show better indicators of meal frequency and diversity, the rates of severe wasting remain nearly the same as those in the younger group (35.7% vs 36.8%). This suggests that nutritional damage happens early and is hard to reverse just by introducing solid foods. From a clinical view, this implies that malnutrition in these children might be caused by factors beyond food access, such as recurring infections or poor nutrient absorption.

3. Protein Quality and Growth

There is a notable rise in the consumption of high biological value proteins (meats, eggs, and dairy) during the second year of life. However, the persistence of acute malnutrition (wasting) indicates that this increase might arrive too late to offset the accumulated deficits. Clinical practice should focus on educating caregivers about the early inclusion of these foods to prevent worsening nutritional status before the child reaches one year old.

4. Environment and Nutritional Risk

Although urban origin is predominant, the shift towards a more varied diet seems to be more influenced by the child's chronological age and psychomotor development (ability to swallow and chew) than by place of residence. This suggests that interventions should be universal and centered on feeding techniques, regardless of whether the child is from a rural or urban setting.

Practical Applications of the Findings

Strengthening Early Nutritional Education

Since the most critical gap in dietary diversity occurs in the 6 to 12-month age group, the immediate practical step involves developing intensive counseling programs for caregivers. These should focus on introducing proteins and micronutrients early in complementary feeding, dispelling myths about delaying certain foods (such as meats or eggs) that, according to the study, are better introduced in the second year.

Wasting Monitoring Protocols

The widespread occurrence of wasting in both groups suggests that nutritional screening should not be done randomly. Clinically, implementing stricter follow-up protocols with weight-for-height indicators is justified, enabling early detection of acute malnutrition before it advances to severe stages, especially in children who do not meet the minimum meal frequency.

Design of Contextualized Dietary Guidelines

The results show that, although there is access to food (as reflected in the consumption of cereals and tubers), the minimum acceptable diet remains a challenge. This enables decision-makers to develop guidelines that not only specify "what to eat" but also emphasize frequency and quantity, tailoring recommendations to urban and rural settings to ensure that as children grow older, their nutritional status actually improves.

Related studies

The results obtained align with the current scientific literature, which identifies acute malnutrition as a prevalent and severe comorbidity in pediatric hospital care in developing countries. The high incidence of wasting in our sample (76.7%) is consistent with cross-sectional studies reporting that malnutrition at admission substantially increases the risk of prolonged hospital stays and infectious complications [10, 11]. For example, previous research has shown

that pneumonia, the main cause of admission in this study, has a significantly more reserved prognosis in infants with deficient anthropometric indices, as malnutrition compromises the host's immune response. Regarding dietary quality indicators, the marked deficiency in minimum dietary diversity observed in the 6-12-month group aligns with reports identifying this period as a critical phase of vulnerability; studies in similar populations indicate that late or monotonous introduction of complementary foods is a key predictor of growth stunting and wasting [12, 13]. Finally, the predominance of caregivers with basic education and temporary employment reinforces the thesis that social determinants of health, especially caregivers' educational level and economic stability, are key determinants of food security and infants' nutritional status, as documented in multiple cohort analyses of childhood malnutrition [13].

Limitations

The cross-sectional design prevents establishing a direct causal link between low dietary diversity and wasting, allowing only the identification of statistical associations. Additionally, the dietary assessment was based on the 24-hour recall provided by the caregiver, which introduces potential memory or social desirability bias, where the informant may overestimate the intake of certain food groups (e.g., meats or dairy) perceived as "correct." Moreover, although the sample size of 171 participants met the planned target, it was drawn from a single hospital center, limiting the generalizability of the results to the national pediatric population or non-hospital settings. There is also a need to explore other underlying biological or clinical factors that could influence nutritional status, such as malabsorption or undiagnosed chronic conditions at admission.

Research lines

It is essential to conduct longitudinal studies that follow the cohort for 6 to 12 months to determine whether the improvement in dietary diversity observed in the second year of life effectively reverses wasting rates or if the consequences of early deficits persist long-term. Likewise, investigating the socioeconomic and cultural factors that limit the minimum acceptable diet in urban environments is necessary, as food availability does not seem to directly lead to optimal nutrition. Finally, evaluating the impact of specific educational interventions for parents—comparing whether nutritional guidance starting at 6 months significantly reduces the transition to severe wasting compared to traditional feeding practices—would be valuable.

Conclusion

This study shows that although a child naturally shifts toward more frequent and diverse eating as they reach the second year, this does not necessarily improve their nutritional status. The continued high rates of wasting in both age groups indicate that the period from 6 to 12 months is a critical vulnerability window, where poor diet quality seems to create a weight deficit that is hard to reverse later.

Abbreviations
BMI: body mass index.
WHO: World Health Organization.

Supplementary information
Supplementary materials have not been declared.

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Author contributions
John Enrique Chiriboga Garnica: Conceptualization, data curation, investigation, methodology, visualization, writing-original draft.
Ana Cristina Farfán Riera: Conceptualization, data curation, investigation, project administration, and original draft writing.
María Lourdes Huiracocha Tutivén: Conceptualization, formal analysis, software, validation, visualization, writing – review and editing.
All authors read and approved the final version of the manuscript.

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Declarations
Ethics committee approval and consent to participate
The study was approved by the Health-Associated Bioethics Committee (COBIAS) of the Faculty of Medical Sciences at the University of Cuenca.

Consent for publication
Not applicable when images, X-rays, or specific patient photographs are not published.

Conflicts of interest
The authors declare no conflicts of interest.

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