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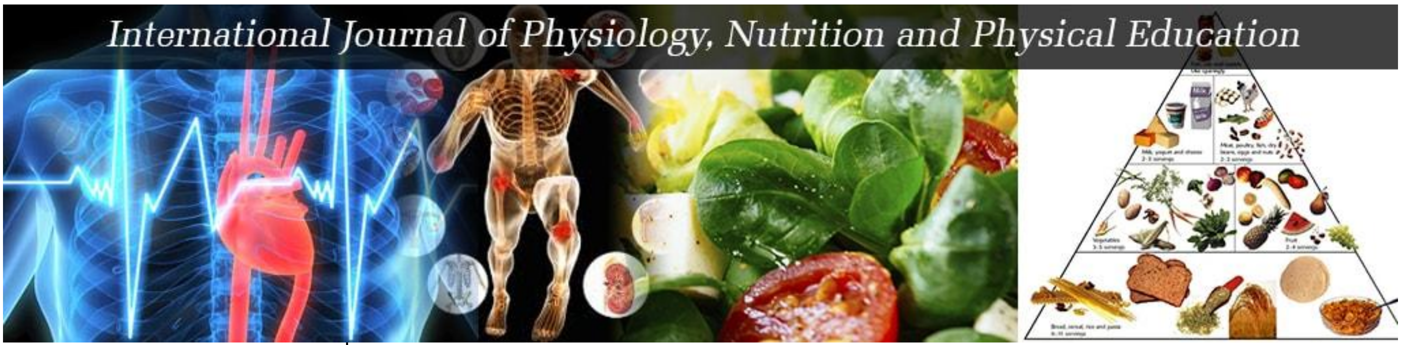

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Childhood malnutrition in Iraq: A nationwide cross-sectional study of under-five children attending primary healthcare centers

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Abstract
Background: Childhood malnutrition remains a critical public health challenge in Iraq, with limited comprehensive data on prevalence and determinants across the country. This study aimed to assess the nationwide prevalence and determinants of malnutrition among children under five years attending primary healthcare centers in Iraq, providing essential evidence for targeted interventions and policy development.
Methods: This cross-sectional descriptive study assessed malnutrition among Iraqi children under five at Primary Healthcare Centers (PHCs) nationwide (excluding the Kurdistan Region) between December 2024 and April 2025. A multistage stratified random sampling selected PHCs and recruited 5,120 eligible children. Data collection included standardized questionnaires covering demographics, health, feeding practices, and maternal knowledge, plus anthropometric measurements following WHO protocols. Quality control ensured accuracy and reliability. Analyses used SPSS for descriptive, bivariate, and multivariate assessments of malnutrition prevalence and predictors. Ethical approval was secured, and informed consent obtained, with strict confidentiality and data protection measures maintained throughout the study.
Results: The study analyzed 5,121 under-five children across Iraq, revealing significant geographic and socio-demographic variation in nutrition status and risk factors. Nearly half had normal nutrition, while 18.8% were stunted, 9.3% underweight, 4.8% wasted, and 12.5% overweight, showing a dual burden. Key predictors included low birth weight, peripheral residence, low maternal education, incomplete vaccination, and poor vitamin A coverage. Early breastfeeding cessation and gaps in Vitamin A and D supplementation were notable. Regional disparities in malnutrition and service availability underscore the need for targeted, governorate-specific interventions to address underlying socioeconomic and healthcare access barriers and to improve child nutrition outcomes.
Conclusion: This study highlights Iraq's complex child malnutrition landscape, revealing undernutrition and rising overweight trends with regional and socioeconomic disparities. It calls for urgent, governorate-specific interventions to strengthen maternal and child health services, improve feeding practices, expand vaccination and education, and implement multi-sectoral policies to reduce malnutrition sustainably.

Keywords: Malnutrition, Children under five, Primary Healthcare, Iraq

Introduction
Childhood malnutrition remains one of the most pressing global health challenges, affecting millions of children under five years worldwide and serving as a significant contributor to child morbidity and mortality. The World Health Organization defines malnutrition as deficiencies, excesses, or imbalances in a person's intake of energy and nutrients, encompassing undernutrition (wasting, stunting, and underweight), micronutrient deficiencies, and overweight conditions [1]. Recent global estimates indicate that in 2024, approximately 150.2 million children under five years were stunted, 42.8 million were wasted, and 35.5 million were overweight globally [2]. The burden of malnutrition disproportionately affects low- and middle-income countries, with Asia and Africa accounting for 94% of all stunted children worldwide [3].

In the Middle Eastern context, Iraq presents a unique case study of childhood malnutrition influenced by decades of conflict, economic instability, and healthcare system disruptions. Current epidemiological data reveals that one in every five children is stunted in Iraq, with chronic malnutrition representing a major public health challenge with long-term developmental consequences [4]. The prevalence of stunting among Iraqi children under five years stands at 12.6%, while wasting affects 3.0% of this population, positioning Iraq as "on course" to meet WHO global targets compared to regional averages [5]. However, these aggregate figures mask significant subnational variations and underlying risk factors that warrant comprehensive investigation.

Recent cross-sectional studies in Iraq have documented varying prevalence rates of childhood malnutrition across different regions. A Baghdad-based study of children aged 3-5 years reported an overall underweight prevalence of 18.2%, with slightly higher rates among females (18.9%) compared to males (17.6%) [6]. Similarly, research conducted in Kurdistan Region demonstrated significant variations in nutritional status, with overweight prevalence reaching 61.4% among 24-month-old boys, highlighting the dual burden of malnutrition affecting Iraqi children [7].

The relationship between conflict exposure and nutritional outcomes has been extensively documented in the Iraqi context. Longitudinal analyses have demonstrated that exposure to conflict-related violence significantly impacts child nutritional status, with acute malnutrition rates nearly doubling from 4% to 7.7% following the 2003 conflict [8, 9]. These findings align with broader literature suggesting that political instability, displacement, and disrupted healthcare services create complex pathways to malnutrition that extend beyond immediate food insecurity.

Global evidence indicates that childhood malnutrition is a highly dynamic process characterized by cycles of onset and recovery, with incidence peaking during specific developmental periods [10]. Recent longitudinal cohort studies have challenged traditional cross-sectional measurement approaches, demonstrating that wasting episodes are more frequent and transient than previously understood, with important implications for intervention timing and effectiveness [11]. This emerging evidence emphasizes the need for more nuanced understanding of malnutrition patterns in conflict-affected populations.

Systematic reviews of malnutrition determinants consistently identify key risk factors including low birth weight, inadequate breastfeeding practices, poor dietary diversity, recurrent infections, maternal education levels, and household socioeconomic status [12, 13]. However, conflicting findings exist regarding the relative importance of these factors across different settings, with some studies highlighting the predominance of socioeconomic determinants while others emphasize infectious disease pathways [14, 15].

Despite the documented burden of childhood malnutrition in Iraq, significant knowledge gaps persist regarding the comprehensive assessment of nutritional status and associated risk factors among children attending primary healthcare centers. Most existing studies have been limited to specific geographical regions or age groups, failing to provide a nationwide perspective on malnutrition patterns and their determinants. The clinical significance of addressing these knowledge gaps is paramount, as primary healthcare centers serve as the first point of contact for families seeking child health services and represent crucial opportunities for early identification and intervention.

The healthcare system in Iraq faces ongoing challenges in implementing standardized nutritional assessment protocols and providing evidence-based interventions. Current data suggest that many children do not receive adequate nutritional counseling or assessment services during routine healthcare visits, representing missed opportunities for prevention and early treatment [16, 17]. Furthermore, limited understanding of how sociodemographic factors, feeding practices, vaccination status, and family health literacy interact to influence nutritional outcomes hampers the development of targeted interventions.

This study addresses a critical clinical need by providing comprehensive data to inform policy development, resource allocation, and intervention design within Iraq's primary healthcare system. The potential impact on patient care includes improved screening protocols, enhanced provider training, and development of context-specific nutritional guidelines. The innovative approach of conducting a nationwide cross-sectional survey across multiple primary healthcare centers represents a novel contribution to understanding malnutrition patterns in post-conflict settings.

Specific Objectives

1. Determining the nationwide prevalence of stunting, wasting, underweight, and overweight among under-five children attending primary healthcare centers in Iraq.
2. Identifying sociodemographic, health, and dietary factors associated with malnutrition, such as birth weight, breastfeeding duration, vaccination status, dietary diversity, household income, maternal education, and access to counseling services.
3. Assessing current nutritional screening practices and family health literacy in relation to child nutritional status and healthcare use.

Methodology

Study Design and Setting

This study employed a cross-sectional descriptive design utilizing a quantitative approach to assess the prevalence and determinants of malnutrition among children under five years of age attending Primary Healthcare Centers (PHCs) across Iraq. The research was conducted between December 1, 2024, and April 1, 2025, across PHCs distributed throughout 16 health directorates, encompassing all Iraqi governorates excluding the Kurdistan Region. This geographical coverage ensured comprehensive representation of both central and peripheral city populations, capturing diverse socioeconomic contexts and healthcare accessibility patterns. The selection of PHCs as study sites was strategically chosen as these facilities serve as the primary entry point for child healthcare services in Iraq, providing routine immunizations, growth monitoring, and treatment of common childhood illnesses. This setting enabled the recruitment of a representative sample of children across various health statuses and socioeconomic backgrounds.

Study Population and Eligibility Criteria

The target population comprised all children under five years of age visiting selected PHCs during the study period for routine healthcare services, including preventive care, vaccinations, growth monitoring, or treatment of minor acute illnesses.

Inclusion Criteria
1. Children aged 0-59 months (under five years)
2. Permanent residents within the PHC catchment area for at least six months
3. Parents or legal guardians providing written informed consent for participation
4. Children presenting for any type of healthcare service at the participating PHCs

Exclusion Criteria
1. Children aged 60 months or older
2. Children with diagnosed chronic conditions known to significantly affect growth and nutritional status (including congenital heart disease, cerebral palsy, chromosomal abnormalities, or other genetic syndromes)
3. Children requiring emergency medical care or critical interventions
4. Non-residents or temporary visitors to the PHC catchment area
5. Children whose parents or caregivers declined participation or withdrew consent

Sampling Strategy and Sample Size Calculation
A multistage stratified random sampling technique was implemented to ensure representative selection and minimize selection bias.

First Stage Sampling: Primary Healthcare Centers were systematically selected from a comprehensive registry provided by the Iraqi Ministry of Health. Centers were stratified into two categories: central urban PHCs (located in city centers) and peripheral PHCs (located in suburban or rural areas). Using systematic random sampling methodology, 20% of PHCs from each stratum within every health directorate were selected, ensuring proportional representation across geographical and socioeconomic gradients.

Second Stage Sampling: Within each selected PHC, a convenience sampling approach was employed to recruit 20 children per facility. To minimize temporal bias and ensure diverse representation, recruitment was conducted across different days of the week and various time periods during facility operating hours.

Sample Size Determination
The sample size calculation was based on the following parameters:
1. Expected malnutrition prevalence: 20% (based on previous Iraqi studies)
2. Confidence level: 95%
3. Margin of error: 2%
4. Design effect: 1.5 (accounting for cluster sampling methodology)
5. Anticipated non-response rate: 10%

Using the formula for complex survey designs, the calculated minimum sample size was 4,608 children. The final targeted sample size of approximately 5,120 children provided adequate power for detecting significant associations and allowed for subgroup analyses across various demographic and geographic strata.
Data Collection Procedures

Training and Quality Assurance
Prior to data collection initiation, comprehensive three-day training programs were conducted for all data collection teams. Each health directorate assembled trained teams consisting of:
1. One physician or senior registered nurse (team supervisor)
2. One trained health worker specializing in anthropometric measurements
3. One data clerk responsible for questionnaire administration and data recording

Training components included
1. Standardized anthropometric measurement techniques following WHO protocols
2. Proper equipment calibration and maintenance procedures
3. Structured questionnaire administration techniques
4. Quality control measures and data validation procedures
5. Ethical considerations and consent procedures
6. Emergency procedures and child safety protocols

Data Collection Instruments
Structured Questionnaire: A comprehensive questionnaire was developed based on established international guidelines and validated instruments. The questionnaire was originally developed in English, professionally translated into Arabic, and subsequently back-translated to ensure linguistic accuracy and cultural appropriateness. The instrument comprised four main sections:

Section I: Demographic Information
1. Child characteristics (age, gender, birth date, birth order)
2. Parental demographics (age, education level, occupation)
3. Household characteristics (family size, income level, residence type)
4. Geographic location and accessibility to healthcare services

Section II: Child Health and Medical History
1. Birth history (birth weight, gestational age, delivery complications)
2. Vaccination status and immunization completeness
3. Medical history including hospitalizations and chronic conditions
4. History of nutritional interventions or supplementation programs

Section III: Feeding Practices and Dietary Assessment
1. Breastfeeding initiation, exclusivity, and duration
2. Complementary feeding introduction and practices
3. Current dietary diversity and meal frequency
4. Food security status and household dietary patterns
5. Micronutrient supplementation (Vitamin A, Vitamin D, iron)

Section IV: Maternal Knowledge and Healthcare Utilization
1. Maternal nutritional knowledge and health literacy
2. Sources of nutritional information and guidance
3. Healthcare-seeking behaviors and service utilization
4. Access to nutritional counseling and education services

Anthropometric Measurements: All anthropometric measurements were conducted following standardized WHO protocols and guidelines:

Weight Measurement
1. Digital electronic scales with 0.1 kg precision
2. Daily calibration using standard weights
3. Children weighed with minimal clothing
4. Two measurements taken and averaged

Length/Height Measurement
1. Infantometer for children under 24 months (recumbent length)
2. Portable stadiometer for children 24-59 months (standing height)
3. Measurements recorded to the nearest 0.1 cm
4. Two measurements taken and averaged

Quality Control Measures
Rigorous quality control procedures were implemented throughout the data collection period:
- Daily equipment calibration and maintenance checks
- Duplicate anthropometric measurements for 10% of participants
- Supervisor spot-checks and field supervision visits
- Re-interviews conducted for 5% of participants to assess data consistency
- Weekly team meetings to address challenges and ensure protocol adherence
- Real-time data validation and completeness checks

Statistical Analysis
Statistical analysis was performed using SPSS version 26.0. The analysis strategy included:

Descriptive Analysis
- Anthropometric z-scores calculated using WHO growth standards
- Prevalence rates with 95% confidence intervals for stunting (height-for-age z-score < -2), wasting (weight-for-height z-score < -2), underweight (weight-for-age z-score < -2), and overweight (weight-for-height z-score > +2)
- Frequency distributions and central tendency measures for demographic and health variables

Bivariate Analysis
- Chi-square tests for categorical variables
- t-tests or Mann-Whitney U tests for continuous variables
- Correlation analysis for examining relationships between variables

Multivariate Analysis
- Logistic regression models to identify independent predictors of malnutrition
- Linear regression for continuous anthropometric outcomes
- Adjustment for potential confounders including age, gender, socioeconomic status, and geographic location
- Model building using forward selection and backward elimination procedures

Ethical Considerations
Ethical approval was obtained from the General Public Health Directorate Ethics Committee (Approval Letter No. 1606, dated November 20, 2024). The study was conducted in accordance with the Declaration of Helsinki and international ethical guidelines for health research.
Informed Consent Process: Written informed consent was obtained from all parents or legal guardians prior to participation. The consent process emphasized:
- Voluntary nature of participation
- Right to withdraw at any time without consequences
- Confidentiality and data protection measures
- Potential benefits and minimal risks of participation
- Contact information for study investigators

Data Protection and Confidentiality
- All data was de-identified with unique study identification numbers
- Personal identifying information was stored separately from study data
- Electronic data storage in password-protected systems with restricted access
- Data handling procedures compliant with national data protection regulations
- Planned data destruction following completion of analysis and publication

Results
Table 1 presents the geographic distribution of participants (n = 5121) across various Iraqi governorates. The numbers reflect the proportional contribution of each governorate based on the number of Primary Health Care Centers operating in each area. Nineveh recorded the highest participant frequency (12.1%), followed by Baghdad Al-Karkh (9.5%) and Baghdad Al-Rusafa (8.7%), which together indicates that the capital city’s large population and PHC density contributed substantially to the overall sample. Southern and central governorates like Basrah (8.3%), Muthanna (7.8%), and Anbar (7.1%) also showed notable representation. Smaller contributions were observed from governorates such as Karbala (3.1%), Najaf (4.2%), and Wasit (4.3%), reflecting either fewer PHCs or lower population density. Overall, the distribution demonstrates an effort to cover diverse regions, ensuring that the data collected represents Iraq’s geographic and demographic variation.

Table 1: Geographic Distribution of Participants across Iraqi Governorates (n = 5121)

Governorates	Frequency	%
Nineveh	618	12.1
Baghdad Al-Karkh	487	9.5
Baghdad Al-Rusafa	446	8.7
Basrah	425	8.3
Muthanna	399	7.8
Anbar	364	7.1
Dhi Qar	323	6.3
Diyala	281	5.5
Salah Al-Din	241	4.7
Maysan	241	4.7
Diwaniyah	240	4.7
Babylon	241	4.7
Wasit	218	4.3
Kirkuk	220	4.3
Najaf	216	4.2
Karbala	161	3.1

Table 2 presents the basic demographic and household characteristics of the study sample. The mean age of the children was 16 ± 11 months, with a nearly equal gender distribution (52.6% male, 47.4% female). The majority resided in central urban areas (71.2%) and most predominantly below 750,000 IQD per month (61.7%), with only 4.4% earning more than 1.5 million IQD. Regarding food habits, less than half of families reported having three daily meals (45.1%), while 29.8% had fewer than three meals, and only 25.1% had more than three. Additionally, 72.3% of households reported having dietary diversity in their meals, reflecting moderate access to balanced nutrition within the sample.

Table 2: Demographic and Household Profile of Participants across Iraq (n = 5121)

Variable	Category	Frequency	(%)
Child's Age (Mean ± SD)	(16 ± 11) months	5121	100.0
Child's Sex	Male	2692	52.6
	Female	2429	47.4
Place of Residence	Urban (City Center)	3648	71.2
	Peri-urban (City Periphery)	1473	28.8
Mother's Educational Attainment	Below Secondary School	3381	66.0
	Secondary School or Higher	1740	34.0
Monthly Household Income (IQD)	< 750,000	3161	61.7
	750,000 - 1.5 million	1737	33.9
	> 1.5 million	223	4.4
Number of Daily Family Meals	< 3	1525	29.8
	3	2310	45.1
	> 3	1286	25.1
Dietary Diversity in Family Meals (Inclusion of protein, fruits, carbohydrates)	Yes	3702	72.3
	No	1419	27.7

Table 3 provides an overview of key indicators related to child health and the utilization of nutritional services in primary healthcare settings. Notably, 15.6% of children were reported as having low birth weight, while over a quarter (27.0%) had incomplete vaccination status according to the Ministry of Health schedule. Recurrent respiratory or gastrointestinal infections affected 13.4% of the children. Regarding nutrition information sources, 72.1% of parents relied on health institutions, whereas 27.9% turned to community advice or social media. Despite the availability of services, 16.5% of children did not receive nutrition services at primary healthcare centers, and nearly one-third of parents (31.6%) were unaware of malnutrition signs. Additionally, 5.1% of children had a history of admission to a nutrition rehabilitation unit, highlighting the continued burden of malnutrition-related health issues.

Table 3: Nutritional Service Utilization and Related Child Health Indicators (Iraq)

Variable	Frequency	(%)
Children with Low Birth Weight (< 2.5 kg)	798	15.6
Children with Incomplete Vaccination Status (per MoH Schedule)	1382	27.0
Children with Recurrent Respiratory or Gastrointestinal Infections	684	13.4
Health Institutions as Source of Nutrition Information	3695	72.1
Community Advice or Social Media as Source of Nutrition Information	1426	27.9
Children Not Receiving Nutrition Services at PHCCs	844	16.5
Parents Lacking Awareness of Malnutrition Indicators	1617	31.6
Children Previously Admitted to a Nutrition Rehabilitation Unit	263	5.1

Figure 1 shows that nearly half of the children (46.3%) were breastfed for less than six months, while about a quarter (26.6%) continued breastfeeding for six months to one year. Only 15.5% were breastfed for more than a year, and 11.6% were not breastfed at all. These findings highlight that early cessation of breastfeeding is common, indicating a need for stronger promotion of extended breastfeeding practices to align with recommended guidelines for optimal child nutrition and health.

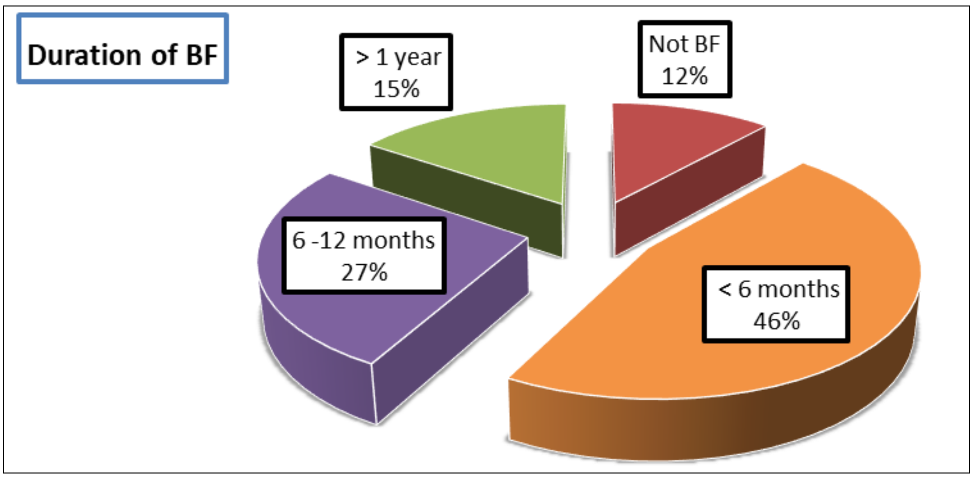

Fig 1: Duration of Breastfeeding among Study Children (Iraq)

Figure 2 shows the nutritional status distribution among children under five in the study. Nearly half of the children (45.6%) had normal nutritional status, while under nutrition indicators were notable, with 18.8% stunted, 9.3% underweight, and 4.8% wasted, reflecting chronic and acute malnutrition challenges. Additionally, 12.5% were overweight, indicating a dual burden of malnutrition that requires targeted interventions addressing both under nutrition and emerging over nutrition among young children.

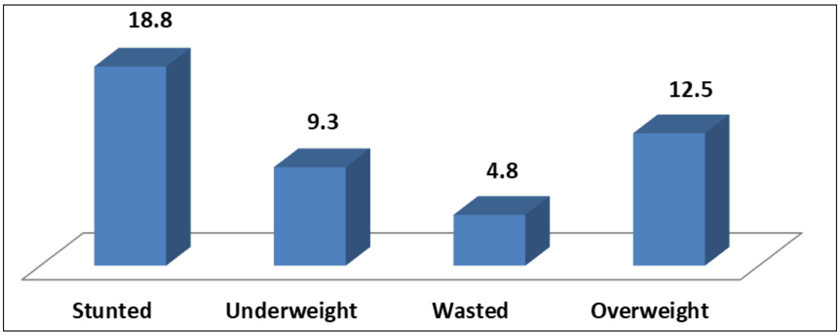

Fig 2: Prevalence of malnourish among Children under Five (Iraq)

Figure 3 highlights the coverage rates of Vitamin A and Vitamin D supplementation among children under five according to the Iraqi Ministry of Health guidelines. The data show that 68.4% of children receive the recommended doses of Vitamin A (100,000 or 200,000 IU based on age), while 58.7% of children start daily Vitamin D supplementation from the first month of life. Despite being essential for child growth and development, both supplementation rates are suboptimal and fall short of the ideal 100% coverage target. This gap indicates potential challenges in program implementation, awareness, or access, underscoring the need for intensified public health efforts to improve vitamin supplementation compliance to prevent deficiencies and associated health risks in the pediatric population.

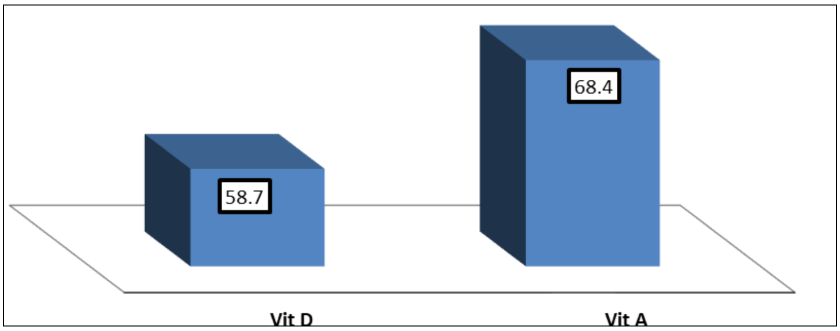

Fig 3: Vitamin A and D Supplementation Coverage in Children (Iraq)

Figure 4 presents the percentage availability of nutrition assessment services for children and nutrition counseling for mothers in primary health care centers (PHCCs) across selected Iraqi governorates. The highest reported coverage is in Maysan (99.2%), Karbala (96.9%), and Diwaniyah (96.7%), indicating strong integration of nutrition services in these areas. In contrast, governorates such as Nineveh (73.3%), Dhi Qar (70%), and Muthanna (69.9%) show comparatively lower levels of service provision, highlighting regional disparities that may affect equitable access to essential nutrition care. Overall, the data emphasize the need for targeted interventions to strengthen PHCC capacity and ensure comprehensive coverage, particularly in underserved regions.

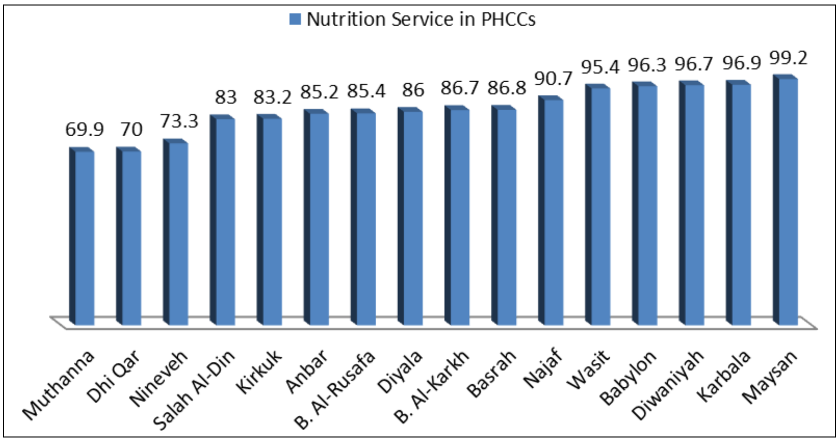

Fig 4: Availability of Nutrition Services in PHCCs by Governorate

Figure 5 illustrates the proportion of under-five children who had been previously admitted to Nutrition Rehabilitation Units (NRUs) across various Iraqi governorates. Notably, Salah Al-Din recorded the highest percentage (11.2%), followed closely by Muthanna (10.5%) and Nineveh (9.7%), indicating a relatively higher historical burden of severe malnutrition in these areas. In contrast, governorates such as Dhi Qar (0.9%), Diwaniyah (1.3%), and Basrah (1.4%) reported the lowest rates, which may reflect either lower prevalence or underutilization of NRU services. This distribution highlights geographical disparities in malnutrition severity and service access, underscoring the need for targeted nutritional interventions and improved coverage in governorates with both high and low admission rates.

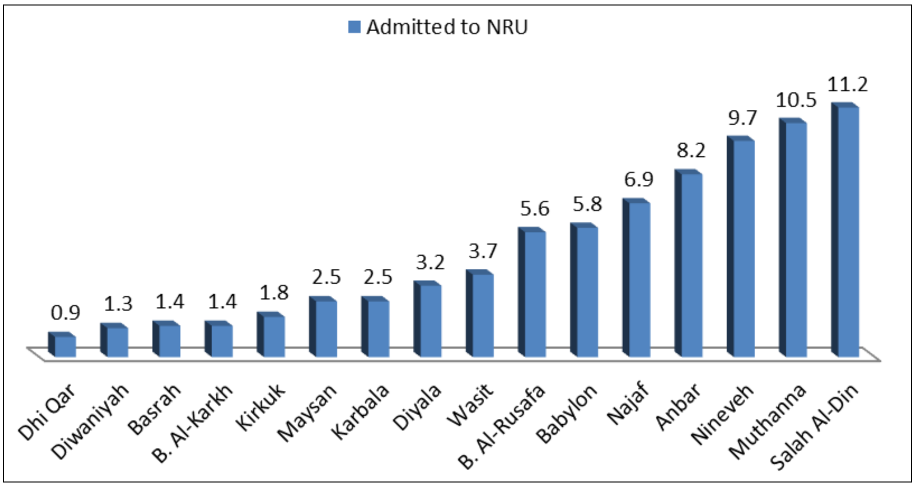

Fig 5: Previous Admission of under five Children to NRUs by Governorate

Table 4 highlights key predictors of malnutrition risk among children as identified by logistic regression analysis. Low birth weight emerged as the strongest predictor, with an adjusted odds ratio of 1.758, indicating that infants weighing less than 2.5 kg at birth are significantly more likely to suffer from malnutrition. Peripheral residence was also a significant factor, suggesting that children living in remote or underserved areas face greater nutritional challenges. Modifiable factors such as incomplete vaccination, low household income, and poor maternal education were all significantly associated with increased malnutrition risk, emphasizing the role of socioeconomic and health service-related determinants. Additionally, poor vitamin A supplementation, limited parental knowledge about malnutrition symptoms, and shorter breastfeeding duration further contributed to the likelihood of malnutrition. Collectively, these findings underscore the multifactorial nature of child malnutrition and point to the critical need for comprehensive interventions targeting healthcare access, parental education, and poverty alleviation to mitigate these risks effectively.

Table 4: Predictors Risk Factors of Malnutrition Identified by Logistic Regression

Variable	Adjusted Odds Ratios	P-value	95% C.I.
Low birth weight (<2.5 kg)	1.758	0.001	1.497 - 2.066
Peripheral area of residence	1.443	0.001	1.233 - 1.688
Incomplete childhood immunization	1.393	0.001	1.203 - 1.614
Low monthly household income (<750,000 IQD)	1.297	0.001	1.125 - 1.495
Maternal education below secondary level	1.264	0.004	1.076 - 1.481
Inadequate vitamin A supplementation	1.246	0.003	1.078 - 1.435
Insufficient parental knowledge of malnutrition signs	1.200	0.024	1.025 - 1.406
Short duration of breastfeeding	1.038	0.036	0.969 - 1.111

Discussion

This nationwide cross-sectional study represents the most comprehensive assessment of childhood malnutrition among under-five children attending primary healthcare centers in Iraq to date. Our findings reveal a concerning dual burden of malnutrition with 18.8% stunting prevalence, 9.3% underweight, 4.8% wasting, and 12.5% overweight among the 5,121 children examined. These results highlight the persistent nutritional challenges facing Iraqi children and underscore the critical need for comprehensive, multi-sectoral interventions targeting the identified risk factors.

Our stunting prevalence of 18.8% is notably higher than the previously reported underweight prevalence of 3.9% in 2018 [18], suggesting either methodological differences or a potential worsening of nutritional status in the post-conflict period. This finding aligns with recent regional assessments indicating that at least 77 million children and adolescents have some form of malnutrition in the Middle East and North Africa [19]. The observed prevalence falls within the moderate public health significance category according to WHO classifications, yet represents a substantial burden requiring immediate attention [20].

Our wasting prevalence of 4.8% represents a concerning finding, particularly when considering the considerable variation across governorates, with Anbar reaching 10.7%, indicating localized acute malnutrition crises that require targeted interventions. This pattern is consistent with recent evidence from conflict-affected regions showing persistent pockets of acute malnutrition despite overall national improvements [21]. The 2023 Joint Child Malnutrition

Estimates highlight that global progress remains insufficient to reach the 2025 World Health Assembly targets, with many countries struggling to achieve malnutrition reduction goals [22].

The dual burden of malnutrition evidenced by 12.5% overweight prevalence represents an emerging public health challenge in Iraq. This finding parallels global trends showing the coexistence of undernutrition and overweight in low- and middle-income countries, often referred to as the "double burden" [23]. Recent evidence indicates that global stunting prevalence declined from 26.4% to 23.2% between 2012 and 2024, yet many regions continue to struggle with multiple forms of malnutrition simultaneously [24]. This phenomenon is particularly common in countries undergoing nutrition transition, where traditional dietary patterns shift alongside urbanization and economic changes [25].

Our identification of low birth weight as the strongest predictor of malnutrition (adjusted OR: 1.758) is consistent with extensive literature demonstrating the critical importance of early life factors in determining nutritional trajectories [26]. This finding aligns with recent longitudinal studies from similar settings showing that birth weight remains a significant predictor of nutritional status throughout early childhood [27]. The persistence of this association underscores the importance of improving maternal nutrition and antenatal care services as foundational elements of malnutrition prevention strategies.

The significant association between peripheral residence and malnutrition risk (adjusted OR: 1.443) reflects well-documented urban-rural disparities in healthcare access and socioeconomic conditions. Recent evidence from Middle Eastern countries has consistently shown that children in rural or peripheral areas face greater nutritional challenges due to limited healthcare infrastructure, food insecurity, and economic disadvantages [28]. This finding emphasizes the need for strengthening primary healthcare services in underserved areas and implementing community-based nutrition interventions.

Our findings regarding incomplete vaccination status as a significant risk factor (adjusted OR: 1.393) align with recent research demonstrating the interconnections between preventive healthcare services and nutritional outcomes [29]. This association likely reflects both direct immunological benefits of vaccination and indirect indicators of healthcare access and health-seeking behaviors among families.

The vitamin supplementation coverage gaps we identified, with only 68.4% receiving adequate Vitamin A and 58.7% receiving Vitamin D supplementation, are concerning given the critical role of micronutrients in child growth and development. Recent systematic reviews have emphasized the importance of comprehensive micronutrient supplementation programs in preventing malnutrition, particularly in settings with limited dietary diversity [30]. The significant regional variations in supplementation coverage highlight implementation challenges that require targeted quality improvement initiatives.

These findings have important implications for clinical practice and public health policy in Iraq. The identification of multiple modifiable risk factors highlights the urgent need for comprehensive interventions that enhance healthcare access, improve maternal education, provide socioeconomic support, and promote optimal feeding practices to reduce the burden of childhood malnutrition. The strong association between malnutrition and low birth weight underscores the critical importance of strengthening antenatal care and maternal nutrition programs as primary prevention strategies.

The dual burden of malnutrition documented in this study demands nuanced clinical approaches that simultaneously prevent undernutrition and reduce the risk of emerging childhood obesity. This requires comprehensive dietary counseling, the promotion of appropriate infant and young child feeding practices, and lifestyle interventions that are culturally sensitive and contextually relevant. Notably, the documented gaps in vitamin supplementation coverage only 68.4% of children receiving adequate Vitamin A and 58.7% receiving Vitamin D point to systemic weaknesses in routine preventive care. Addressing these gaps will require the implementation of systematic quality improvement measures, continuous staff training, and community-based outreach to enhance micronutrient supplementation rates and reduce preventable deficiencies.

Additionally, the finding that one-third of parents are unaware of the signs of malnutrition represents a critical area for targeted intervention. Integrating structured nutritional counseling into routine primary healthcare visits could substantially improve early detection and timely management, ultimately preventing progression to severe forms that require costlier therapeutic care. Such cost-effective strategies should prioritize vulnerable groups, including children from peripheral areas, those with incomplete vaccination status, and families with limited educational backgrounds. The study's predictive model can further guide risk stratification and efficient resource allocation within the primary healthcare system, strengthening Iraq's capacity to tackle childhood malnutrition more effectively.

Conclusion

This nationwide study provides clear evidence of a complex malnutrition landscape among Iraqi children under five, marked by a concerning coexistence of undernutrition and emerging overweight, significant regional disparities, and multiple interrelated risk factors spanning socioeconomic, maternal, healthcare, and dietary dimensions. The findings emphasize the urgent need for integrated, governorate-specific strategies that strengthen antenatal and child health services, promote optimal breastfeeding and feeding practices, improve vaccination and micronutrient supplementation coverage, and expand community education to raise parental awareness of malnutrition signs. Addressing the identified geographic and socioeconomic gaps through comprehensive, multi-sectoral public health policies and strengthened primary healthcare delivery will be essential for Iraq to reduce the burden of childhood malnutrition and achieve sustainable improvements in child health outcomes.

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