University of Dongola
Faculty of Medicine & Health Sciences
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❖ **Proposal:**

Title:

Prevalence and Associated Risk factors of malnutrition among pediatric patients under five years (6–59 months) at Dongola specialized hospital in Northern State, Sudan, October 2026.

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Introduction:

1.1-Background:

Malnutrition remains a major global public health challenge affecting the survival, growth, and development of millions of children under five years of age. According to the World Health Organization (WHO), malnutrition encompasses deficiencies, excesses, or imbalances in energy and nutrient intake and includes conditions such as stunting, wasting, underweight, and overweight. Children in the first five years of life are particularly vulnerable because this period is critical for physical growth, brain development, and immune system maturation.

Recent estimates from the UNICEF-WHO-World Bank Joint Child Malnutrition Estimates (2025) indicate that approximately 150.2 million children under five years were affected by stunting, while 42.8 million experienced wasting globally in 2024 (8). Among these, 12.2 million children suffered from severe wasting, a life-threatening form of malnutrition associated with a significantly increased risk of mortality. Malnutrition not only contributes to child morbidity and mortality but also has long-term consequences, including impaired cognitive development, poor educational performance, reduced economic productivity, and increased susceptibility to infectious diseases.

1.2-Problem statement:

Globally, childhood malnutrition is a critical public health crisis responsible for nearly half of all deaths in children under five (9). Effective community management requires early identification using validated screening tools and targeted interventions tailored to condition severity. Millions of children in low- and middle-income countries suffer from chronic and acute undernutrition that drives preventable morbidity and mortality (WHO) (8).

In Sudan, the nutritional landscape is exceptionally dire. Nationwide assessments indicate that approximately 2.5 million children under five require urgent nutritional rehabilitation, with severe acute malnutrition cases climbing to nearly 800,000. Broad community studies demonstrate that national global acute malnutrition (GAM) rates stand at 16.3% and stunting at 38.2%. Consequently, despite international humanitarian frameworks, Sudan continues to experience alarming rates of stunting, wasting, and underweight that persistently exceed WHO emergency thresholds (5,7) .

In Northern State—specifically within the Dongola locality—there is a critical lack of up-to-date, localized data regarding malnutrition and its underlying drivers. Broad national surveys and UNICEF situation reports fail to capture unique regional dynamics such as household food insecurity, maternal literacy, infant feeding practices, and healthcare accessibility (UNICEF, 2021). This severe shortage of context-specific evidence directly hinders local health authorities from developing targeted policies and effective intervention programs [6].

1.3-Research Questions:

What is the prevalence of stunting, wasting, and underweight among children under five years of age in Dongola Specialized hospital based on WHO anthropometric indicators?

What are the socio-demographic factors (such as maternal education, household income, family size, and residence) are associated with child malnutrition in this population?

How do child feeding practices including exclusive breastfeeding, the timing and adequacy of complementary feeding, and dietary diversity are associated with the nutritional status of children under five?

What is the association between child health-related factors (such as a history of diarrhea, acute respiratory infections, and immunization status) and the occurrence of malnutrition?

What maternal and household factors (such as maternal nutritional knowledge, household water and sanitation conditions, and household food security status) are associated with child malnutrition in Dongola specialized hospital?

1.4-Objectives:

General Objective:

To measure the prevalence and associated factors of malnutrition among children under five years of age in Dongola Specialized hospital, Northern State, Sudan.

Specific Objectives:

1. To measure the prevalence of malnutrition (stunting, wasting, and underweight) among children under five years in Dongola Specialized hospital using WHO anthropometric indicators.

2. To assess the socio-demographic factors associated with malnutrition, such as maternal education, household income, family size, and residence.

3. To evaluate the child feeding practices and their association with malnutrition, including exclusive breastfeeding, complementary feeding, and dietary diversity.

4. To find the association between child health-related factors (history of diarrhea, acute respiratory infections, immunization status) and malnutrition.

5. To identify maternal and household factors such as maternal nutritional knowledge, water and sanitation conditions, and food security status associated with child malnutrition.

1.5 Study hypothesis

Null Hypothesis (H_0):

There is no statistically significant association between socio-demographic factors, child feeding practices, clinical factors and malnutrition among children under five years attending Dongola Specialized Hospital.

Alternative Hypothesis (H_1):

There is a statistically significant association between socio-demographic factors, child feeding practices, health-related factors, maternal characteristics, and malnutrition among children under five years attending Dongola Specialized Hospital

1.6-Justification and Rationale:

This study addresses the critical challenge of pediatric malnutrition, where outdated macro-level data hinder effective decision-making in the face of ongoing economic and environmental shifts (11). Because knowing prevalence alone is insufficient for intervention design, the study investigates both nutritional outcomes and localized, modifiable risk factors—such as feeding practices and socioeconomic status (12). A cross-sectional design was selected as a fast, cost-effective method to capture a current, comprehensive snapshot of these variables at a single point in time (13) . Ultimately, the research bridges the gap between broad statistics and local realities, delivering actionable, up-to-date evidence for clinicians and policymakers to protect high-risk children.

1.7-Significance of the study:

The findings of this study will provide evidence-based information for pediatric healthcare providers, nutrition programs, policymakers, and community leaders. The results will help identify high-risk children and guide targeted nutritional interventions and health education programs in Dongola locality.

2 Literature Review:

2.1 Global and Regional Burden of Under-Five Malnutrition

The joint estimates, published in 2025, cover indicators of stunting, wasting, severe wasting and overweight among children under 5. Globally, there are 150.2 million

children under 5 affected by stunting. These children begin their lives at a marked disadvantage: they may never attain their full possible height and their brains may never develop to their full cognitive potential. There are also 42.8 million children under 5 suffering from wasting, of which 12.2 million have severe wasting (4). Children with wasting have weakened immunity, are susceptible to long term developmental delays, and face an increased risk of death, particularly when wasting is severe. The number of children affected by wasting and severe wasting reported by the Joint Child Malnutrition Estimates (JME) are prevalence-based estimates predominantly based on survey data. These estimates should be considered an underestimate of the annual burden as they do not account for the cumulative number of cases that occur throughout the year.

2.2 The Pediatric Malnutrition in Sudan

Children who are well nourished have a better chance of being healthy, able to develop, learn, and be productive. Sudan is currently experiencing an unprecedented and catastrophic escalation in pediatric malnutrition. Nationwide assessments indicate that approximately 2.5 million children under five require urgent nutritional rehabilitation, with severe acute malnutrition cases climbing to nearly 800,000. The localized destruction of food infrastructure, inflation, and massive population displacements have placed overwhelming pressure on health networks. Broad community studies demonstrate that national global acute malnutrition (GAM) rates historically stood at 16.3% and stunting at 38.2%. However, recent situational surveillance from 2024 to 2026 indicates that acute wasting levels have breached emergency thresholds across multiple regions, severely impacting vulnerable child demographics (7) .

2.3. Review of Related Studies

Pakistan: A large-scale cross-sectional survey utilizing multi-stage sampling and WHO growth standards to investigate children under five across rural and urban settlements in Pakistan.

 Key Findings: The study established high regional burdens: stunting at over 48%, underweight at nearly 40%, and wasting around 16%. Multivariable logistic regression revealed that lower household wealth index, lower maternal education level, younger child age brackets, large family sizes, and recent diarrheal infections were primary predictors strongly associated with childhood undernutrition (1).

Regional / Africa (Ethiopia / East Africa)

A community-based cross-sectional study surveying 504 children aged 6–59 months using a multistage sampling technique and assessing acute malnutrition via Mid-Upper Arm Circumference (MUAC) and weight-for-height Z-scores.

 Key Findings: The results revealed a high acute malnutrition prevalence of 31.0%. Binary and multivariable logistic regression identified that younger age (6–11 months),

maternal illiteracy, single-mother household status, lack of sanitation facilities (latrines), and recent episodes of diarrhea and respiratory tract infections were statistically significant associated factors (4).

Local/Sudan (ministry of health/UNICEF)
Broad epidemiological and cross-sectional assessments tracking nutritional indices across various Sudanese states to evaluate national stunting and wasting targets.

 Key Findings: Nationally, the prevalence of stunting among children under five in Sudan reaches approximately 36.4% (with severe stunting around 15%), while global acute wasting hovers around 13.6%, consistently exceeding WHO emergency thresholds(WHO)[4]. State-level analyses across Sudan emphasize that household food insecurity, inflation, suboptimal infant and young child feeding (IYCF) practices, and limited access to safe drinking water are the principal localized drivers accelerating acute malnutrition (3).

2.4 Associated Factors and Predictors of Malnutrition

 Socio-Demographic and Economic Factors: Household income, parental occupation, and maternal education are heavily correlated with nutritional status. Lower levels of maternal education restrict health-seeking behaviors and nutritional literacy, directly increasing a child's risk of stunting and underweight.

 Infant and Young Child Feeding (IYCF) Practices: Suboptimal feeding practices—such as delayed initiation of breastfeeding, non-exclusive breastfeeding during the first six months, and poor dietary diversity during complementary feeding—are primary behavioral drivers of nutritional failure.

 Environmental and WASH Conditions: Access to safe, clean drinking water, adequate sanitation facilities, and proper hygiene practices are critical. Unsafe water and open sanitation heavily predispose children to environmental enteropathy and recurrent waterborne infections.

 Health-Related and Clinical Factors: Infectious disease cycles create a destructive synergy with malnutrition. Recurrent episodes of acute gastroenteritis (diarrhea), acute respiratory infections (ARIs), and vaccine-preventable diseases accelerate nutrient malabsorption, suppress appetite, and deplete metabolic reserves, rapidly precipitating acute wasting.

5-Methodology:

5.1-Study design:

A "hospital based", descriptive, analytical cross-sectional study design will be used to collect data between 4-22 October 2026. The survey was designed to provide baseline information regarding childhood malnutrition at Dongola specialized hospital.

5.2-Study Area:

This study will be conducted at Dongola specialized hospital located in Dongola the capital city of the Northern State, Sudan.

Sample frame in Dongola specialized hospital is contain primary public referral facility in the region equipped with pediatric department including “pediatric in patients department, specialized clinical nutritional unit”.

5.3-Study Population:

- Target group: Pediatric patients aged 6 months to 59 months (under five years).

- Setting: Children attending Dongola Specialized Hospital (both inpatient and outpatient departments).

- Geographic scope: Dongola city, Northern State, Sudan.

- Time frame: All eligible children presenting during the 4-22 October 2026

5.6. Inclusion and exclusion criteria :

Inclusion Criteria:

- Children aged 6 months to 59 months (under five years).

- Pediatric patients admitted or attending outpatient clinics at Dongola Specialized Hospital during the study period.

- Children whose parents/guardians provide informed consent.

- Availability of complete medical records and anthropometric measurements (weight, height/length, MUAC).

- Both male and female children.

Exclusion Criteria:

- Children older than 5 years or younger than 6 months.

- Pediatric patients with chronic or congenital conditions that independently affect growth (e.g., congenital heart disease, genetic syndromes, cerebral palsy).

- Children with acute critical illness where nutritional assessment is not feasible.

- Patients with incomplete records or missing anthropometric data.

- Children whose parents/guardians refuse consent.

- Readmissions of the same child during the study period (to avoid duplication).

5.7-Sample Size Determination

Sample size will be calculated using the single population proportion formula:

Cochran's Formula (14).

$$n^0 = \frac{Z^2 \cdot p \cdot q}{d^2}$$

Definition of Variables

n:sample size.

Z: The standard normal deviate corresponding to the desired confidence level. For a

95% confidence interval, Z = 1.96.

P: The estimated prevalence of malnutrition in the target population

We don't have prior locality-specific estimate for Dongola, we will use **0.50 (50%)** to

yield the maximum possible sample size

q:(1-p)

d: The margin of error (precision) acceptable, usually set at 0.05

n = {(1.96)^2 0.50 (0.50)}/{(0.05)^2}

n = {3.8416 0.25}/{0.0025} =~ 384

Non-Response Adjustment:

$$n = \frac{n^0}{1\text{-}r}$$

n_{{adjusted}} = {384}/{1 - 0.10} ~= 427 participants

5.8-Data Collection Tools and Measurements

Data will be collected using structured, face to face interviewer-administered questionnaires through Kobo Toolbox and google form covering socio-demographics, health history, and IYCF practices. Anthropometric measurements (weight, height/length) will be taken using standardized, calibrated equipment following WHO guidelines:
Weight: Measured to the nearest 0.1 kg using digital infant/child scales.
Height/Length: Measured to the nearest 0.1 cm using a rigid height board (infantometer for children under 24 months, stadiometer for older children).

Research Questionnaire Structure: Designed first consent , and across six key domains:

1. Socio-Demographics: Child, parental education, occupation, and household structure.
2. Feeding Practices (IYCF): Exclusive breastfeeding, complementary feeding timing, meal frequency, and dietary diversity.
3. Health & Morbidity: Recent illnesses (diarrhea, ARI), immunization history, and Vitamin A supplementation.
4. Maternal Knowledge & Hygiene: Nutritional awareness and handwashing/food sanitation practices.
5. WASH & Food Security: Drinking water sources, sanitation facilities, and household food stability.
6. Anthropometrics: Objective measurements using digital scales, length/height boards, and MUAC tapes.

Sampling technique: a consecutive sampling technique

A facility-based cross-sectional study design will be adopted to assess the prevalence of malnutrition and its associated factors among children under five years in Dongola locality. To select the study participants, a consecutive sampling technique will be employed.

All eligible children aged 6 to 59 months accompanied by their primary caregivers presenting to the selected healthcare facilities (such as pediatric outpatient clinics and nutrition centers) during the study period will be consecutively invited to participate until the required sample size is achieved.

5.9-Dependent and independent variables:

Dependent Variable (Outcome)

- Nutritional status of children under five
- Measured by anthropometric indices such as:
- Weight-for-age (underweight)
- Height/length-for-age (stunting)
- Weight-for-height (wasting)
- Mid-upper arm circumference (MUAC)
- Presence of clinical signs of malnutrition

Independent Variables (Associated/Risk Factors)

1. Child-related factors
   - Age (in months)
   - Sex (male/female)

- Birth weight
- Immunization status

- Presence of chronic illness or recurrent infections (e.g., diarrhea, pneumonia)
- Feeding practices (exclusive breastfeeding, complementary feeding, weaning age)

2. Maternal/Parental factors
   - Mother's age
   - Mother's education level
   - Mother's occupation
   - Nutritional knowledge and practices
   - Parity and birth spacing

3. Household/Socioeconomic factors
   - Family income level
   - Household size
   - Access to clean water and sanitation
   - Food security status
   - Housing conditions

4. Healthcare-related factors
   - Access to healthcare services
   - Frequency of hospital visits/admissions
   - Availability of nutritional counseling

5.10- Data Management and Statistical Analysis

Data will be checked for completeness, coded, and entered into statistical software (e.g., Python , spss). Descriptive statistics (frequencies, percentages, means, and standard deviations) will summarize variables. Bivariate logistic regression will screen candidate variables, and multivariable logistic regression models will identify independent predictors of malnutrition, reporting adjusted odds ratios (AOR) with 95% confidence intervals and $p < 0.05$ as statistically significant.
Data will be processed and converted into WHO anthropometric indices (HAZ, WHZ, WAZ) using Python programming language, taking advantage of its specialized public health and statistical libraries for automated Z-score calculation and high-precision visual data representation.
Children with Z-scores below -2 standard deviations (SD) from the median will be

classified as malnourished (stunted, wasted, or underweight).

$$\text{Wasting Prevalence} = \{\text{Number of children with WHZ} < -2\} / \{\text{Total number of children in the sample}\} \times 100$$

$$\text{Stunting Prevalence} = \{\text{Number of children with HAZ} < -2\} / \{\text{Total number of children in the sample}\} \times 100$$

$$\text{Underweight Prevalence} = \{\text{Number of children with WAZ} < -2\} / \{\text{Total number of children in the sample}\} \times 100$$

5.11 WHO definition

1. Under-five children: Pediatric patients aged between 6 months and 59 months attending Dongola Specialized Hospital during the study period.
2. Stunting (Chronic Malnutrition): Height-for-age Z-score (HAZ) below -2 standard deviations (-2 SD) from the median of the WHO child growth standards.
3. Wasting (Acute Malnutrition): Weight-for-height Z-score (WHZ) below -2 standard deviations (-2 SD) from the median of the WHO child growth standards.
4. Underweight: Weight-for-age Z-score (WAZ) below -2 standard deviations (-2 SD) from the median of the WHO child growth standards.
5. Exclusive Breastfeeding: Feeding an infant only breast milk with no other liquids or solids, except for drops or syrups consisting of vitamins, mineral supplements, or medicines, for the first six months of life.

5.12- Ethical Considerations

Ethical approval will be obtained from the Research Ethics Committee / Ministry of Health in the Northern State. Prior to data collection, the purpose, risks, and benefits of the study will be clearly explained to all participating mothers or legal guardians. Participation will be strictly voluntary, and they will be informed of their right to withdraw from the study at any time without any negative consequences to their care or services. Given the field context, verbal informed consent will be secured (documented via witness verification or caregiver agreement as approved by the review board). To ensure privacy and confidentiality, all collected data will be anonymized using identification codes rather than personal names, and physical/digital records will be stored securely, accessible only to the research team.

5.13- Work Plan and Timeline

5.14- Budget breakdown:

Self-dependent / self-funded research project.

Phase / Activity	September 2026	October 2026	November 2026
1. Proposal Development & Ethical Approval *(27 Sep – 01 Oct 2026)*			
2. Field Data Collection & Anthropometry *(04 – 22 October 2026)*			
3. Data Entry, Cleaning & Statistical Analysis *(25 Oct – 05 Nov 2026)*			
4. Results Writing & Discussion *(08 – 19 November 2026)*			
5. Report Writing & Dissemination *(03 – 22 November 2026)*			

Category & Item Description	Detailed / Justification	Cost in Sudanese Pounds (SDG)
Local Transport, and data collection	Local transport to collect data	100,000 SDG
Statistical Analysis	Professional statistician , SPSS analysis, and data tabulation	150,000 SDG
Questionnaires	Printing, internet google form	60,000 SDG
Final Research Report Printing & Binding	Printing and binding final copies of the research	100,000 SDG
TOTAL BUDGET		410,000 SDG

6-References

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