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Assessment of Nutrition Status for Sudanese Children (6-59 months) Internally Displaced Persons Camps in Kosti, White Nile State, Sudan

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ABSTRACT

Background: Malnutrition among displaced children remains a major public health issue, especially due to the heightened vulnerability of this age group.
Objective: This study aimed to assess the nutritional status of children aged 6–59 months in two displaced camps, Alalgaia and Dababt-Bosin, in East Kosti, White Nile State, Sudan.
Methods: This cross-sectional study and data were collected between December 2023 and January 2024. Data were collected from 110 children and their mothers, using questionnaires that focused on socio-demographic, health, and dietary aspects. The data were analyzed using SPSS Version 22.0.
Results: Most mothers (40%) were aged between 18 and 24 years, and 52.7% were illiterate. Approximately 66.1% of the mothers had between 1 and 5 children under the age of five. The majority of fathers (62.7%) were over 30 years old. Nutritional assessments using MUAC showed that 58.2% of children were normal, while 28.2% had moderate acute malnutrition (MAM) and 13.6% had severe acute malnutrition (SAM). Based on the prevalence of Z-scores, 42.7% of children were wasted, 37.3% underweight, and 28.2% stunted. Severe forms included 18.2% severely underweight, 14.5% severely wasted, and 10.9% severely stunted, while overweight and obesity were minimal (1.8%). Using BMI-for-age, 54.5% were within normal range, 37.3% had MAM, 6.4% had SAM, and 1.8% were overweight and obese. No significant relationships were found between age of children and MUAC status ($p = 0.185$) or age group and weight-for-age ($p = 0.185$). Dietary patterns showed poor meal frequency and limited consumption of fruits, milk, and protein-rich foods, with a reliance on staple items like Kisra, Miakilo, and Acida.
Conclusion: The high prevalence of malnutrition highlights the urgent need for targeted nutritional interventions and healthcare services to improve the well-being of displaced children in these camps.

Keywords: Malnutrition, nutritional assessments, displaced camps, child nutrition, Sudan.

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INTRODUCTION

Malnutrition among children under five is a persistent and growing public health emergency in Sudan, especially among internally displaced populations. The displacement caused by the ongoing conflict has severely disrupted access to nutritious food, healthcare, and clean water, particularly in camps where families rely heavily on humanitarian aid. The current crisis has resulted in a high prevalence of undernutrition, with 31% of Sudanese children underweight and over 2.2 million stunted (1). Displaced children are more vulnerable to diseases, including cholera, and suffer from long-term physical and cognitive impairments due to poor nutrition. Despite efforts by global agencies, logistical constraints, insecurity, and funding gaps hinder effective intervention (2). Therefore, assessing the nutritional status and dietary intake of displaced children is critical to inform targeted policies and emergency response strategies aimed at reducing child malnutrition and improving overall health outcomes.

Malnutrition remains one of the most critical global public health challenges, especially in developing countries. It significantly affects children under five, with an estimated 45% of all deaths in this age group attributed to undernutrition (3). The World Health Organization (WHO) identifies malnutrition as the leading threat to public health globally, particularly in low-income and conflict-affected regions (4). Malnutrition encompasses deficiencies, excesses, or imbalances in energy or nutrient intake and poor nutrient utilization by the body (5). It is a major cause of illness, death, and long-term physical and cognitive impairment in children, especially in displaced populations.

Assessing the nutritional status of children is essential for identifying growth problems, malnutrition, and related health risks. This is achieved through comprehensive evaluation of anthropometric, dietary, clinical, biochemical, and socioeconomic indicators (6). Globally, in 2014, the prevalence of stunting (height-for-age), wasting (weight-for-height), and underweight (weight-for-age) among children under five was 24.7%, 7.8%, and 15.1%, respectively (7). Despite progress, malnutrition remains most prevalent in developing nations (8), where children face systemic barriers to adequate nutrition, healthcare, and sanitation.

Children displaced by conflict face heightened vulnerability due to food insecurity, inadequate health services, and poor living conditions. Displacement increases dependence on humanitarian aid, where food quality and quantity directly impact nutritional status (9). In Sudan, around 31% of children under five are moderately or severely underweight, and over 2.2 million are stunted—more than one in three children (10). This reflects a long-standing crisis of undernutrition, worsened by poor dietary diversity, insufficient health infrastructure, and limited access to essential services. The majority of internally displaced people live in appalling humanitarian conditions with little access to essential services. Children make up over half of those relocated, with 27% of them being younger than five. According to the research, girls under the age of 18 make up about 28% of the IDP population (11).

Since the outbreak of conflict in April 2023, Sudan has witnessed an unprecedented displacement crisis. Over 13 million people have been displaced, with more than 8 million newly displaced internally (12). An estimated 11.3 million internally displaced persons (IDPs) now live across all 18 states in Sudan, especially in Khartoum, Darfur, and Kordofan (13). White Nile State alone received over 50,000 IDPs, many of whom live in overcrowded camps with limited access to basic services (14). In total, more than 24.8 million people, including nearly 14 million children, are in need of humanitarian assistance (15). Sudan is currently facing the largest child displacement crisis in the world. Nearly five million children have fled their homes, including one million who have crossed into neighboring countries such as South Sudan, Egypt, and Chad. These children face violence, trauma, and deprivation, all of which heighten the risk of acute and chronic malnutrition. The ongoing conflict has destroyed vital infrastructure and severely disrupted food systems, leading to intergenerational consequences for child health and development (16,17).

METHODS

A cross-sectional study was conducted in two displaced persons' camps, namely Alalgaia and Dababt-Bosin. These camps are located in East Kosti, White Nile State, Sudan, and were established on June 15, 2022, to accommodate Sudanese individuals

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displaced by the outbreak of war in western Sudan. The source population consisted of all children aged 6–59 months living in the displaced persons' camps who visited the health centers during the study period.

All children aged 6–59 months and their caregivers of both genders who were present at the health centers during the study period were included. A total of 110 mother–child pairs participated in the study. A pre-tested structured interview questionnaire, consisting of closed-ended questions, was used to collect background information about the respondents, demographic data, health data, anthropometric measurements (height, weight, and mid-upper arm circumference [MUAC]), and dietary intake.

To assess dietary patterns, a food frequency questionnaire (FFQ) was administered to caregivers. The FFQ aimed to evaluate overall dietary quality rather than precise nutrient intake. Food items were categorized into eight major groups: cereals, animal products, dairy products, vegetables, fruits, wild fruits, legumes, and sweets. Respondents reported consumption frequency using five categories: 1–3 times per week, 4–6 times per week, monthly, rarely, and never. This method is commonly used to assess food diversity and frequency (18).

Study Variables and Measurements

Weight was measured using a Salter hanging spring scale with a 100 g graduation and a capacity of 26 kg. Children were weighed with minimal clothing and without shoes, and measurements were recorded to the nearest 0.1 kg. Scales were calibrated regularly using known weights, and readings were checked to ensure the indicator returned to zero before each use. Each child was weighed twice for accuracy.

Recumbent length was measured for children under two years of age, while standing height was measured for those aged two years and above, recorded in centimeters to the nearest 0.1 cm. Nutritional status was assessed using three anthropometric indices: weight-for-age, weight-for-height, and height-for-age, based on World Health Organization (WHO) child growth standards. Z-scores were used to classify nutritional status as normal (-2 to +2 SD), moderate acute malnutrition (MAM: -2 to -3 SD), and severe acute malnutrition (SAM: < -3 SD) (19).

MUAC was measured on the left arm, at the midpoint between the acromion (shoulder tip) and olecranon (elbow tip). The upper arm was fully exposed, and a non-stretchable MUAC tape was used to take the measurement snugly but without compressing the soft tissue. MUAC was recorded to the nearest 0.1 cm following standard anthropometric procedures (20).

Body Mass Index (BMI)-for-Age

BMI-for-age was calculated by dividing weight in kilograms by the square of height in meters (kg/m^2), and results were interpreted using WHO growth charts. Classification was as follows: < -3 SD (severe acute malnutrition), -2 to -3 SD (moderate acute malnutrition), -1 to 1 SD (normal), 1 to 2 SD (overweight), 2 to 3 SD (obese), and > 3 SD (extremely obese) (21).

Ethical Considerations

Ethical approval was obtained from the Standing Committee of University of Science and Technology, Aden, Yemen (MEC No. MEC/AD080). All mothers were fully informed about the study's purpose and procedures. Participation was voluntary, and caregivers were assured of their right to withdraw at any time without penalty. Confidentiality and anonymity of participants were strictly maintained throughout the study.

RESULTS

This study emphasizes the nutritional condition and prevalence of malnutrition and looks at the demographic and socioeconomic characteristics of children (6–59 months) and their families. A total of 110 respondents at the period of study provided information on a number of variables, including family size, parental education, age, gender, and access to critical nutrition and health services.

Demographic and Socioeconomic Data of the Respondents

Among the 110 children surveyed, most were 6-19 months old (56.4%), with smaller proportions aged 20-33 months (20.9%), 34-47 months (14.5%), and 48-59 months (8.2%); girls slightly outnumbered boys (56.4%) compared with boys (43.6%). Mothers were predominantly young, with 40% aged 18-24 years, 33.6% aged 25-30 years, 22.7% over 30 years, and only 3.6% under 18 years, whereas fathers were generally older, with 62.7% being over 30 years, 27.3% aged 25-30 years, and 10% aged 18-24 years.

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Educational attainment was low; over half of mothers were illiterate (52.7%) and only 0.9 % had university degrees, while 32.7% of fathers were illiterate and 1.8 % had university education, though nearly half (49.1 %) had completed basic school. Most households were large; 65.5% comprised 6-10 members and 14.5% had 11-15 members, leaving 14.5% with 2-5 members and 5.5% with more than 15. Regarding the number of children in the families, about two-thirds (66.1%) had 1 to 5 children, while one-third (33.9%) had 6 to 10. When looking at birth order, 44.5% of the children surveyed were fourth-born or later, 20.9% were first-born, another 20.9% were second-born, and 13.6% were third-born.

Table 1: Demographic and Socioeconomic Data (n=110)

Variables	Frequency	Percentage
Age of children/month		
6-19	62	56.4
20-32	23	20.9
33-47	16	14.5
48-59	9	8.2
Gender of children		
Male	48	43.6
Female	62	56.4
Age of Mothers/ years		
<18 years	4	3.6
18-24 years	44	40.0
25-31 years	37	33.6
>31 years	25	22.7
Age of fathers/ years		
18-24 years	11	10.0
25-31 years	30	27.3
>31 years	69	62.7
Mother's education		
Illiterate	58	52.7
Basic school	42	38.2
Secondary school	9	8.2
University	1	0.9
Father's education		
Illiterate	36	32.7
Basic school	54	49.1
Secondary school	18	16.4
University	2	1.8
Family size		
2-5	16	14.5
6-10	72	65.5
11-15	16	14.5
>15	6	5.5
Number of children in the family		
1-5	72.7	66.1
6-10	37.3	33.9
Position of child in the family		
First	23	20.9
Second	23	20.9

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Third	15	13.6
Fourth and above	49	44.5

Nutritional Status of Children

Based on anthropometric Z-scores, 37.3% of the children were underweight, including 18.2% who were severely underweight, while 44.5% fell within the normal weight-for-age range. Stunting affected 28.2% of the sample, with 10.9% classified as severely stunted, indicating long-term insufficient nutrient intake and frequent infections, particularly during critical periods of growth (22). Whereas 60.9% had normal height-for-age. Wasting was observed in 42.7% of children, of whom 14.5% were severely wasted; 40.9% had normal weight-for-height, and 1.8% were overweight. Wasting, present in 42.7% of the sample (including 14.5% severely wasted), is alarmingly high and reflects acute food insecurity or recent weight loss due to illness or poor diet. Wasting significantly increases the risk of child mortality, particularly when associated with severe acute malnutrition (SAM). Using BMI-for-age, 6.4% of children met criteria for severe acute malnutrition (SAM) and 37.3% for moderate acute malnutrition (MAM); just over half (54.5%) were in the normal range, while 0.9% were overweight and another 0.9% obese. points to an emerging double burden of malnutrition, a coexistence of undernutrition and overweight, often due to poor-quality, energy-dense, nutrient-poor diets (23). However, these findings indicate a high burden of acute and chronic malnutrition among displaced children, particularly in the form of wasting and underweight, both of which reflect recent nutritional deficits and potential food insecurity.

Table 2: Nutritional Status of Children (n=110)

Variables	Frequency	Percentage
Prevalence of underweight among children based on weight-for-age (WFA) Z-scores		
Underweight (<-2)	41	37.3
Severe underweight (<-3)	20	18.2
Normal (>-2)	49	44.5
Prevalence of stunting among children based on height-for-age (HFA) Z-scores		
Stunting (<-2)	31	28.2
Severe stunting (<-3)	12	10.9
Normal (>-2)	67	60.9
Prevalence of wasting among children based on Weight for Height (WFH) Z-scores		
Wasting (<-2)	47	42.7
Severe wasting (<-3)	16	14.5
Normal (>-2)	45	40.9
Overweight (above 1)	2	1.8
Prevalence of BMI for Age among children		
SAM (<-3)	7	6.4
MAM (-2 to -3)	41	37.3
Normal (-1 to 1)	60	54.5
Overweight (1 to 2)	1	0.9
Obese (2-3)	1	0.9
Prevalence of acute malnutrition and bilateral pitting edema among children		
Mid-Upper Arm Circumference (MUAC)		
Severe acute Malnutrition (SAM) (<11.5cm)	15	13.6
Moderate acute Malnutrition (MAM) (11.5- <12.5cm)	31	28.2
Norma (>12.5cm)	64	58.2
Bilateral pitting Edema	0	0.0

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The prevalence of acute malnutrition and bilateral pitting edema among children, based on Mid-Upper Arm Circumference (MUAC), showed that 13.6% of children had Severe Acute Malnutrition (SAM) with MUAC less than 11.5 cm, 28.2% had Moderate Acute Malnutrition (MAM) with MUAC between 11.5 cm and less than 12.5 cm, and 58.2% had normal MUAC measurements greater than 12.5 cm. No cases (0.0%) of bilateral pitting edema were observed.

Physical Activity, Vaccination, and Supplementation among the Children

Among the children assessed, 25.5% engaged in no physical activity, remaining mostly static while sleeping, watching TV, or riding in a car, whereas the majority (74.5%) performed only mild activity such as walking or casual play, and none were classified as very active. Vaccination coverage was notably high, with 81.8% immunized and 18.2% not; of those vaccinated, 41.1% had received the full five essential vaccines, and 36.7% received only polio and measles vaccines. The remaining 22.2% received different combinations of vaccines. Exactly half of the children (50%) received nutritional supplements, while the other half did not; among those supplemented, vitamin A was given to 63.6%, ferrous sulfate to 54.5%, zinc to 32.7%, and multivitamins to 21.8%. Nutritional supplementation was also assessed, showing that exactly half of the children, or 50%, received nutritional supplements. Among the supplemented children, 63.6% were given vitamin A, 54.5% received ferrous sulfate, 32.7% were provided with zinc, and 21.8% took multivitamins. Consequently, the other half of the group did not receive these supplements, with (36.4%) lacking vitamin A, (45.5%) missing out on ferrous sulfate, (67.3%) not having zinc, and (78.2%) not receiving multivitamins. These numbers show gaps in the coverage of micronutrients and point to the possibility of using targeted supplementing techniques to avoid deficiencies that are known to impair a child's immunity and growth.

Table 3: Physical activity, vaccination among children (n=110)

Variables	Frequency	Percentage
Physical activity of child		
No activity (Static for long periods such as sleeping, showing T.V, travelling by car.)	28	25.5
Mild activity (Move around, playing, jumping and jogging, walking slowly and less active gameplay.)	82	74.5
Very active (Running (Race), brisk walking, Bike riding, Dance, Swimming, climbing, jump rope and gymnastics like football.)	00	00
Vaccination of child		
Yes	90	81.8
No	20	18.2
Type of vaccine Received:		
All of them (the fifth vaccine)	37	41.1
Polio and measles	33	36.7
Other	20	22.2
Supplementation taken by child		
Yes	55	50
No	55	50
Types of Supplements Taken:		
Child supplemented by Vitamin A		
Yes	35	63.6
No	20	36.4
Child supplemented by ferrous format		
Yes	30	54.5
No	25	45.5

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Child supplemented by zinc		
Yes	18.2	32.7
No	37.3	67.3
Child supplemented by multivitamin		
Yes	11.8	21.8
No	42.7	78.2

Dietary Intake and Meal Patterns

According to the number of meals per day, the majority of respondents (83%) were taking 1-2 meals per day, and only 17% were taking 3-4 meals per day. This infrequent eating pattern raises the possibility of insufficient nutrient intake, especially in kids whose energy and micronutrient requirements are higher for growth and development. Such restricted eating patterns are frequently indicative of food insecurity, a lack of varied and adequate food sources, and a dependence on sporadic food assistance in humanitarian or displaced contexts. Undernutrition, stunting, and other types of malnutrition may result from these eating habits, particularly if the few meals ingested are deficient in nutritional diversity and nutrient density (5).

In terms of food frequency, cereals emerged as a staple, with 70% of participants consuming bread and 51% regularly eating kisra 1-3 times per week. Animal products such as meat stew and fish are also popular, with 71% and 70% of respondents consuming them 1-3 times weekly, respectively. Interestingly, chicken consumption appears limited, with only 19% eating it regularly, while 63% report never consuming chicken. A decrease in food rations and inadequate intake could be the main factors contributing to malnutrition in the camp.

When it comes to dairy, 50% of participants enjoy Rob 1-3 times a week, and 51% consume fresh milk more frequently, 4-6 times per week. As for vegetables and fruits, while 60% include salad in their diet 1-3 times weekly, there's a notable trend of non-consumption for certain fruits: 72% never eat apples, 61% never consume guava, and 58% never have mango.

In the legumes and sweets category, 67% of respondents enjoy lentils (Addas) 1-3 times per week, yet 82% do not partake in fava beans (Fulmasri) or beans (Fasolia). Sweets appear to be infrequently consumed as well. On a positive note, wild fruits like Karkade have made an impression, with 66% of respondents including them in their diets.

Previous Medical History

A review of past illnesses showed that iron-deficiency anemia had been documented in 30.9% of the children, while the majority (69.1%) had no such history. Wasting had previously affected 27.3% of children, leaving 72.7% unaffected. Nearly all children (93.6%) had experienced malaria at some point, with only 6.4% remaining malaria-free. Typhoid was less common, reported in just 8.2% of children versus 91.8% without prior infection. Other acute diseases were noted in 59.1% of the sample, whereas 40.9% had no record of such conditions. Nearly half of malnutrition cases are linked to recurrent diarrhea and/or intestinal infections due to the lack of access to sufficient safe drinking water and poor sanitation facilities, according to Lawry et al. (24).

Table 4: Previous Medical History of Children (n=110)

Previous history of child with iron Anemia	**Frequency**	**Percentage**
Yes	34	30.9
No	76	69.1
Previous history of child with wasting		
Yes	30	27.3
No	80	72.7
Previous history of child with Malaria		

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Yes	103	93.6
No	7	6.4
Previous history of child with typhoid		
Yes	9	8.2
No	101	91.8
Previous history of child with other acute diseases		
Yes	**65**	**59.1**
No	**45**	**40.9**

Association between Age Group vs. Weight-for-Age

The analysis clearly demonstrates that there is no statistically significant link between the ages of children and their weight-for-age status ($p > 0.05$). This indicates that the distribution of underweight, severely underweight, and normal weight categories remains consistent across various age groups. In essence, age does not significantly influence weight status among children. Recognizing this insight is essential for developing effective interventions focused on improving child nutrition and enhancing overall health outcomes.

Association between Age of Children and MUAC status

The findings of this study highlight a concerning level of malnutrition among children under five, with notable rates of underweight, stunting, and wasting. These patterns reflect broader trends observed in low-income and resource-limited settings, where poor dietary diversity, low meal frequency, and limited access to essential nutrients are common contributors to undernutrition. Similar findings have been reported in studies conducted in sub-Saharan Africa and South Asia, where inadequate infant and young child feeding practices, alongside household food insecurity, play significant roles in poor nutritional outcomes (25,26).

Low maternal education levels and large household sizes, as found in this study, have been consistently associated with higher risks of child malnutrition in other research. For instance, studies emphasize the importance of maternal literacy and awareness in ensuring adequate feeding and healthcare practices. Furthermore, although immunization coverage was relatively high, incomplete vaccination and inconsistent supplementation could weaken children's resistance to infections, exacerbating the effects of malnutrition, as seen in a study by (27).

Interestingly, the lack of a significant relationship between child age and weight-for-age in this study suggests that undernutrition is widespread across all age groups within the first five years of life, aligning with the findings of multiple DHS (Demographic and Health Survey) reports that emphasize the persistent and chronic nature of undernutrition in similar populations (28-31).

CONCLUSION

This study reinforces the urgent need for integrated interventions that address immediate dietary gaps as well as underlying social and economic determinants. Strengthening caregiver education, improving access to health services, and promoting diverse, nutrient-rich diets are crucial strategies for reducing childhood malnutrition and improving long-term health outcomes. Children under five, particularly those in IDP camps, are at heightened risk of malnutrition due to factors like food insecurity, limited access to healthcare, and poor living conditions.

Recommendations

Strengthening growth monitoring programs and routine nutritional screening through community-based mechanisms is essential, especially in regions with high malnutrition prevalence (32). By adhering to these recommendations and fostering collaborative efforts, stakeholders can effectively assess and address the nutritional needs of children in Kosti's IDP camps, mitigating the impact of the ongoing humanitarian crisis.

Conflict of Interest

The authors declare that no conflict of interest.

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