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Original Research Article

Prevalence of malnutrition among children under five years old in Khartoum State, Sudan

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ABSTRACT

Introduction: Malnutrition is the most common nutritional disorder in developing countries and it remains one of the most common causes of morbidity and mortality among children worldwide.

Aim: To identify the prevalence of malnutrition (underweight, stunting and wasting) among children under 5 years old living in Khartoum state, Sudan.

Material and methods: A cross-sectional community-based descriptive study was conducted, to collect primary information from households using a scientific questionnaire, anthropometric measurements (mid-upper arm circumference – MUAC, weight and length/height), and clinical evaluations of the malnourished children to check the presence of severe protein energy malnutrition (PEM).

Results and discussion: The results showed that socioeconomic factor, poor nutrition, and mothers' knowledge and feeding practices led to increase in the prevalence of malnutrition. MUAC indicator showed that 20.9% of children were badly nourished and 79.1% of the children were well nourished. In addition, to poor economic situation, the study found that about 15.4% of children were underweight, 8.8% were moderate underweight and 6.6% were severe underweight. The prevalence of wasting was 21.1% (12.3% moderate and 8.8% severe) and the prevalence of stunting was 24.9% (15.1% moderate and 9.7% severe). The World Health Organization standard showed that the prevalence of global malnutrition, moderate malnutrition and severe malnutrition was 12.8%, 8.0% and 13.6%, respectively. The National Center for Health Statistics reference showed that the prevalence of global malnutrition, moderate malnutrition and severe malnutrition was 23.1%, 10.2% and 12.9%, respectively.

Conclusions: We conclude that improvements in child feeding, and better maternal education are needed to maintain the children's nutritional status.

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1. Introduction

Malnutrition is the most common nutritional disorder in developing countries and it remains one of the most common causes of morbidity and mortality among children worldwide. Malnutrition affects physical growth, morbidity, mortality, cognitive development, reproduction, and physical work capacity, and it consequently impacts on human performance, health and survival.[1,2] It is estimated that 150 million children under 5 years are underweight and more than 20 million suffer from severe malnutrition.[3–5] About 47 million children under 5 years are stunted in the sub-Saharan Africa, whereas in the Eastern and Southern Africa 24 million are stunted.[6] Stunting is an indicator of past growth failure, which is a sign of poor nutritional history. It is associated with a number of long-term factors including chronic insufficient protein and energy intake, frequent infection, sustained inappropriate feeding practices and poverty.[7] Wasting indicates current or acute malnutrition resulting from failure to gain weight or actual weight loss.[7] In Sudan, 31.0% of children under 5 years are moderately or severely underweight, 32.5% suffer from moderate or severe chronic malnutrition and 14.8% suffer from global acute malnutrition.[8] Also, in Khartoum state the prevalence of malnutrition among 6–59 months old children was 11.8% for moderate acute malnutrition and 7.3% for severe wasted.[9] The problems of increased prevalence of malnutrition were related to poor sanitary conditions and inadequate food intake.[10] Mother's education was found to be the strongest factor associated with malnutrition among the children under 5 years of age.[11]

In Sudan the nutritional status for children under 5 years old depends on the living standard of the population and the households' income. Children who belong to families having limited access to resources are mostly children affected with malnutrition.[12] Furthermore, a child's nutritional status can be affected by poor economic situation and[13] socioeconomic, demographic, and cultural factors.[14] Moreover, to maintain nutritional status and, in turn, for better health growing of the children's, both maternal education and nutrition are needed.[11]

2. Aim

The objective of the present study was to measure the prevalence of malnutrition in the three forms: wasting, stunting and underweight (severe and moderate for each type) and to identify the socioeconomic characteristic of households.

3. Material and methods

3.1. Study area

Khartoum state in Sudan covers 22 122 km^2 with an approximate population of 7 152 102. The state is divided into seven localities, al Khartoum, al Khartoum Bahri, Omdurman, Jabal Awliya, Sharq Alnil, Ombada and Karari. The current study was conducted in Dar El Salam in Ombada locality with a total population of 582 661 living in 52 blocks; the recommended sample size for the assessment according to households number was 505 households.

3.2. Sampling procedures

A cross-sectional descriptive study was designed to collect primary information from households using a scientific questionnaire. The questionnaire covered demographic data, birth data, family size, gender, parent's education and occupation, quality of food eaten by children, number of meals eaten per day and source of income of the study population. In addition, physical appearance of people and their living conditions were observed; interaction between people and their activities were highly considered.

3.3. Anthropometric measurement

Anthropometric measurements (mid-upper arm circumference – MUAC, weight and length/height) were carried out according to the nutrition guidelines method (MSF[14], Gibson[15]).

3.4. Body weight

Body weight was measured using a hanging baby scale with a 15 g capacity (mechanical baby hanging scale, capacity up to 15 kg or 25 kg SECA310) for children unable to stand. While for older children a mechanical dial weighing scale, made in Japan, with capacity of 130 kg was used. All children were weighed with light clothing, without shoes, to the nearest 0.1 kg; measurements were double-checked. The scales were checked for accuracy before starting the survey and after, and then rechecked periodically.

3.5. Length/height

Heights/lengths were carefully measured using an inelastic measuring tape to the nearest 0.1 cm. Children older than 24 months (height more or equal to 85 cm) were measured while standing, and those less than 24 months or less than 85 cm height were measured while lying down.

3.6. Mid-upper arm circumference

MUAC was measured in centimeters using children's (shakir insertion) and was recorded to the near 0.1 cm. The measurement was taken on the left arm, at the middle point between the elbow and the shoulder while the arm was relaxed.

3.7. Age

Age was recorded using Medecines' Sans Frontieres method; if birth dates have been recorded on a health card or immunization card, determination of age is simple. In such cases, the date of birth is directly recorded onto the questionnaire in order to avoid mistakes in calculating the age. If birth dates are not recorded, a local calendar of events is used. The mother is asked whether the child was born before or after certain major

Table 1 – Distribution of age and sex among children.

Age, months	Boys, no (%)	Girls, no (%)	Total, no (%)	Boys to girls ratio
0–17	15 (68.2)	7 (31.8)	22 (5.4)	2.1
18–29	44 (48.9)	46 (51.1)	90 (21.9)	1.0
30–41	30 (38.0)	49 (62.0)	79 (19.2)	0.6
42–53	46 (41.1)	66 (58.9)	112 (27.3)	0.7
54–60	60 (55.6)	48 (44.4)	108 (26.3)	1.3
Total	195 (47.4)	216 (52.6)	411 (100.0)	0.9

events until a fairly accurate age is pinpointed. If that is not possible, children are selected on the basis of height. Only children measuring more than 65 cm and less than 110 cm in tall height were included in the sample.

3.8. *Edema*

Clinical evaluations of the malnourished children were undertaken to check the presence of severe protein energy malnutrition (PEM), which is one of the signs of kwashiorkor. Thumb pressure was applied to the child's feet simultaneously for 3 s.[16]

3.9. *Data collection and analysis*

Anthropometric body measurements (weight, length/high and MUAC) for children under 5 years old within households were collected to assess the growth and development of children. International and national Sudanese standard methods were used as indicators for child nutrition status during the assessment time in the field. Statistical Package of Social Sciences (SPSS) v. 15 was used to estimate the frequencies of descriptive variables (gender, education, income and age), cross-tabulation was used to find the relationship between variables in the study area. To determine the level of significance, χ^2 test was used. Socio-economic data were separately analyzed to avoid data duplication using SPSS. ENA Smart software programs were used to calculate the prevalence of severe acute malnutrition and global acute malnutrition.

3.10. *Ethical approval*

The study was ethically approved by Khartoum Ministry of Health Research unit, Sudan and Medical and Health Studies Board of the University of Khartoum.

4. Results

This cross-sectional community-based descriptive study was conducted to assess the nutritional status of the children and the impact of socio-economic characteristics of households in Khartoum State, Sudan. In total, 505 families (74.0% females and 26.0% males) and 411 children under 5 years old (52.6% girls and 47.4% boys) (Table 1) were studied. Most fathers in the current study either completed their basic education (34.5%) or were illiterate (32.1%), while 40.6% of mothers completed their basic education and 35.4% were illiterate (Fig. 1). About 20.9% of mothers who received their basic education continued breastfeeding their children for two years, while only 1.2% of those who received their university education continued breastfeeding their children for two years (Fig. 2).

Approximately 38.6% of households and their children were eating two meals, while 61.4% of households and their children were eating three meals per day. The average income of 30.7% of households' was less than 345 SDG and that of 14.5% of households' was over 600 SDG (exchange rate at the time of study: 1 USD = 3.75 SDG). Therefore, the correlation between family income and number of meals eaten per day for households was highly significant ($P = .007$) (Table 2).

MUAC was assessed in for 370 children who accepted measurement (41 children refused it). Approximately 79.0% of children less than 5 years old were well nourished, 18.1% had mild malnutrition and 2.9% had moderate malnutrition (Table 3).

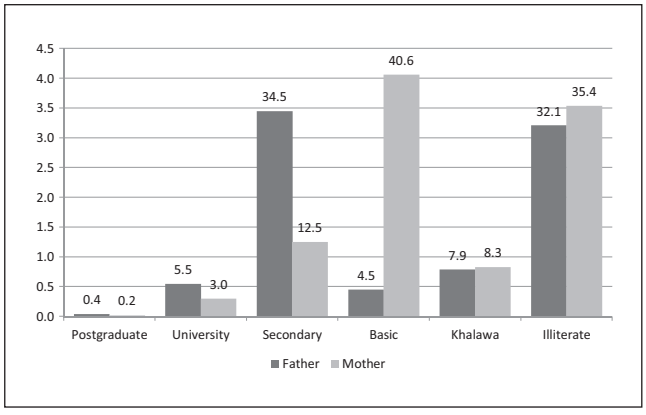

Fig. 1 – Education level of household.

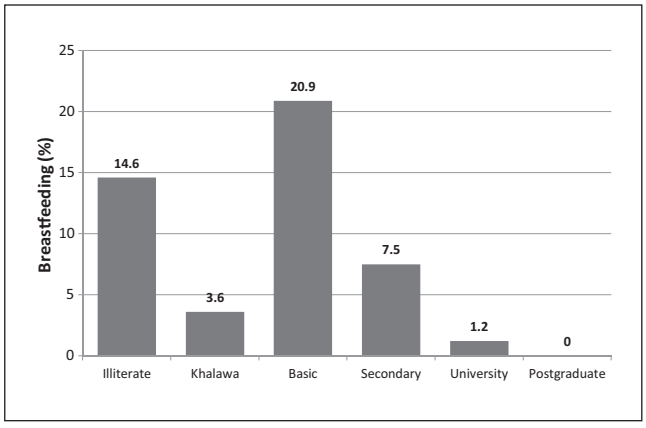

Fig. 2 – Relationship between mother's education and child breastfeeding.

Table 2 – Relation between family income and number of meals eaten per day.

Family income per month, SDG	Number of meals eaten per day for both adult and children, no. (%)		
	Two meals	Three meals	Total
≤345[a]	77	78	155 (30.7)
350–400	55	96	151 (29.9)
401–450	21	35	56 (11.1)
451–500	12	17	29 (5.7)
501–600	10	31	41 (8.1)
>600	20	53	73 (14.4)
Total	195 (38.6)	310 (61.4)	505 (100.0)

Exchange rate at the time of study: 1 US$ = 3.75 SDG.
[a] Dawan Ezaka estimates the poverty line below 300 SDG/month.

Table 3 – MUAC for children.

MUAC (cm)	Children at age of 6–60 months, no. (%)	Indicators
>13.5	293 (79.0)	Well nourished
12.5–13.5	67 (18.1)	Mild malnutrition
12.0–12.4	11 (2.9)	Moderate malnutrition
11.5–11.9	0 (0.0)	Severe malnutrition
Total	371 (100.0)	

Considering the gender, the prevalence of global acute malnutrition, moderate acute malnutrition, severe acute malnutrition and edema WHZ < -2 for all children were 21.8% (boys 20.7% and girls 22.6%); 8.0% (boys 8.5% and girls 7.5%); 13.8% (boys 12.2% and girls 15.1%); and prevalence of edema 0.0% ($n = 0$) means ± SD of WHZ -0.68 ± 2.41 (Fig. 3).

The prevalence of underweight, moderate underweight, severe underweight and edema WAZ < -2 for all children were 21.9% (boys 20.0% and girls 23.6%), 12.4% (boys 10.8% and girls 13.9%), 9.5% (boys 9.2% and girls 9.7%) and 0.0% ($n = 0$), respectively. The prevalence of edema was 0.0% ($n = 0$) means ± SD of WAZ 0.85 ± 1.62 (Fig. 4).

The prevalence of stunting, moderate stunting and severe stunting (<−2 z-score) for all children was 25.3% (boys 26.2% and girls 24.5%), 13.9% (boys 15.9% and girls 12.0%) and 11.4% (boys 10.3% and girls 12.5%), respectively (Fig. 5).

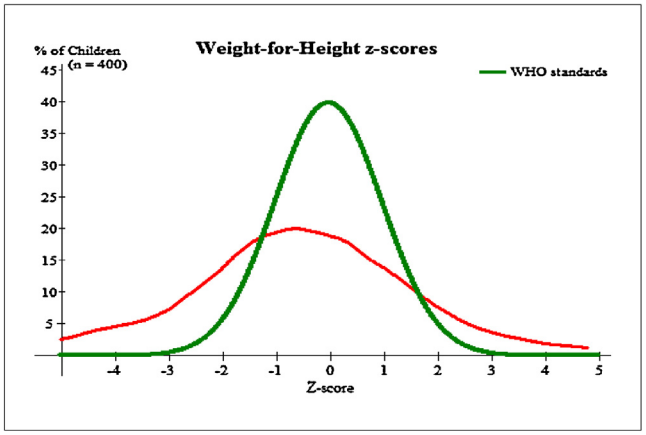

Fig. 3 – Prevalence of global acute malnutrition (weight-for-height z-scores) for all children.

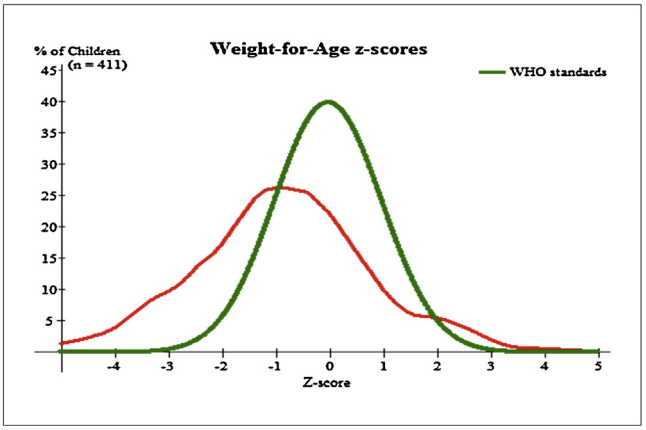

Fig. 4 – Prevalence of underweight (weight-for-age z-scores <−2) for all children.

The prevalence of severe, moderate and normal wasting in acute malnutrition at 0–59.9 months based on weight-for-height was 13.8%, 8.0% and 78.2%, respectively. However, severe wasting and moderate wasting were highly presented at ages 6–17 months (36.4% and 13.6%), respectively (Table 4).

The acute malnutrition and edema when edema absent based on weight-for-height z-scores were calculated used

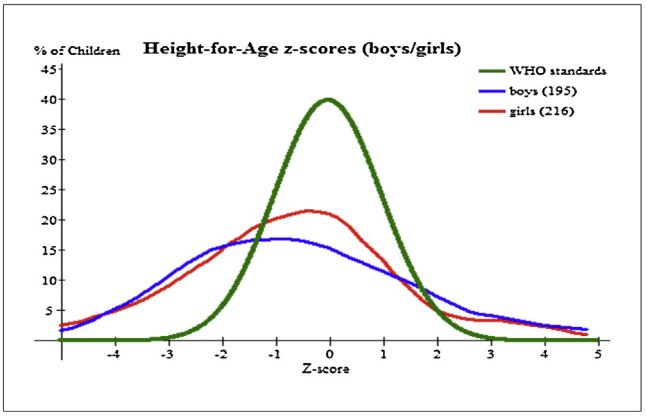

Fig. 5 – Prevalence of stunting (height-for-age z-scores) for all children.

Table 4 – Prevalence of acute malnutrition by age based on weight-for-height z-scores and/or edema.

Age, months	Total, no.	Severe wasting*, no. (%)	Moderate wasting**, no. (%)	Normal***, no. (%)	Edema (%)
0–17	22	8 (36.4)	3 (13.6)	11 (50.0)	0.0
18–29	89	22 (24.7)	5 (5.6)	62 (69.7)	0.0
30–41	79	10 (12.7)	3 (3.8)	66 (83.5)	0.0
42–53	108	5 (4.6)	9 (8.3)	94 (87.0)	0.0
54–59.90	102	10 (9.8)	12 (11.8)	80 (78.4)	0.0
Total	400	55 (13.8)	32 (8.0)	313 (78.2)	0.0

* z-Score less than −3.
** z-Score more than or equal to −3 and less than −2.
*** z-Score more than or equal to −2.

Table 5 – Prevalence of acute malnutrition based on weight-for-height z-scores (and/or edema) for sex using WHO and NCHS references.

References	Indicators of acute malnutrition		
	Prevalence of global malnutrition*	Prevalence of moderate malnutrition**	Prevalence of severe malnutrition***
WHO standard			
Boys (N = 188)	39 (20.7; 13.6–27.9)	16 (8.5; 4.9–12.1)	23 (12.2; 5.9–18.6)
Girls (N = 212)	48 (22.6; 16.6–28.6)	16 (7.5; 5.2–9.9)	32 (15.1; 10.3–19.9)
Total (N = 400)	87 (21.8; 16.8–26.7)	32 (8.0; 5.8–10.2)	55 (13.8; 9.3–18.2)
NCHS standard			
Boys (N = 195)	45 (23.1; 15.2–30.9)	21 (10.8; 7.1–14.4)	24 (12.3; 6.4–18.2)
Girls (N = 216)	50 (23.1; 17.3–29.0)	21 (9.7; 7.0–12.5)	29 (13.4; 8.60–18.2)
Total (N = 411)	95 (23.1; 17.9–28.3)	42 (10.2; 8.1–12.4)	53 (12.9; 8.6–17.2)

Comment: All numbers are given as: no. (%; 95% C.I.).
* z-Score less than −2 and/or edema.
** z-Score less than −2, no edema.
*** z-Score less than −3 and/or edema.

World Health Organization (WHO) standard and National Center for Health Statistics (NCHS) references it was 13.8% and 12.9%, respectively. The WHO standard showed that the prevalence of global malnutrition, moderate malnutrition and severe malnutrition was 12.8%, 8.0% and 13.6%, respectively. The NCHS reference showed that the prevalence of global malnutrition, moderate malnutrition and severe malnutrition was 23.1%, 10.2% and 12.9%, respectively (Table 5).

5. Discussion

The major global health problem faced by the developing countries today is malnutrition.[17] The causes of malnutrition are multi-factorial, with dietary and environmental factors contributing to the risks of malnutrition in children.[18] In the present study, among the total of 505 families studied 74.0% were females and 26.0% were males, and among 411 children 52.6% were girls and 47.4% were boys. Similarly, Dabone et al.[5] found that the percentage of girls (52.4%) was slightly higher than that of boys (47.6%), and in Garhwal Himalayas the percentage of girls was 7% more than that of boys.[19] In contrast, Gobostswang[20] reported that the percentage of boys was 51% higher than that of girls 49%. Parental education had been identified as a predictor of undernutrition; we found that most parents either completed their basic education or were illiterate, and their average income was low. Similarly, Moestue and Huttly[21] found that 53% of mothers and 63% of fathers were illiterate, while Nyirandutiye et al.[22] noted that 77.7% of mothers were uneducated. It is indicated that the main factors that affected children under 3 years of age were occupation and education of the parents, marital status, family income, maternal nutritional knowledge and residence.[23]

Anthropometry has become a practical tool for evaluating the nutritional status of children in developing countries.[24] MUAC is often used for community screening in therapeutic feeding programs.[25] However, in many hospitals in sub-Saharan Africa weight is the only systematically measured anthropometric index.[26] Using MUAC we found that 79.0% of children were well nourished, 18.1% had mild malnutrition and 2.9% had moderate malnutrition. In Sudan, Kabkabyia had experienced a high global acute malnutrition rate (>15%) among children under 5 years for the past 5 years, while food security managements indicated that the town was relatively better off in terms of food security compared to other areas in North Darfur.[27] Nyirandutiye et al.[22] surveyed 1740 children using MUAC, and found that the prevalence of acute malnutrition was 6.3%, with the prevalence being significantly higher among girls (8.3%) than boys (4.5%) and 11.0% among children aged 6–11 months compared to 5.4% in older children. Over 40% of Indian children are malnourished, which is twice as high as those in sub-Saharan Africa.[28]

The prevalence of moderate and severe underweight was defined as the proportion of children whose weight-for-age

was below −2 and −3 standard deviation scores (SDS), respectively.[29] The prevalence of moderate and severe wasting and stunting was defined as the proportion of children whose weight-for-height (wasting) and height-for-age (stunting) were below −2 and −3 SDS, respectively. In the present study the prevalence of global acute malnutrition, moderate acute malnutrition and severe acute malnutrition for children (boys and girls) was 21.8%, 8.0% and 13.8%, respectively. The prevalence of global underweight, moderate underweight and severe underweight was 21.9%, 12.4% and 8.8%, respectively. Underweight, weight-for-age is a composite index of height-for-age (stunting) and weight-for-height (wasting), it is a sign of current under nutrition.[30] In Saudi children the prevalence of moderate and severe underweight was 6.9% and 1.3%, respectively.[29] In Sudanese children the global malnutrition was 11.8% and moderate malnutrition was 11.1%.[31]

Wasting in individual children and population groups can change rapidly and shows marked seasonal patterns associated with changes in food availability or disease prevalence to which it is very sensitive.[7] In the present study severe wasting and moderate wasting were highly presented at age 6–17 months (36.4% and 13.6%), respectively. The prevalence of global stunting, moderate stunting and severe stunting was 26.2%, 13.1% and 11.4%, respectively. In addition, the acute malnutrition and edema when edema absent based on weight-for-height z-scores were calculated used WHO standard and NCHS references it was 13.8% and 12.9%, respectively. Magboul et al.[32] indicated that wasting was 11.3% in Khartoum and Omdurman towns and 4.9% in Khartoum north. In Saudi children the prevalence of moderate and severe wasting was 9.8% and 2.9%, respectively.[29] Dutta et al.[19] indicated that the rate of malnutrition among children in the Garhwal Himalayas is very high. The majority are severely stunted and wasted, indicating a high prevalence of both chronic and acute malnutrition.[19] Alredaisy and Ibrahim[12] mentioned that global wasting was 23.7% (12.3% moderate and 11.4% severe). Stephen et al.[33] indicated that the prevalence of stunting in developing countries is expected to decline from 36.0% in 1995 to 32.5% in 2000. Stunting affects 48.0% of children in South Central Asia, 48.0% in Eastern Africa, 38.0% in South Eastern Asia, and 13.0%–24.0% in Latin America.[33] In Uganda the prevalence of global stunting was 52.4% and severe stunting was 24.9%.[34] The prevalence of both global acute malnutrition and stunting was higher in the age groups 0–12 months and 13–24 months compared to the other age groups.[34] In Saudi children the prevalence of moderate and severe stunting was 10.9% and 2.8%, respectively; the prevalence was lower in girls for all indicators.[29] Better supplementary food can improve the nutritional status of and decrease the prevalence of stunt in children; therefore, development of supplementary food should be the priority and its intake with breastfeeding should be emphasized.[35]

6. Conclusions

Socio-economic factor, poor nutrition, and mothers' knowledge and feeding practices led to increase in the prevalence of malnutrition. Therefore, improvements in child feeding and better maternal education are needed to maintain the nutritional status of children under 5 years old living in Khartoum state, Sudan.

Conflict of interest

The authors declare no conflict of interest.

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