

Full Length Research Paper

## Anthropometric parameters of malnutrition in children 5-15 years old in Khartoum State, Sudan

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A cross sectional descriptive study was conducted using a structured questionnaire and anthropometric measurements to assess chronic malnutrition (stunting) and acute malnutrition (wasting) for 570 children at 60 to 180 months age, including 294 girls and 276 boys at Dar EL Salam, Khartoum State, Sudan. The prevalence of malnutrition was calculated using World Health Organization (WHO) Anthro Plus; it was shown that severe and moderate chronic malnutrition in both male and female was 4.6 and 15.25%, respectively. The prevalence of chronic malnutrition (stunting) in male was 6.2 and 17.43% for severe and moderate stunting and in females was 3.03 and 12.85% for severe and moderate stunting, respectively. The prevalence of acute malnutrition in both males and females according to the BMI-for-age body mass index (BMI) was 6.99 and 19.19% for severe and moderate acute malnutrition. The prevalence of acute malnutrition (wasting) in males was 6.66 and 19.66% for severe and moderate acute malnutrition and in female was 6.95 and 18.93% for severe and moderate acute malnutrition.

**Key words:** Cross-sectional study, chronic malnutrition, acute malnutrition, World Health Organization (WHO) Anthro Plus.

### INTRODUCTION

World Health Organization (WHO, 2000) defines malnutrition as the cellular imbalance between supply of nutrients and energy and body's demand to ensure growth, maintenance and specific function (WHO, 2000). Clinically, malnutrition is characterized by inadequate or excess intake of protein, energy and micronutrients. In the world, annually, over three million deaths occur from protein energy malnutrition (PEM) in the children under five (Stephan et al., 2000). Currently, 195 million under-five children are affected by malnutrition; 90% of them live in sub-Saharan Africa and South Asia (Black et al., 2008). At least 20 million children suffer from severe acute malnutrition and another 175 million are

undernourished (Black et al., 2008). Severe malnutrition has high mortality rate among admitted children in hospital in Saharan Africa (Maitland et al., 2006). The mortality rates and causes of death are an indicator of social progress and inequalities within and between societies (Razum and Breckenkamp, 2007).

Wasting indicates current or acute malnutrition resulting from failure to gain weight or actual weight loss (Bruce, 2001). Stunting is an indicator of past growth failure, which is a sign of poor nutritional history. Stunting results from long-term nutritional deprivation, inadequate childcare and poor environmental and socio-cultural conditions, poor educational achievement and reduced

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capital and social progress (Black et al., 2008). Child parental education, maternal nutritional knowledge, age, gender and father's occupation may be considered as important risk factors for stunting among school children aged 6 to 12 years (Smith et al., 2003; Khuwaja et al., 2005; Olwedo et al., 2008; Alredaisy and Ibrahim, 2011).

The prevalence of overweight in urban primary-school children in Babol comparing body mass index (BMI) values to the BMI index for age and sex was 5 to 8 and 12.3%, respectively (Hajian et al., 2011). Abdelmageed (2007) indicated that malnutrition situation in different schools in Khartoum State, Sudan for children between 7 to 12 years is considering a serious issue, about 44% of boys and 46% of girls were malnourished; 24% of boys and 17% of girls were at risk of being malnourished, only 19% of boys and girls were normal. On the other hand, Ngwenya and Nnyepi (2011) indicated that among Sudanese children aged 10 to 18 years in Khartoum, more than 9% of the children were obese and 10.8% were overweight.

In Sudan, factors that influencing nutritional status of children less than 10 years in rural western Kordofan included mothers' level of education and environmental degradation as well as those factors which are working at the country level, such as absence of social development programs, insufficient productive capital investment in agriculture and industry, inappropriate development policies (Alredaisy and Ibrahim, 2011). The nutrition status in Sudan is poorly characterized by high level of underweight and chronic malnutrition, well persistently elevated level of acute malnutrition. Therefore, the available data about nutritional status of children under 5 years in Sudan reflects the worse and miserable situation, especially in the marginalized rural areas (Abdalla et al., 2009), but the situation is extending to urban area of Sudan. Therefore, the aim of this study was to measure the prevalence of malnutrition (wasting, stunting and underweight) severe and moderate for each type, and to identify the socio-economic characteristic of households.

## METHODOLOGY

### Study location

This study was conducted in Ombada locality namely Dar El Salam, Khartoum state, Sudan. The state has an area of 22,122 km<sup>2</sup> and an estimated population of approximately 7,152,102. The state included seven localities, Khartoum, Khartoum Bahri, Omdurman, Jabal Awliya, Sharq Alnil, Ombada and Karari locality. Dar El Salam was established in 1983 to 1987, during famine periods and natural disasters such as desertification (Eltype, 2003). Dar El Salam area was expanded to 52 blocks with total population of 582,661 due to civil war in Western, Eastern and Southern Sudan. The population in the study area was heterogeneous in terms of ethnic and tribal composition. The area has twenty one nongovernmental organizations (NGOs) working in health service, and primary health care units, in addition to eight governmental health centers and eight clinics. intellectual capacity, and is a strong predictor

of human.

### Study design

The cross-sectional descriptive study was designed to collect information of nutrition status for the children from 15th March to 15 April, 2012. Approximately 5% of samples were collected to represent the community of Dar El Salam. Sample size was calculated based on the total population of Dar El Salam (582,661) using the following formula:

$$N = Z^2.PQ / D^2$$

Where: N: is the required sample size, Z: is the value of the standard normal variable corresponding to 95% level of significance, P: estimated prevalence of malnutrition in the area ( $p = 0.1$ ) and ( $Q = 1-p$ ), D: marginal of error at 5% (standard value of 0.05)

Therefore, a total of 505 household with 570 children at age groups 60 to 180 months participated in the present study. Questionnaire was designed to collect primary data from households using cluster sampling approach. Secondary data was collected from Federal Ministry of Health report, consultation of experts working in Federal Ministry of Health (FMOH) and Non Governmental Organizations (NGOs), publications of united nation (UN) statistical report, World Food Programme (WFP), World health organization annual reports, Food and Agriculture Organization (FAO) reports and scientific articles from search engine such as pub med.

### Anthropometric measurements

Body weight was estimated using mechanical dial weighing scale with capacity of 130 kg to the nearest 0.5 kg. All children were weighed with light cloth without shoes. Height was measured using non elastic measuring tape to the nearest 0.1 cm and age was estimated from birth certificate.

### Nutrition indicators

In conformity with the national guidelines for nutrition surveys, acute malnutrition (wasting) was the main nutrition indicator used to monitor the effect of the nutritional status of the children. Weight and height (a measure of acute malnutrition (wasting)), height for age (a measure of chronic malnutrition) and weight for age (an indicator of both chronic and acute malnutrition) were used in the present study.

### Data analysis

Data was analyzed using Statistical Package of Social Sciences (SPSS) version 15 to estimate the frequencies of descriptive variables (Gender, level of education, income and age), cross tabulation was used to find the relationship between variables and Chi-square was used to determine the level of significance. P value less than 0.05 were accepted as statistically significant. WHO Anthro software v 1.04 was used to estimate the prevalence of malnutrition among the 570 children at age 60 to 180 months. The National Centre for Health Statistics/World Health Organization (NCHS/WHO) guidelines and cut off points were also used to determine the degree of stunting and wasting. WHO Anthro software version v1.04, expressed as z-scores for each of the anthropometric indices of malnutrition against both the new WHO child growth standards and the older National Center for Health

**Table 1.** Distribution of age and gender among the children.

| Age (months) | Boys (%)    | Girls (%)   | Total (%)  | Boy: girl ratio |
|--------------|-------------|-------------|------------|-----------------|
| 60-71        | 4 (57.14)   | 3 (42.8)    | 7 (1.22)   | 1.33            |
| 72-83        | 43 (44.79)  | 53 (55.20)  | 96 (16.84) | 0.81            |
| 84-95        | 41 (59.42)  | 28 (40.57)  | 69 (12.10) | 1.46            |
| 96-107       | 46 (50.54)  | 45 (49.45)  | 91 (15.96) | 1.02            |
| 108-119      | 32 (55.17)  | 26 (44.82)  | 58 (10.17) | 1.23            |
| 120-131      | 23 (40.35)  | 34 (59.64)  | 57 (10)    | 0.67            |
| 132-143      | 21 (36.84)  | 36 (63.15)  | 57 (10)    | 0.58            |
| 144-155      | 30 (49.18)  | 31 (50.81)  | 61 (10.70) | 0.96            |
| 156-167      | 21 (46.66)  | 24 (53.33)  | 45 (7.89)  | 0.87            |
| 168-180      | 13 (44.82)  | 16 (55.17)  | 29 (5.08)  | 0.81            |
| Total        | 274 (48.50) | 296 (51.50) | 570 (100)  | 9.77            |

**Table 2.** Prevalence of chronic malnutrition (stunting) in males and females.

| Age (years) | No. | Severe % (< -3 SD) | Moderate% (< -2SD) | Mean±SD    |
|-------------|-----|--------------------|--------------------|------------|
| 5-7         | 172 | 3.1                | 60.3               | -1.15±4.0  |
| 8-10        | 206 | 13.8               | 36.8               | - 2.0±4.16 |
| 11-15       | 192 | 28.5               | 55.4               | -3.71±5.27 |
| Total       | 570 | 4.6                | 15.25              | -0.79±1.34 |

**Table 3.** Prevalence of chronic malnutrition (stunting) in male.

| Age (years) | No. | Severe% (< -3 SD) | Moderate % (< -2SD) | Mean±SD     |
|-------------|-----|-------------------|---------------------|-------------|
| 5-7         | 88  | 4.4               | 24.7                | -2.73±3.74  |
| 8-10        | 101 | 18                | 10.6                | - 2.11±4.23 |
| 11-15       | 85  | 39.3              | 17.1                | -5.0±4.69   |
| Total       | 274 | 6.2               | 17.43               | -0.98±1.26  |

Statistic NCHS/WHO reference put in high considerations.

#### Ethical approval

The Study was approved by Medical and Health Studies Board committee of the University of Khartoum and Ministry of Health Research unit of Khartoum State

## RESULTS

Approximately 48.50% of boys and 51.50% of girls of age 60 to 180 months participated in the present study (Table 1). About 82.3% of fathers in Dar El Salam were laborers and 0.2% of fathers were jobless, while 9.1% of mothers in Dar El Salam were labourers and 85.7% were jobless (housewives). The prevalence of chronic malnutrition (stunting) was calculated using WHO Anthro Plus, it is shown that severe and moderate chronic malnutrition in both male and female based on (< -3 SD and < -2 SD reference height-for age z-scores) for the children was

4.6 and 15.25%, respectively, with the means and standard deviation (mean ± SD = -0.79 ± 1.34) (Table 2). The prevalence of chronic malnutrition (stunting) in male groups based on (< -3 SD and < -2 SD reference height-for age z-scores) at age groups 60 to 180 months, using WHO Anthro Plus was 6.2 and 17.43% for severe and moderate stunting, with the means and standard deviation (mean ± SD = -0.60 ± 1.26) (Table 3).

The prevalence of chronic malnutrition (stunting) in female groups based on (< -3 SD and < -2 SD reference height-for age z-scores) at age groups (60 to 180) months, using WHO Anthro Plus, was 3.03 and 12.85% for severe and moderate stunting, respectively, with the means and standard deviation (mean ± SD = -0.608 ± 1.37) (Table 4). Acute malnutrition based on (< -3 SD and < -2 SD reference BMI-for-age z-scores) was 6.99 and 19.19% for severe and moderate acute malnutrition for age groups 60 to 180 months (Table 5). The prevalence of acute malnutrition (wasting) in males based on (< -3 SD and < -2 SD reference BMI-for-age z-scores) was 6.66 and 19.66% for severe and moderate acute

**Table 4.** Prevalence of chronic malnutrition (stunting) in female.

| Age (years) | No. | Severe% (< -3 SD) | Moderate% (< -2SD) | Mean±SD    |
|-------------|-----|-------------------|--------------------|------------|
| 5-7         | 84  | 1.9               | 40.8               | -0.47±1.46 |
| 8-10        | 105 | 8.1               | 40.3               | 0.65±1.31  |
| 11-15       | 107 | 20.3              | 47.4               | 1.80 ±4.11 |
| Total       | 296 | 3.03              | 12.85              | 0.60 ±1.37 |

**Table 5.** Prevalence of acute malnutrition (wasting) in males and females.

| Age (years) | No. | % < -3SD | % < 2 SD | % < +1 SD | % < +2 SD | % < +3 SD | Mean±SD    |
|-------------|-----|----------|----------|-----------|-----------|-----------|------------|
| 5-7         | 172 | 23.4     | 55.6     | 58.6      | 14.4      | 5.8       | -1.22±5.07 |
| 8-10        | 206 | 15.5     | 43.5     | 38.8      | 5.1       | 1.1       | -2.17±4.17 |
| 11-15       | 192 | 31       | 93       | 18.3      | 76.7      | 2.2       | -3.85±5.37 |
| Total       | 570 | 6.99     | 19.19    | 11.75     | 2.67      | 0.91      | -7.24±1.46 |

**Table 6.** Prevalence of acute malnutrition (wasting) in male.

| Age (years) | No. | % < -3 SD | % < 2 SD | % < +1 SD | % < +2SD | % < +3 SD | Mean± SD    |
|-------------|-----|-----------|----------|-----------|----------|-----------|-------------|
| 5-7         | 88  | 29.6      | 49.3     | 56.7      | 24.3     | 9.6       | 0.67±5.1    |
| 8-10        | 101 | 5.3       | 35.2     | 40.5      | 10.8     | 2.2       | -1.82 ±4.17 |
| 11-15       | 85  | 31.7      | 112.1    | 8.2       | 0        | 0         | -4.79±4.9   |
| Total       | 274 | 6.66      | 19.66    | 10.54     | 3.51     | 1.18      | -0.73±1.41  |

**Table 7.** Prevalence of acute malnutrition (Wasting) in female.

| Age (years) | No. | % < -3 SD | % < 2 SD | % < +1 SD | % < +2SD | % < +3 SD | Mean±SD    |
|-------------|-----|-----------|----------|-----------|----------|-----------|------------|
| 5-7         | 84  | 16.2      | 64.3     | 62.7      | 3.8      | 1.9       | -1.83±5.1  |
| 8-10        | 105 | 23.9      | 47.5     | 35.1      | 0        | 0         | -2.46±4.11 |
| 11-15       | 107 | 69.5      | 77.5     | 26.9      | 13.7     | 4         | -3.13±5.63 |
| Total       | 296 | 6.95      | 18.93    | 12.47     | 1.75     | 0.59      | -0.64±1.39 |

malnutrition in male for age groups 60 to 180 months (Table 6). The prevalence of acute malnutrition (wasting) in female groups based on (< -3 SD and < -2 SD reference BMI-for-age z-scores) according to age group 60 to 180 months was 6.32 and 17.05% for severe and moderate acute malnutrition in study population (Table 7).

## DISCUSSION

About 82.3% of fathers in Dar El Salam were labourers and 0.2% were jobless, while 9.1% of mothers were labourers and 85.7% were jobless (housewives). In agreement with Majlesi et al. (2001) the better parental jobs have positive effect on nutritional status of children. In the present study, the prevalence of malnutrition was calculated using WHO Anthro Plus. The results shows

that severe and moderate chronic malnutrition (stunting) in both male and female was 4.6 and 15.25%, respectively. The prevalence of chronic malnutrition was higher in males compared to females. The prevalence of acute malnutrition (wasting) in both males and females was 6.99 and 19.19% for severe and moderate acute malnutrition. The prevalence of acute malnutrition (wasting) was higher in males compared to females.

Goon et al. (2011) found that high prevalence of both chronic and acute malnutrition was observed in 9 to 12 years old children attending public primary schools in Makurdi, which are unexpected from an urban region. However, the fact is that most of the children attending primary school in this region are from relatively low socio-economic background (Goon et al., 2011). Therefore, the low socio-economic background of these children suggests that factors such as education, occupation and economic status of parents may also account for the high

prevalence of under nutrition among our study (Goon et al., 2011). Three studies reported the prevalence of stunting 14 to 17% and wasting (25 to 32%) among school-aged children in Pakistan using the World Health Organization/National Centre of Health Statistics (WHO/NCHS) reference (Khuwaja et al., 2005).

Recent study showed that in Pakistani primary schools, 8% of children were stunted and 10% children were thin (Mushtag et al., 2011). Stunting and thinness were not significantly associated with gender (Mushtag et al., 2011). In contrast, there were 17.0% severely stunted girls as compared to 14.8% boys (Dutta et al., 2009). Wamani et al. (2007) indicated that gender differences were more marked in low socio-economic groups with boys being more undernourished, consistent with previous literature (Wamani et al., 2007). Prevalence of stunting significantly increased with age among both boys and girls ( $P < 0.001$ ) while thinness showed significant increasing trend with age among boys only ( $P = 0.034$ ) (Mushtag et al., 2011) while Dutta et al. (2009) noted that age do not show a significant relationship with stunting or wasting.

Significantly higher prevalence of stunting and thinness were found among the rural and the urban poor, the least educated, the residents of low-income neighborhoods and those having crowded houses (Mushtag et al., 2011; Dutta et al., 2009). One of the explanations could be that the boys are rarely at home, they tend to be active, running around in the neighborhood as compared to the female children who probably eat whatever small feeds that their mothers got since they are always with them at home (Onis et al., 1993). Furthermore, in Sub-Saharan Africa Wamani et al. (2007) reported that low social economic status of the parents predisposes the boy child to stunting. Indeed in the internal displaced people (IDP) camps settings, the parents/caretakers have very poor social economic status; owing to several years of deprivation, homelessness, loss of their wealth, lack of farming and employment opportunities (Onis et al., 1993). In Burkina Faso Dabone et al. (2011) reported that the prevalence of stunting was 8.8%, and that of thinness was 13.7%. Overweight was low 2.3% and affected significantly more children in private schools ( $p = 0.009$ ) and younger children 7 to 9 years ( $p < 0.05$ ). Thinness and stunting were significantly higher in peri-urban compared to urban schools ( $p < 0.05$  and  $p = 0.004$ , respectively) (Dabone et al., 2011).

## Conclusion

Study of nutritional status among children at age 5 to 15 years revealed with a high prevalence of malnutrition among the children. More research was needed to determine the nutritional status of children and made proper intervention to improve nutrition status. Enhancement of the social and economic progress of the

people is needed for example, by increasing household income and employment opportunities for better jobs.

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