ANTHROPOMETRY AS AN INDICATOR OF NUTRITIONAL STATUS IN SUDANESE PREPUBERTAL SCHOOL CHILDREN (6-9 YEARS) AT ALFITAIH VILLAGE, KHARTOUM, SUDAN, SEPTEMBER 2014


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ABSTRACT

Objectives: To determine the prevalence of malnutrition (wasting, stunting, underweight and obesity), to assess the nutritional status of children using triceps skin fold thickness, to calculate total body fat percent for children, and to identify the socioeconomic status of households in the study area. Methodology: A total of 94 children from two basic schools were selected using stratified random sampling, Anthropometric measurements (weight, height and skin fold thickness) were recorded for each child according to WHO protocols. Scientific questionnaire was designed to collect information about families. Total body fat percent was calculated using Jackson and Pollok three site skin fold formula. Data was analyzed using SPSS version 20 and WHO anthro plus version 1.0.4. Results: Girls were 54, and 40 were boys. In 50% of families the income was between 1000-1500 SDG which is equivalent to 100-150$ Per month. About 63% of fathers were non-skilled labourers and 84% of mothers were housewives. For all children the prevalence of underweight was 22.34%, while obesity was 2.13%. Stunting prevalence was 23.15%. BMI was normal in 65.96% but 26.6%, and 2.13% had mild to moderate decrease in BMI (< -1 SD and < -2 SD) respectively. Triceps skin fold thickness measurements had shown that only 53.3% were between the 5th and 90th percentile according to national health and nutritional examination survey III (NHANES III) percentiles. Total body fat percent was normal in 44.12% only. Conclusion and recommendations: The study revealed high prevalence of under nutrition of different types and intensities; more research is needed by health authorities to determine the magnitude and causes of malnutrition in school children.
INTRODUCTION

Definitions: Malnutrition: Oxford Advanced Learner's Dictionary defines malnutrition as: a poor condition of health caused by a lack of food or a lack of the right type of food[1]. The United Nations Children's Fund (UNICEF) defines malnutrition as: a broad term commonly used as an alternative to under nutrition but technically it also refers to over nutrition. People are malnourished if their diet does not provide adequate calories and protein for growth and maintenance or they are unable to fully utilize the food they eat due to illness (under nutrition). They are also malnourished if they consume too many calories (over nutrition).[2]

Wasting: Moderate and severe - below minus two standard deviations from median weight for height of reference population. [3]

Stunting: Moderate and severe - below minus two standard deviations from median height for age of reference population. [3]

Underweight: Moderate and severe - below minus two standard deviations from median weight for age of reference population; severe - below minus three standard deviations from median weight for age of reference population. [3]

Anthropometry, a means of assessing malnutrition, encompasses a variety of human body measurements, such as weight, height, skin fold thicknesses and circumferences. [4]

It is estimated that over 46% of people in Sudan are under the poverty line according to the last government release, while the cost of living is very high. This is more marked in rural areas. Therefore it is needed to investigate the prevalence of under nutrition in children in rural areas. Both under nutrition and over nutrition as well as imbalanced diet can lead to significant health problems in such children.

Objectives: To determine the prevalence of malnutrition(wasting ,stunting, underweight and obesity) , to assess the nutritional status of children using Triceps skin fold thickness, to calculate total body fat percent for children, and to identify the socioeconomic status of households in the study area.

Methodology: A cross-sectional community-based descriptive study was done at the middle part of Alfitaih village which is a sizable village about 23 km south of the center of
Khartoum. There are two basic schools, one for girls and the other for boys. The total population in this study was 240 pupils aged 6-9 years; 100 boys and 140 girls.

Stratified random sampling technique was used. The sample size was calculated using this formula

\[
 n = \frac{NZ^2P(1-P)}{Nd^2 + Z^2(1-P)}
\]

\(n\) = Sample size  \(Z\) = Standard error  
\(N\) = Study population  \(d\) = confidence level 5% (0.05)  
\(P\) = prevalence (0.5).

The required sample size is 91.4

A total of 94 children were selected. Nearby percentages were taken from different age groups according to the total of each group.

Anthropometric measurements (weight, height and skin fold thickness) were recorded for each child according to WHO protocols. Tools used were: questionnaire, height scale, electronic weighing scale, and digital skin fold caliber. Consent of the parents was taken.

Triceps skin fold thickness was converted to anthropometric indices using NHANES III percentile charts. Also Skin fold thickness was used to calculate total body fat using Jackson and Pollok three site skin fold formula.

These sites differ between males and females. In males: chest (Diagonal fold, midway between upper armpit and nipple), abdomen (Vertical fold, one inch to the right of navel), and thigh (Vertical fold, midway between knee cap and top of thigh) skin folds were measured. In females: triceps (Vertical fold, midway between elbow and shoulder), supra-iliac (Diagonal fold, directly above iliac crest), and thigh (Vertical fold, midway between knee cap and top of thigh) were measured.

Data was analyzed using SPSS version 20 and WHO anthro plus version 1.0.4. And the results were displayed in tables, and figures.
RESULTS
The total number of children was 94, 54 females and 40 males. About 63% of fathers were non-skilled labourers and 84% of mothers were housewives. In 50% of families the income was between 1000-1500 SDG, and 17.02% of households had income below 1000 SDG.

By using weight for age z scores (WAZ) 22.11% of all children were underweight with no marked gender variations (figure 1), while obesity was 2.5%. The prevalence of stunting according to height for age z scores (HAZ) was higher in females (24.07% and 3.70% moderate to severe respectively) than in males (17% and 7.50% moderate to severe respectively) (figure 2). Body mass index for age z score (BMIZ) showed that mild wasting (<-1 SD) was 30% and 24% for males and females respectively (figure 3).

In 46.7% of those children the triceps skin fold thickness (TSFT) was below the 5th percentile and it was between the 5th and 90th percentile in only 53.3% of them according to NHANES III percentiles. The calculated percentiles of TSFT of the present study were shown in table (1) for boys and table (2) for girls. The mean of TSFT for all males was 5.4 mm and 7.3 mm for females. Total body fat percent was less than normal in 56.38% of all children while only 43.62% had normal fat percent.

![Figure 1](image-url)

**Figure (1): The prevalence of underweight between males and females based on WAZ of WHO 2007 in study population**
Figure (2): The prevalence of chronic malnutrition (stunting) between males and females based on HAZ of WHO 2007 in study population

Figure (3): The prevalence of acute malnutrition (wasting) between males and females based on BMIZ of WHO 2007 in study population

Table (1): Percentiles* Values of TSFT (in millimeter) for Boys

<table>
<thead>
<tr>
<th>Age (year)</th>
<th>5th</th>
<th>10th</th>
<th>25th</th>
<th>50th</th>
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<td>3.22</td>
<td>4.30</td>
<td>5.20</td>
<td>6.80</td>
<td>7.74</td>
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</table>

*The percentiles were calculated using SPSS version 20
Table (2): Percentiles* Values of TSFT (in millimeter) for girls

<table>
<thead>
<tr>
<th>Age(year)</th>
<th>Percentile 5th</th>
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<th>Percentile 25th</th>
<th>Percentile 50th</th>
<th>Percentile 75th</th>
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*The percentiles were calculated using SPSS version 20

Table (3): Mean of TSFT (in millimeter) by age and gender

<table>
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<tbody>
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<tr>
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</tr>
<tr>
<td>8</td>
<td>5.20</td>
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Table (4): Comparison between the means of TSFT (in millimeter) of present study and other studies within the same age group for both males and females

<table>
<thead>
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<td>Bahrain</td>
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</tr>
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<td>Turkey</td>
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</table>

DISCUSSION

Malnutrition generally implies under-nutrition and refers to all deviations from adequate and optimal nutritional status in infants, children and adults. The assessment of under nutrition among infants and children in the community is best undertaken by basic and simple anthropometric measurements such as body weight, length or height and mid upper arm circumference (MUAC) and comparing them with generally accepted standards for the age.\[8\]

In our study most of fathers were non-skilled labourers, while most of mothers were housewives. Approximately half of household’s incomes were moderate, and 17.02% had low income. Babar et al.\[9\] reported that the nutritional status of children of lower socio economic class was poor as compared to their counter-parts in upper socio economic class. The inequities between the poorest and the richest population groups were marked with significantly higher prevalence of stunting and thinness among the rural and the urban poor, the least educated, the residents of low-income neighborhoods and those having crowded houses.\[10\]
The overall prevalence of under nutrition (underweight, wasting and stunting) was 47.62%. This percentage is seriously alarming. It is approximately similar to findings of Taha et al \[4\] study at Dar Elsalam (a suburb of Khartoum populated by low income families) which revealed that 46.03% of studied children were under nourished. It is lower than results of Fatima \[11\] at Khartoum which revealed a prevalence of 64.8% in studied children, and also lower than that of school children in India as reported by K Bose \[12\] which was 57.2%.

Approximately one fifth of children were underweight (moderate to severe) with no marked gender variations (figure1). Fatima \[11\] found that more than one third of studied children were underweight. In India only 16% were underweight as reported by K Bose.\[12\]

Regarding HAZ the prevalence of stunting for all children was similar to underweight (figure 2). Higher percentages were recorded in females (7% more than males). This was different from the results reported by Taha et al\[4\] that higher prevalence of stunting was in males (more than 7% difference). This needs more investigations including parental height.

BMIZ showed that approximately one quarter of females had mild wasting (< - 1 SD). In males the prevalence was higher. This may be partially explained by that females had more prevalence of HAZ below the mean in comparison to males. Moderate wasting (< - 2SD) was very low in both males and females (figure 3). While there is a global acceptance that body mass index (BMI) should be used for assessment of obesity/adiposity in children \[13\], there has not been a similar consensus regarding use of BMI for assessment of under nutrition in children.\[14\]

Skin fold thickness measurement is another practical and valuable technique in evaluating both the nutritional status and body fat ratio. Many methods have been applied for assessment of body fat ratio. These methods are expensive and not superior to anthropometric measurements. Furthermore, some of these methods are invasive, while others have the risk of radiation exposure.\[15\]

Females had a higher mean of TSFT measurements in comparison to males. This may be due to higher physical activity in males and hence higher rates of catabolism (Table 3). The calculated percentiles of the present study showed that the 5th percentile was decreasing by age in males (table 1). In females it was decreasing by ages 6 and 7 years and increase by age 8 years (table 2). This may be partially explained by that females get more fat when progress to puberty while males lose fat.
The mean of TSFT of children in the present study was lower than that of United States according to NHANES III of the same age group. It is lower than in Bahrain children as reported by Nadia et al \cite{16}, and lower than Turkish children as reported by Yuca \cite{15} (Table 4). This can be explained by many factors. Sudanese children were chosen from low socioeconomic area, so their nutritional habits is not like that of the other three countries considered. Most of the villagers in Sudan used to walk for long distances and children usually go to school on foot beside genetic factors. NHANES III also reported higher means of TSFT in females. The same results were in Bahrain and Turkey.

Reduced subcutaneous adipose tissue is typically observed in children with chronic malnutrition.\cite{17} The results of total body fat percent showed that less than half of children had normal body fat percent with significant gender variation \( p = 0.816 \). Cameron et al \cite{18} recommended that new equations based on skin fold-thickness combinations from African children provide more accurate estimates.

**CONCLUSION AND RECOMMENDATIONS**

The study revealed a high prevalence of under nutrition of different types and intensities among prepubertal school children aged 6-9 years in the study area. Stunting was more in females. The mean of TSFT was less in males than in females.

*What is needed to overcome this problem of under nutrition among young pupils?* As under nutrition in such young children may have serious consequences on their present and future health it is necessary to address the underlying causes leading to this serious health problem by: Improving their families incomes; Educating parents to pay more attention on their children’s nutritional status; Improving school health services; Activating the nutrition departments that are found in hospitals, so as to manage under nourished and at risk children; A full study on malnutrition including a full past history of childhood diseases and susceptibility to infections; as well as complete biochemical profile; Family spacing should be advised with an optimum period of two years (the usual duration of lactation).

**REFERENCES**


