Prevalence of Thinness, Stunting and Anemia Among Rural School-aged Sudanese Children: A Cross-sectional Study

by Sarar Mohamed1,* and Mohamed Diab Hussein2,*

1Department of Pediatrics, College of Medicine, King Saud University, Riyadh, Saudi Arabia and 2Department of Pediatrics, Dongola Police Hospital, Dongola, Sudan

Correspondence: Sarar Mohamed, Department of Pediatrics (39), College of Medicine, King Saud University, P.O. Box 2925, Riyadh 11461, Saudi Arabia. Fax: 00966114672439. E-mail <sararmohamed@hotmail.com>

*These authors contributed equally to this work.

SUMMARY

Background: Nutritional status of school-aged children has an important impact on their physical and mental development. Data on anemia, thinness and wasting among school-aged Sudanese children were limited.

Aim: To determine the prevalence of anemia, thinness and wasting among school-aged Sudanese children.

Subjects and Methods: This cross-sectional study enrolled 835 primary school children aged 6–14 years, who live in Dolgo area in the northern region of Sudan. Weight and height of each child were measured and body mass index (BMI) was calculated. All measurements were plotted on the World Health Organization (WHO) height for age and BMI charts. Hemoglobin was also measured for all participants, and anemia was defined according to the WHO standards.

Results: Anthropometric measurements showed that 59 children (7.1%) were stunted and 193 were thin (23.1%). The prevalence of anemia was 29.7%. Stunting, thinness and anemia were significantly common in children <10 years of age (p < 0.0001).

Conclusions: We found a high prevalence of stunting, thinness and anemia among school-aged children in a rural area in Sudan. Our findings warrant the need to implement interventions to improve nutritional status of children in Sudan.

KEYWORDS: Anemia, stunting, thinness, school-aged children, Sudan.

INTRODUCTION

Nutritional status of school-aged children has an important impact on their physical, emotional and mental development. It also affects their school performance and academic achievement [1]. The World Health Organization (WHO) recognized the nutritional status of school-aged children as one of the important indicators of the nutrition and health of the population [2–4]. The WHO released the first growth curves for school-aged children and adolescents in the year 1997 [5]. These curves facilitate the identification of stunting (low height-for-age) and thinness [low body mass index (BMI)-for-age] [5]. While underweight is still a major health problem affecting school-aged children in developing countries, overweight and obesity are emerging as health challenges affecting this age-group in the developed countries [6, 7]. It was estimated that 171 million
children worldwide are stunted, mainly in Africa [3]. Also, one-quarter of school-aged children, worldwide, are anemic, particularly in South East Asia and Africa [3, 4].

In Sudan, most children start primary school at the age of 6 years and continue until the age of 13–14 years [8]. As Sudan is one of the poorest countries in Africa, Sudanese children suffer from many nutritional problems like anemia, thinness and stunting [9]. A previous report found that 23.6% of male and 15% of female school children in the capital Khartoum were stunted [6]. Limited data are available on the nutritional status of school-aged Sudanese children living in the rural areas. Therefore, the aim of this study was to determine the prevalence of anemia, stunting and thinness among school-aged children in a rural area in the northern region of Sudan.

MATERIAL AND METHODS

Study area and population
This study was conducted in Dolgo area in the northern region of Sudan. The population of the northern region of Sudan is 750 000 according to the recent census, with the majority living in rural areas, including 9500 in Dolgo area [10]. This area includes Dolgo town and the six villages on its outskirts. Dolgo town is located on the east bank of the river Nile, 140 km north of the capital of the region (Dongola). Most of the residents in this area are farmers while a few are laborers, employees or working abroad [8]. We selected this study area because the Dolgo town and the surrounding villages have similar socioeconomic characteristics to other areas in the region [8]. Therefore, our findings would be fairly representative of the whole region.

Educational and health facilities in the area include 11 coeducation primary schools and 2 secondary schools, one for boys and the other for girls [8]. The number of primary school children in this area is 905. There is one rural health facility in Dolgo town that is managed by only one physician.

Study design and sampling
This population-based cross-sectional study enrolled primary school children aged 6–14 years, who live in Dolgo area in the northern region of Sudan. An informed consent was taken from parents and guardians of children. The ethics committee of Dongola Police Hospital, Sudan approved this study.

All children attending the 11 primary schools in Dolgo area were included in the study. Children who failed to attend the school on the day when blood testing and growth measurements were performed, and those whose parents did not consent to participate in the study were excluded.

Data collection
The research team that included the principal investigator, two nurses, two laboratory technicians and two nutritionists collected the data. The principal investigator trained the research team members on how to perform the study. The research team visited the 11 primary schools in Dolgo area on 11 and 12 February 2014 to collect the data. Anthropometric measurements and hemoglobin level were performed for all participants.

Anthropometric measurements
Weight and height of each child were measured using stadiometer and weight scale according to standard WHO procedures [11]. Decimal age of children was calculated to the precise day by subtracting the date of birth from the date of examination using school records. BMI of each child was calculated using standard formula and plotted in the WHO BMI 5–19 years chart (WHO growth reference 2007) [5]. Also, height of each child was plotted in the WHO height for age chart [5, 11].

Laboratory methods
Capillary blood sample of 10 μl was obtained from every child, and hemoglobin level was measured immediately by using the HemoCueR system and Drapkins reagents, HemoCue AB, Angelholm, Sweden.

In this study, anemia was defined as hemoglobin level <115 g/l in children <11 years of age, and hemoglobin level <120 g/l in children >11 years [12].

Statistical analysis
The data were analyzed using SPSS, version 17 (SPSS Inc., Chicago, Illinois, USA). Frequencies and percentages were used to summarize data.
The differences between the groups were assessed using Student’s *t*-test and chi-square tests. *p*-value < 0.05 was considered significant. The WHO BMI 5–19 years chart and height-for-age charts were used (WHO growth reference 2007) [5]. Children with height $<-2$ SD in height-for-age chart were considered stunted according to the WHO growth reference 2007 [5, 11]. Also, BMI $<-2$ SD was considered thin, and $>2$ SD was considered overweight or obese [5, 11].

**RESULTS**

Of the 905 children attending all primary schools in Dolgo area, 26 were excluded from the study because their parents and guardians refused to participate. Also, 44 children failed to attend for anthropometric measurements and blood testing. Thus, 835 students completed the study (response rate of 92.3%).

Anthropometric measurements of the study group showed that 59 children (7.1%) were stunted ($<-2$ SD) and 19 (2.3%) were severely stunted ($<-3$ SD). Stunting is significantly common in children $<10$ years of age (*p* < 0.0001) (Table 2). BMI analysis revealed that 193 children were thin (23.1%; Table 1). Thinness is more common in children $<10$ years of age compared with those $>10$ years (Table 2). Also, the prevalence of overweight and obesity was 7.1% (Table 1).

About one-third of the enrolled children (248) were found to be anemic, giving a prevalence of 29.7% among the study group (Table 1). The majority of affected children had mild anemia and only four had severe anemia. It is more common in children $<10$ years of age compared with those $>10$ years (*p* < 0.0001), and in males compared with females (*p* = 0.068) (Tables 2 and 3).

**DISCUSSION**

Nutritional status of children is an important indicator of their health. We previously reported high prevalence of acute malnutrition and anemia in children $<5$ years of age living in a rural area in the northern region of Sudan [13, 14]. In the current study, we investigated the prevalence of thinness, stunting, overweight and obesity and anemia in school-aged children living in another rural area in the same region of Sudan. We used the WHO growth standard and found that the prevalence of thinness in school-aged children was 23.1% [5, 15]. This high figure indicates that about a quarter of the participants suffered from acute undernutrition. This is comparable with our previous finding among children $<5$ years of age who live in the same region [15]. Similar results were reported from Khartoum, the capital of Sudan, where the prevalence of underweight was found to be 19.6% among secondary school children (15–18 years old) [16]. In contrast, Nabag FO reported high prevalence of underweight among primary school children in Khartoum that reached 41% and stunting of 21.4% [17]. This high prevalence of acute malnutrition and stunting could be explained by the different study techniques used. Unlike the WHO standard we used in our cohort, Nabag FO used weight-for-age, height-for-age and skin-fold thickness of triceps muscle. The high prevalence of acute malnutrition observed in Sudanese
children reflects the change in socioeconomic status of residents occurred in the past three decades. This was a result of some climatic changes such as drought and floods in addition to war and displacement that may have affected the nutritional status of the enrolled children. In agreement with our results, high prevalence of undernutrition among school-aged children was reported from other developing countries (Table 4) [18–22].

In the current study, we found that the prevalence of stunting in school-aged children in Dolgo area was 7.1%. Variable prevalence of stunting was observed among primary school children in different countries (Table 4) [1, 18, 20, 22]. Stunting is an indicator of chronic malnutrition and reflects the cumulative effect of undernutrition, socioeconomic factors and recurrent infections. For these reasons, wide variations in the prevalence of stunting have been observed in different countries [1, 18, 20–22]. In our cohort, we found that stunting and thinness were significantly associated with age <10 years but not with sex. This is not surprising, as young children require a balanced diet that may not be available to achieve optimum growth, and therefore, lead to malnutrition. Contrary to our findings, a systematic review showed that boys are more stunted than girls in Sub-Saharan Africa [21]. Unlike our cohort, this systematic review recruited children <5 years of age from 10 countries that may explain the differences between the two studies. Also, our study group is homogenous, lives in small area and shares the same resources. Other factors affecting height of school-aged children compared with younger children include genetic factors, ethnicity, hormonal changes and pubertal growth spurt [2, 4, 5, 21].

The prevalence of overweight and obesity is rising, not only in the developed countries but also in resource-limited nations [7, 24]. Many factors were blamed for this rise in prevalence of obesity, including the change in dietary habits and the decline in physical activity leading to sedentary life. This results in changing the body energy balance with more intake than expenditure. We found that the prevalence of overweight and obesity in the current study was 7.1%. This is lower than the 10.8–20.5% prevalence reported in urban areas of Sudan [17, 25]. This could be explained by the readily available fast food and the more sedentary life in urban areas compared with rural.

Although nutritional anemia is among the 10 major causes of hospital admission in Sudan, data on the prevalence of iron deficiency are scanty in this country [10]. We previously reported that the prevalence of anemia among preschool children in a rural
area in the northern region of Sudan was alarmingly high at 80.4% [14]. In the present study, we found that the prevalence of anemia among school-aged children, in the same region, was 29.7%. This difference could be explained by the fact that the diet of preschool children is likely to contain low iron and other micronutrients, leading to anemia [8]. Furthermore, consumption of meat is probably more limited in younger children, and this may have contributed to the high prevalence of anemia. To our knowledge, so far there have been no published studies that investigated the prevalence of anemia among school-aged children in Sudan. However, a governmental report indicated that anemia affected almost one-third of children in Khartoum [26]. Similar findings were reported from other developing countries (Table 4) [1, 23, 27]. Measures to combat anemia in children are urgently needed in Sudan. One of these evidence-based interventions is iron supplementation. A recent systematic review investigated the role of iron supplementation in primary school-aged children [3]. This review confirmed that iron supplementation improved global cognitive scores, intelligence quotient among anemic children and improved attention and concentration. Iron supplementation also improved height and weight among anemic children. This systematic review also confirmed that iron supplementation reduced the risk of iron deficiency by 79% and the risk of anemia by 50% [3].

The current study has some limitations including the relatively small number of children enrolled and the lack of a control group. Also, the study area was small. A prospective longitudinal multicenter study is needed to validate our findings and to give an insight into the etiology of malnutrition and anemia observed.

In conclusion, we found a high prevalence of stunting, thinness and anemia among school-aged children in a rural area in Sudan. Our findings warrant the need to implement evidence-based interventions to improve nutritional status of children in Sudan and to formulate a national strategic plan for health promotion coupled with health education.

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**REFERENCES**


