Nutritional status of Yemeni schoolchildren in Al-Mahweet Governorate

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الحالة التغذوية للتلاميذ اليمنيين في محافظة المحويت

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خلاصة: تم بحث الحالة التغذوية لتسعمئة وثمانية وأربعين تلميذاً اختيروا بطريقة عشوائية من مدارس محافظة المحويت. وتراوحت أعمارهم بين 5 و18 سنة وكان متوسط العمر 10.6 ± 2.8 سنوات. ولقد وُجد أن 3.4% من التلاميذ كانوا يعانون نفاد الحديد، وأن 43.4% كانت ثخانة طيات الجلد لديهم دون المتوسط. ولقد كان نصف التلاميذ تقريباً إما مقزّمين أو يعانون نقص الوزن المزمن. وكان واحد من كل عشرين طفلاً ناقص التغذية. وكان اثنان من كل خمسة أطفال يعانون من نفاد مخزون الشحوم، وكان خُمسهم تقريباً مصابين بفقر الدم. ووُجد أن قياسات المعالم التغذوية لدى سكان الحضر كانت أعلى بدرجة يُعتد بها عنها بين أطفال الريف. وكانت مستويات الفرّيتين بالمصل أعلى بدرجة يُعتد بها إحصائياً بين الذكور عنها بين الإناث، بينما كانت متوسطات الطول في مقابل العمر، والوزن في مقابل العمر، وثخانة طيات الجلد، أقل.

ABSTRACT The nutritional status of 948 children selected randomly from Al Mahweet Governorate schools was investigated. Age range was 5–18 years with a mean of 10.6 ± 2.8 years. Among the children, 3.4% had depleted iron and 43.4% had below average skin-fold thickness. Approximately half of the children were either stunted or chronically underweight and 1 child in 20 was underfed. Depleted fat stores affected two-fifths of the children and approximately one-fifth were anaemic. Urban residents scored significantly higher on nutritional parameters than rural children. Serum ferritin levels were significantly greater among males than females whereas mean height-for-age, weight-for-age and skin-fold thickness were lower.

L'état nutritionnel des enfants yéménites dans le Gouvernorat d'Al-Mahweet

RESUME L'état nutritionnel de 948 enfants choisis au hasard dans des écoles du Gouvernorat d'Al-Mahweet a été examiné. Les âges étaient compris entre 5 et 18 ans avec une moyenne de 10,6 ± 2,8 ans. Parmi les enfants, 3,4 % avaient épuisé leurs réserves de fer et 43,4 % avaient une épaisseur des plis cutanés en dessous de la moyenne. Environ la moitié des enfants avaient un retard de croissance ou une insuffisance pondérale et 1 enfant sur 20 était sous-alimenté. L'épuisement des réserves adipeuses touchait deux cinquièmes des enfants et environ un cinquième était anémique. Les résidents urbains avaient des scores significativement plus élevés que les résidents ruraux en ce qui concerne les paramètres nutritionnels. Les niveaux de ferritine sérique étaient significativement plus importants chez les garçons que chez les filles tandis que le rapport moyen taille/âge, le rapport poids/âge et l'épaisseur des plis cutanés étaient inférieurs.

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Introduction

Iron deficiency anaemia (IDA) and protein energy malnutrition (PEM) are the most common nutritional problems worldwide. IDA is estimated to affect 800–900 million people worldwide and approximately 46% of those in developing countries [*1*]. PEM is estimated to affect 500 million children [*2*]. Undernutrition not only results in growth retardation, but also affects development and increases susceptibility to infection and disease [*3*].

In the Republic of Yemen, IDA is common among children. Karrar estimated the prevalence at 90% among the general population [*4*]. Diet is a major contributing factor to the high prevalence in the Republic of Yemen. Access to iron-rich foods is limited in poor families. Furthermore, the absorption of iron is inhibited by polyphenols in tea, and drinking tea with meals is a common habit in the country [*5*]. Parasitoses also add to the problem. Schistosomes and *Trichuris trichiura*, for example, infect 28.8% and 20.81% of children, respectively, in Al-Mahweet town and governorate (Y.A. Raja'a, unpublished report, 1998).

Preschool children have been the subjects of various nutritional surveys and studies. The 1979 national nutrition survey of the north-east governorates found that 66% of rural children and 17% of urban children were anaemic [*6*]. More specifically, 80% of children in Tihama region were anaemic, 53% in the southern highlands and 66% in the northern highlands [*7*]. Furthermore, almost all preschool children in the south-eastern governorates were anaemic in a 1982–83 study [*7*]. The 1992 Yemen Demographic and Maternal and Child Health (YDMCH) survey revealed that 73.5% of Tihama preschool children were suffering from anaemia and 16% suffered from severe anaemia [*8*].

PEM levels are high among Yemeni children. The 1996 multiple cluster survey found that 45% of children were suffering from moderate to severe stunting [< –2.0 height-for-age Z-score (HAZ)] and 38% were underweight [< –2.0 weight-for-age Z-score (WAZ)]. Furthermore, 16% were suffering from wasting [< –2.0 weight-for-height Z-score (WHZ)] [*9*].

The present study measured anthropometric and iron nutritional status of an ignored slice of the community, i.e. schoolchildren. The children studied live in one of the poorest governorates in the north-west of the Republic of Yemen.

Methods

This cross-sectional study investigated the anthropometric and iron nutritional status of schoolchildren in Al-Mahweet governorate in north-western Republic of Yemen. The children's nutritional parameters were compared by sex, residence and age.

Of 948 children of 5–18 years of age included in the study, 488 were urban residents (291 males and 197 females) and 460 rural residents (423 males and 37 females). Urban residents were selected randomly from the five schools in the town, i.e. 197 from the two girls schools and 291 from the three boys schools. Rural residents were chosen from the 58 schools of the Al-Mahweet governorate. The Adopting Education Office classifies the governorate into five areas (central, north, south, west and east) and two schools were selected randomly from each area. At each school, one class of each of the six grades was picked randomly to comprise the 460 pupils. Children were interviewed and their nutritional status was assessed by anthropometric measurements and blood measurements for haemoglobin (Hb) and serum ferritin.

All measurements were carried out for children aged 10 years or less (n = 451), whereas weight and height measurements were not taken for those over 10 years of age (n = 497) because of the lack of local standards for comparison.

Standing height was measured by stadiometer to the nearest 0.1 cm. Weight was measured using a Seca scale graduated in 0.2 kg. Triceps skin-fold thickness (SFT) was measured in millimetres using Harpendale calipers. Blood samples of 3 mL were collected from those who consented (876 children). Hb levels were measured in a drop of 20 µL of whole blood diluted in Drapkin solution and read in a battery-operated Delphi haemoglobin meter. Serum ferritin was measured for a randomly selected sub-sample of 272 children. A commercial enzyme-linked immunosorbent assay (Bio-Rad) was used. Samples were measured in duplicate for the first 100 samples until the technique was mastered. Only one measurement was made for the remaining samples. A multiscan MCC/340P reader was used to determine concentrations. Data were coded and analysed with *SPSS* release 9. *Epi-Info*, version 6.02 was also used for anthropometric analyses [*10*].

Malnutrition was judged on the basis of standard deviation below the growth standards of the United States National Center for Health Statistics (NCHS) as published by the World Health Organization [*11*]. Reference percentiles of SFT were based on the Health Examination Survey and the first National Health and Nutrition Examination Survey (NHANES) in the United States [*12*]. We used the indicators for anaemia set by the World Health Organization in 1975 [*13*]. Ages at midyear were used in the anthropometric calculations except for the age of 10 years for girls, which was calculated at the beginning of the year because the midyear reference value was not defined.

Results

Nutritional characteristics of the schoolchildren and prevalence of undernutrition

Table 1 **Nutritional parameters and prevalence of undernutrition among schoolchildren**

Nutritional parameter	No. examined	Mean ± *s*	% below recommended
Haemoglobin (g/L)[a]	876	131.72 ± 13.9	18.3
Ferritin (ng/mL)[b]	272	51.29 ± 6.58	3.4
Triceps skin-fold thickness (mm)[c]	929	6.07 ± 2.18	43.4
WAZ[d]	451	–1.91 ± 0.74	47.0
WHZ[d]	434	–0.66 ± 0.76	4.0
HAZ[d]	438	–2.24 ± 1.02	59.0

[a] *Haemoglobin indicators of anaemia set by World Health Organization 1975.*
[b] *Ferritin levels below 12 ng/mL.*
[c] *Indicators set by National Health and Nutrition Examination Survey in the United States.*
[d] *< –2 s WAZ, WHZ and HAZ calculated for age 10 years or less.*
s = standard deviation. *WAZ = weight-for-age Z-score.*
WHZ = weight-for-height Z-score. *HAZ = height-for-age Z-score.*

of both protein energy and iron nutritional status are shown in Table 1.

Severe stunting indicating chronic undernourishment (< –3 HAZ) was found in 24.1% of the children. Those who were severely underweight (< -3 WAZ) were 4.9%. This index indicates both acute and chronic undernutrition. Severe wasting (< –3.0 WHZ) affected 0.2% indicating current and acute undernourishment.

The mean Hb level for those 10 years of age or less (n = 403) was 127.4 g/L whereas that of those over 10 years (n = 473) was 135.4 g/L (t = 8.9, P < 0001). The mean serum ferritin level for those 10 years of age or less (n = 119) was 59.7 ng/mL whereas that of those over 10 years old (n = 153) was 53.8 ng/mL (t = 1.1, P = 0.26).

Associations of PEM and IDA with sex, residence and age of the child are shown in Tables 2 and 3. Mean HAZ, WAZ and SFT were found to be lower among boys than girls. On the other hand, serum ferritin was higher among male children than female (Table 3). Urban residents had higher HAZ, WAZ, WHZ, SFT and mean Hb and serum ferritin levels than their peers in rural areas.

Post-hoc Scheffe analysis of the association between age and nutritional status revealed significant differences in mean HAZ between age 5 years and age 8 years (P = 0.0023). Differences in mean WAZ favoured age 5 years over ages 6, 7, 8 and 9 years, with P-values of 0.025, 0.005, 0.009 and 0.021 respectively. Mean SFT for those 10 years of age or less (n = 440) was 5.97 mm whereas that of those over 10 years of age (n = 489) was 6.15 mm (t = 1.3, P = 0.195). Mean Hb level of those aged 9 years was significantly lower than for those aged 10 years (P = 0.025) or more (P < 0.0001). Mean Hb level for those aged ≥ 11 years was significantly greater than that of those aged 7 and 8 years also (P < 0.0001).

Discussion

The study found PEM rates that were comparable with the average rates in the least developed countries (LDC) [5]. Previous reports about PEM in Yemeni children primarily studied the problem among those under 5 years of age [4,6–9]. Unfortunately, schoolchildren have not been targeted in any previous study we found.

Our study found that more than half of the children (59%) were stunted and that almost half (47%) scored below average weight-for-age, i.e. were underweight. Wasting was found to affect 4% of the children. In addition, 43.4% of the children had below average SFT. The rates for stunting (HAZ) and underweight (WAZ) found in our study are higher than those reported in the 1996 Multiple Indicator Cluster Survey in which stunting affected 45% and underweight affected 38% of the sample [9]. This comparison might indicate worsening food access during the time between the two surveys. However, as age and area were not the same, this conclusion may not be warranted. The area in our study was confined to one of the poorest Yemeni governorates.

Our work also highlights the prevalence of below-average nutritional status and stored fat. Estimations of anaemia in our study were approximately half that reported for other developing countries [1]. Moreover, average Hb level (131.7 g/L) was found to be much better than that estimated by Karrar [4]. The present rate limits the need for intervention to only 18.3% of the schoolchildren in the area of study.

Sex differences in mean anthropometric measurements tended to favour female children with the exception of mean serum ferritin. The reason for the differences between the sexes might be physiological. It might also be that the boys in this study

Table 2 **Anthropometric measurements in relation to sociodemographic characteristics of the schoolchildren**

Socio-demographic characteristic	HAZ				WAZ				WHZ				SFT (mm)			
	No.	Mean	*s*	*P*	No.	Mean	*s*	*P*	No.	Mean	*s*	*P*	No.	Mean	*s*	*P*
Sex				< 0.0001				< 0.0001				0.395				< 0.0001
Male	278	–2.42	0.96		288	–2.04	0.69		278	–0.69	0.73		707	5.68	1.9	
Female	160	–1.92	1.06		163	–1.69	0.77		156	–0.62	0.81		222	7.29	2.4	
Residence				< 0.0001				< 0.0001				0.001				< 0.0001
Rural	217	–2.43	0.96		226	–2.08	0.68		217	–0.78	0.69		452	5.35	1.6	
Urban	221	–2.05	1.05		225	–1.75	0.76		217	–0.55	0.81		477	6.74	2.4	
Age (years)				0.016				0.001				0.129				0.097
5	17	–1.44	1.13		19	–1.27	0.91		17	–0.45	0.77		17	6.11	1.50	
6	39	–2.40	0.99		41	–2.00	0.83		39	–0.63	0.68		40	6.24	1.54	
7	107	–2.29	1.20		112	–2.01	0.80		107	–0.77	0.72		108	5.83	1.54	
8	96	–2.30	0.97		96	–1.99	0.71		96	–0.75	0.73		95	5.71	1.38	
9	80	–2.33	0.95		83	–1.95	0.63		80	–0.65	0.78		80	5.68	1.73	
10	99	–2.12	0.94		100	–1.78	0.65		95	–0.51	0.82		100	6.47	2.16	
≥ 11	–	–	–		–	–	–		–	–	–		489	6.15	2.52	

HAZ = height-for-age Z-score; WAZ = weight-for-age Z-score; WHZ = weight-for-height Z-score; SFT = triceps skin-fold thickness.
P-values are calculated by t*-test for sex and residence; one-way* ANOVA *was used for age.*
s = *standard deviation.*

Table 3 **Haemoglobin and serum ferritin in relation to sociodemographic characteristics of the schoolchildren**

Sociodemographic characteristic	Haemoglobin (g/L)				Serum ferritin (ng/mL)			
	No.	Mean	s	P	No.	Mean	s	P
Sex				0.799				< 0.0001
Male	686	131.8	13.8		242	59.0	43.4	
Female	190	131.5	14.3		30	35.6	22.9	
Residence				0.029				0.002
Rural	457	130.7	12.6		195	60.7	45.0	
Urban	419	132.8	15.1		77	45.7	31.8	
Age (years)				< 0.0001				0.68
5	15	126.5	16.2		4	87.4	55.9	
6	31	128.5	10.6		6	63.8	40.0	
7	92	126.4	14.3		24	63.6	62.7	
8	94	126.2	14.6		27	55.4	33.5	
9	80	124.3	13.9		33	60.6	53.0	
10	91	132.0	13.4		25	54.2	34.6	
≥ 11	473	135.4	12.6		153	53.8	38.1	

P-values were calculated by t-test for sex and residence; one-way ANOVA *was used for age.*
s = *standard deviation.*

spend more time in heavy leisure or work activities or that the girls have better access to food in the home.

Urban residents had better anthropometric and iron nutritional status than their rural peers. This finding indicates that poor dietary conditions exist in the rural areas where 75% of the Yemeni population lives [*14*]. The differences may be attributed to variances in food access, income, resources and services between rural and urban areas.

Nutritional status among the age groups did not exhibit a definite pattern, although, stronger indicators were noted among younger children.

In conclusion, approximately one-half of the children were either stunted or chronically underweight and 1 in 20 children was underfed. Depleted fat stores affected two-fifths of the children. One-fifth of the children were anaemic and PEM was very common in the area of study. Nutritional anaemias, however, were found to be less prevalent than expected or previously estimated. Rural residents need to be given priority in food programmes and dietary education.

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