Original Article

Assessment of Nutritional Status in Children from Eastern Sudan

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ABSTRACT

Background: Malnutrition is a very important risk factor leading illness and death in children worldwide.

Objective: The aim of this study was to assess the nutritional status and relevant haematological and biochemical parameters in school children.

Materials and Methods: Cross sectional study, was conducted in 120 (70 boys and 50 girls) school going children of 6-7 years of age, for the assessment of their nutritional status. The haemogloblin concentration (Hb%) was measured by equation method, packed cell volume (PCV) was estimated by scale of microhameatocrit reader, and mean corpuscular hemoglobin concentration (MCHC) was calculated. Serum total protein, albumin, iron, total iron binding capacity and transferrin were measured by colorimetric methods. Weight (kg) and height (cm) were measured and body mass index was calculated. Data were analyzed using SPSS version13.0.

Results: The mean values for hematological, biochemical and anthropometrical measurements were much below the normal ranges**.** The anthropometric percentile measured in the children showed malnutrition cases in 32 (26.7%) and malnutrition and underweight in 73 (60.8%) while the body mass index showed underweight in males in 23 (19.2%) and in females 11 (9.2%).

Conclusions: Malnutrition is common in our study population and was seen in 48.3 of children. It was accompanied by anaemia in 60.8 % of children.

Key words: Biochemical parameters, Hematological parameters, Anthropometric measurements, Nutritional status, Anemia.

Nutrition is defined as the qualitative and quantitative requirements of diet necessary to maintain a good health[1]. Good nutrition continues to be the corner stone for survival, health, and appropriate development. Children require adequate calories and nutrients to meet the high demands of normal growth and development[2].Nutritional requirements are carbohydrates, proteins (for essential Amino acids), fatty acids (for essential fatty acids) vitamins, minerals, water[3]. Obesity results when food intake exceeds the energy expenditure[4]. Undernutrition (malnutrition) results from deficiency in one or more of these basic nutrients and may be caused by: insufficient dietary intake, mal -absorption, poor utilization of nutrients and increased catabolism[5]. This condition is characterized by subnormal blood level of hemoglobin. It is usually the result of a chronic dietary deficiency of iron although it may also results from deficiencies of other nutrients such as protein, copper, folacin, vitamin B6, vitamin B12, vitamin C or loss of blood that has not been replaced fully[6]. Malnutrition in adults (secondary *malnutrition*) may be caused by diseases or conditions interfering with nutrient intake or their use by the body[7]. Generally, the most serious malnutrition occurs when the diet is deficient in energy and protein. Disadvantaged diets are often lacking in energy and protein, which automatically leads to deficiencies in most of other essential nutrients. Children suffering

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from energy and protein malnutrition also tend to have deficiencies of iron, calcium and other vitamins and minerals[8]. The aim of this study was the assessment of nutritional status and relevant haematological and biochemical parameters of basic school children in Kassala State, Eastern Sudan.

MATERIALS AND METHODS:

Subjects: The nature of this study was cross-sectional community based study, in which the sampling technique used was population based non-probability convenience sampling. The study was conducted in Fatuo, Subdarat and Shukrea villages, Kassala State, Sudan. 120 school going children were subjected to the study (70 boys and 50 girls) in Eastern Sudan, Kassala State, three kilometers away from Kassala town at the banks of Algash river. The age of the children ranged between 6-7 years. Prior written consent was obtained from their parents, who were also interviewed regarding their educational, economical and nutritional status. The study was approved by local ethical committee.

Anthropometric Measurements: The parameters measured were weight (kg), height (cm). From these two the body mass index was calculated as under:

$$\text{Body mass index} = \left(\frac{Wieght\ (kg)}{Height\ (m)}\right)^2$$

Laboratory Investigations: 4 ml of blood was collected from each child. The blood specimen was divided for examination into whole blood and serum. The blood was collected in heparin container for estimation of Hb and PCV. After separation from red blood cells, the serum was kept in refrigerator at 4 °C until analyzed for serum total protein, serum albumin, serum iron and total iron binding capacity. Haemoglolin concentration (Hb%) was measured by Drabkin's colorimetric method (cyanomethemolgobin formation) and packed cell volume (PCV) was estimated by scale of microhameatocrit reader. The concentration of red blood cells was measured in the given blood sample and was expressed as volume of erythrocyte, while mean corpuscular hemoglobin concentration (MCHC) was calculated using the formula:

$$\text{MCHC g/dl} = \frac{Hb \times 100}{PCV}$$

The serum total protein, albumin, iron, transferrin, and total iron binding capacity were measured by colorimetric methods (SPEKOL 11 spectrophotometer).

Statistical analysis: Statistical analysis was performed with the SPSS (version13.0) package. Summary statistics including means and standard deviations were calculated for different continuous variables. Frequencies and proportions were also calculated for selected variables.

RESULTS:

Table (1) shows the distribution of student from various villages (fatou, subdarat and shukrea) included in this study.

Table (1): Sources of study subjects

School	Number of Subjects	%
Fatou	40	33.3
Subdarat	44	36.7
Shukrea	36	30.0
Total	120	100

Table (2): Age groups of study subjects:

Age group (months)	No of subjects	% of total
72-75	35	29.2
76-78	11	9.2
79-81	4	3.3
82-84	70	58.3
Total	120	100

Table (2) shows the age groups of children included in this study in months. The majority of children were between the age group of 82-84 (72-75 %), 70 (58.3%), 35 (29.2%) respectively in each of the villages. Anthropometric parameters are shown in table (3) for 120 school children of age 6-7 years. The mean values ± SD of

anthropometric parameters measured were 18.171 ± 2.528 kg, 113.01 ± 7.236 cm, and 14.282 ± 1.943 kg /m^2 for weight, height, and body mass index respectively**.**

Further as shown in table (4), the body mass index of 85.8 % of the children was less than 16 kg/m^2, which was considered as severe underweight according to cut-off-point recommended by (WHO, 1995)[9]. Our results revealed that 1.7% of the children were having mild thinness, 10.8% had moderate thinness while 85.8% had severe thinness**.**

Table (3): Status of studied children according to anthropometric percentile (weight – for – age and height – for – age).

Anthropometric measurement	Males					Females				
	<5th	5th	10th	50th	90th	<5th	5th	10th	50th	90th
Weight (kg) W/A	10	20	6	3	1	11	10	2	3	3
Height (cm) H/A	6	14	5	2	3	5	6	10	6	4

Table (4): Body mass index categories of the studied children

BMI value	Number of subjects	% of total
≥18.5	2	1.7
17- 18.49	2	1.7
16- 16.99	13	10.8
<16	103	85.8

The mean value ± standard deviation of Hb, PCV, MCHC, serum total protein, serum albumin, serum iron, total iron binding capacity and transferring saturation are presented in table (5).

The distribution of parents according to education, occupation and monthly income level is presented in table (6). The highest ratio of illiteracy was recorded among mothers with 98.3% whereas 65% of fathers were found to be illiterate, whereas the highest score of primary and Khalwa graduates were recorded among fathers (15.8, 12.5), respectively. The occupation of children's fathers in the study samples showed that the majority were labourers (63.3%), and the remaining were farmers (18.3%), merchants (10.8%), those working abroad (4.2%), and government employees (0.8%). While the majority of mothers were house wives (99.2%) as shown in table (6). The level of income gained by children's parents revealed that the monthly income of most of the fathers was between 5000 Sudanese Dinar (SD) to 20000SD (65%). As regards to the social status of the parents, among the total of 120 children, only 2.5% of children were found to have separated parents as shown in Table (7).

Table (5): Showing Biochemical and Hematological parameters (mean ± SD) among the studied group

Parameters	Study population R=120
Hb	9.9 ± 1.6 g/dl
PCV	30.16 ± 4.8 %
MCHC	33.2 ± 1.09 g/dl
Serum total protein	7.01 ± 1.14 g/dl
Serum albumin	3.9 ± 0.49 g/dl
Serum Iron	65.8 ± 11.3 mg/dl
Total binding capacity	382.2 ± 34.5 mg/dl
Transferrin	17.5 ± 4 %

DISCUSSION:

This study recorded higher levels of malnutrition (58- 48.3% underweight) compared to the previous work in Sudan in a unpublished thesis by Mohamed FB in 2002, where 12.8% were undernourished of whom 7.3%, 3.7% and 1.8% were stunted, underweight and wasted respectively. However our result compared to that reported by Elbushra and Eltom in 1988[10], where 55% of them were stunted our result recorded lower level of malnutrition, in comparison with data reported by Federal

Table (6): Showing the Parent's education, Occupation and monthly Income

Parameter	Father		Mother	
	No.	%	No.	%
Parents education				
Illiterate	78	65	118	98.3
Khalwa	15	12.5	1	0.8
Primary	19	15.8	1	0.9
Intermediate	4	3.3	0	0
Secondary	1	0.8	0	0
Deceased	3	2.5	0	0
Total	120	100	120	100
Occupation				
Laborers	76	63.3	1	0.8
Farmer	22	18.3	0	0
Government employee	1	0.8	0	0
Merchants	13	10.8	0	0
Working in abroad	5	4.2	0	0
Deceased	3	2.5	0	0
House wife	0	0	119	99.2
Total	120	100	120	100
Income in dinars / month				
Class1(>26000)	36	30	0	0
Class2(25000-21000)	3	2.5	0	0
Class3(20000-11000	39	32.5	0	0
Class4(10000-5000)	39	32.5	0	0
Deceased father (income of mother below 5000)	3	2.5	3	0.8
No income	0	0	117	99.2
Total	120	100	120	100

No: number of subjects.

Table (7): Social status of parents of the studied children

Parents separation	No.	%
Yes	3	2.5
No	117	97.5
Total	120	100

No: number of subjects

Ministry of Health National Nutrition Department in Algadarif State[11] where, 14.6% of the samples were under nutrition, our result recoded high score of malnutrition. In comparison with data reported by Abdullah in 2003[12] where 63.5% of the samples were stunted our result recorded low level of malnutrition. In comparison with those reported by Abou-zeid et al in 2006[13] in Kingdom of Saudi Arabia where 14.2% of the children were underweight and 12.2% were stunted, our results recorded higher levels of malnutrition.

This study illustrates that 60.8% of the children had hemoglobin level below 11 g/dl and 0.8% had hemoglobin level less than 7 g/dl, indicates higher anemic cases than that reported by Mohamed in 2002 in El-Shagalwa Village, River Nile State, where 4.03% had hemoglobin level lower than 11 g/dl (unpublished M.Sc thesis submitted on Assessment of nutritional status of (6-7 years) aged primary school children at El-shagalwa village in Shendi province River Nile State, Gazira, Wad Madani, Sudan, to University of Gazira Wad Madani Sudan). The domino effect reported by Abdullah in 2003[12] where 56.5% of the children had hemoglobin level less than 11g/dl, our research outcome says that anemic children of 60.8% is lower than

our study. Comparing our result to that recorded by Suleiman in 1995 (Unpublished M.Sc. thesis on the role of health education and nutrition education in control of iron deficiency anemia and its complications in school children (6-14) years in Rahad Area in Sudan submitted to University of Gezira) at El-Rahad Rural Council, Butana province where 63% were recorded as having hemoglobin level less than 11g/dl, our result recorded lower level of anemic cases (60%), whereas comparing the data reported by Abou-zeid et al in 2006[13] where the prevalence of anemia was 11.6% in Saudi school children living at high altitude, are lower than that recorded by us in the present study.

We observed that the educational level of parents had an effect on nutritional status of their children. This may explain the importance of education in improvement of nutrition education to achieve the proper feeding for proper growth and health keeping in children. The nutritional status of children was greatly influenced by the occupation of their fathers. There was an association between the occupation of fathers and malnutrition. Most of the malnourished children fathers were laborers and had low income. 99.2% of mothers were housewives. This aggravates the cause of malnutrition. Working mothers contribute to improvement of their family income and reduced food shortage and malnutrition. Moreover, educated working mothers improved the quantity and quality of the diet. There was significant association between nutritional status of children and their family size. This explained the absolute dependence of many individuals on their father's occupation. In poor communities this aggravates the cause of malnutrition and food shortage. The parent's separation showed no effective association between nutritional status and child's parents separation. The studied children were selected from Fatou Village in Kassala State, Sudan. The major food stuff consumed daily in this area was Kissra (a traditional Sudanese recipe for a classic accompaniment of fermented rye and wheat flour that's fried), milk, rice, legumes, bread and dates. The weekly consumed diet contained vegetables and legumes, while the monthly consumed diet contained meat, fish and sweets. This village (Fatou) the study area suffers from many problems. It is surrounded by displaced people and contains only one simple medical center in addition to poor environmental situation in rural Kassala.

CONCLUSION:

This study revealed low level of the following parameters (lower than the normal level) Hb, PCV, TIBC, transferrin saturation. 60.8% of the children were suffering from moderate anemia according to WHO (1995). Comparison of the anthropometric parameters measured with reference values of National Center for Health Statistic showed that 58(48.3%) were underweight, 11(9.2%) were stunted and 4(3.3%) were wasted. Poverty, low educational level of their parents, occupation of their parents, more number of children per parent, non availability of resources and inadequate facilities are some of the factors considered for such a huge proportion of children being malnourished. We suggest that these problems can be solved by educating the parents, providing better medical facilities and good nutritious meals to the school going children.

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