Nutritional Status of Children Less Than Five Year Old Suffering Anemia and Night Blindness in Khartoum State, Sudan

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Abstract

This work investigates nutritional status of children less than five year old suffering anemia and night blindness in Khartoum State with particular emphasis to three central children hospitals in Khartoum, Khartoum north and Omdurman. The sample size was 138 children determined by 10% rate of prevalence of nutritional deficiency diseases among children living in Khartoum State, and distributed proportionally according to the number of children suffering these two diseases in each hospital. In addition, hemoglobin and anthropometric measurements were done. Results depict that, physical symptoms of anemia are loss of appetite (87.7%), paleness (93.5%), exhaust, and eating clay (29%), while for night blindness they were xerophthalmia (20%); Pinot spots (52%); karatomalacia (12%), and Cornea ulceration (4%). Acute malnutrition constituted 63% of cases of children suffering anemia and night blindness. Children suffering anemia and night blindness distributed among different age groups have very low percent of hemoglobin concentration below 60% standard, confirming for prevalence of Iron deficiency anemia. Malnutrition was highest among children aged 1-3 year old, and females are less malnourished compared to males. There was low energy (calories), Iron and Vitamin A levels of intake among these children. Some recommendations were suggested to reduce anemia and night blindness among children in Khartoum State.

Keywords: *Anemia, night blindness, malnutrition, Khartoum State*

Introduction

Nutrition deficiency diseases are worldwide spreading. In Sudan, one child out of ten dies before completing five years due to these diseases (UNICEF, 2008). Malnutrition due to micro nutrients deficiency (hidden hunger) represents the most prevailing form of nutrition deficiency diseases where more than two billions are suffering from it in the world; in addition to more than 250,000 children are affected by night blindness every year and more than half dies approximately (UNICEF, 2008). In Sudan, the estimated rate of prevalence of hidden hunger is 4.8% while the rate of anemia (iron deficiency anemia) for children less than five years old is about 55.1% (National Ministry of Health, 2008; World Health Organization, 2009). In Khartoum State, anemia due to Iron deficiency is distributed as 76% in Khartoum town, 75.3% in Khartoum north town, and 23.9% in Omdurman town (National Ministry of Health, 2008; World Health Organization, 2009). However, nutritional deficiency diseases as causes of death during early childhood, have contributed by around 51% among overall causes of death during this period (UNICEF, 2008).

Areas nutritionally insecure in Sudan include rural areas of low crop and animal production; areas of low purchasing power and education and knowledge; and areas of low access to health facilities, in addition to areas with low access to water especially during dry season (Cambrez et al., 1998; FAO/WFP, 2006). Nutrition insecurity leads to protein – energy malnutrition. Nutrition status is measured directly by dietary surveys, biochemical data, and anthropometric and clinical examination methods. While food adequacy is necessary for a household to achieve nutrition security, but it is not in itself sufficient. This is because some other key contributors to good nutrition are also important, such as poverty reduction, female education and a healthy environment.

This paper objects to investigate nutritional status of children less than five year old suffering anemia and night blindness in Khartoum State and to propose some recommendations to reduce their incidence.

Methodology

Data collection

The fieldwork took place in February 2009 through to February 2012 in central pecialized children hospitals in each of the three towns, including Ga'far Bin Oaf Hospital in Khartoum, Child Emergency Outpatient of Omdurman Hospital, and Ahmad Grasim Hospital in Khartoum north. A questionnaire was designed to collect relevant nutritional data of children suffering anemia and night blindness, as well clinical data on symptoms of anaemia and night blindness. To estimate the sample size, based on that rate of prevalence of nutritional deficiency diseases in Khartoum State which is 10% (Khartoum State, Ministry of Health 2009), the following formula is used:-

$$n = \frac{Z^2 Pq}{d^2}$$

n = sample size; Z = 1.96; P = prevalence rate of nutritional deficiency diseases; q = 1 – P; d = 0.05

The 10% prevalence rate of nutritional deficiency diseases in Khartoum State is used to get q which gave 138 individuals, as follows:

$$n = \frac{(1.96)^2 \times (1 - 0.1)}{(0.05)^2}$$

$$n = \frac{3.8416 \times (0.9)}{(0.05)^2} = \frac{3.8416 \times 0.9}{0.0025} = 138$$

To determine the share of each Hospital from this sample size, the equation of distribution in proportion to size of population (children suffering nutritional deficiency diseases) in each hospital is used, as follows:

Cases of malnutrition in Khartoum (15628 = $\frac{100 \times 15628}{49003}$ =32

Cases of malnutrition in Khartoum north (12602) = $\frac{100 \times 12602}{49003}$ = 26%

Cases of malnutrition in Omdurman (20773) = $\frac{100 \times 20773}{49003}$ = 42%

The total cases of malnutrition in Khartoum State = 49003
The share of each town (hospital) of the sample size is determined as:

Khartoum = $\frac{138 \times 32}{100}$ = 44

Khartoum north = $\frac{138 \times 26}{100}$ = 36

Omdurman = $\frac{138 \times 42}{100}$ =58

Before conducting the fieldwork, anemia and night blindness were determined by testing blood samples of the sick children which is executed by Technicians working in each of the three hospitals, and by one of the authors. In addition, files of sick children were used. Symptoms of anemia and night blindness were specified by Doctors during their routine rounds in the hospital. Following that, the questionnaires were filled with mothers of the sick children whom were chosen purposively. Hemoglobin measurement was done by Colorimeter, by taking 20 micro millimeter of the blood of the 138 sick children in a test tube, and 4 milliliter of Drabakin was added with 14.8 15 gram/deciliter concentration and fully mixed, left for five minutes to be read by Colorimeter. This gave that: Hemoglobin gm/Deciliter X 6.8 (constant factor) = Hemoglobin %

Anthropometric measurements are done using Salter's scale to measure weight versus age for all the 138 children to determine their nutritional status. The nutritional status index of weight versus age is a quick and accurate method to determine the nutritional status of children less than five year old.

The evaluation of the nutritional status of children less than five year old was done using tables of estimation of rate for children less than five year old which is published by World Health Organization. The most indexes used to measure body to estimate nutritional status is weight for age index. Taking the measurement of weight is easier compared to measuring height and enable for more precision. Therefore, this measure is used into observing gradual growth in body volume and organs and helps into detection of early malnutrition.

Food weight measurement was also done which weights for 3 kilograms (electronic scale) to measure the amount of food consumed during the day. To determine average of energy, protein, iron and Vitamin consumed relative to the size of the household, children under study were divided into age groups including less than one year, 1-3 years, and 4-6 years; and -1 year + 1-3 years, -1 year + 4-6 years, (1-3)+(4-6) years and another age group including all age classes of 1 year + (1-3) + (4-6) years. This classification facilitates comparison between food consumption according to age groups of children less than five year old. Nutrients intake were calculated using food composition

tables for population in Sudan, provided by Sukar (1985). Conditions for rejection included all children transferred from other States of Sudan hospitals during fieldwork, and the study has restricted to those who live permanently in Khartoum State during the time of fieldwork. The data was statistically analyzed to calculate frequencies, percentages and Chi – square test.

The Study Area

Khartoum States consists of the three towns of Khartoum, Khartoum north and Omdurman (Fig.1). Rate of population increase in Greater Khartoum was 4.92 in 1956, 7.76 in 1973, 8.75 in 1983, and 13.7 in 1993 (MFEP 1956–1993). The number of persons per square kilometer was 55.6 persons in 1973, 85.5 in 1983 and 169 in 1993. In addition Khartoum state accepted 39% of internal migration of the country in 1983 and 45% in 1993 (MFEP 1956 – 1993). This population increase is reflected in the expansion of informal squatter areas (El Bushra, 1995) and consequently higher demand for public services.

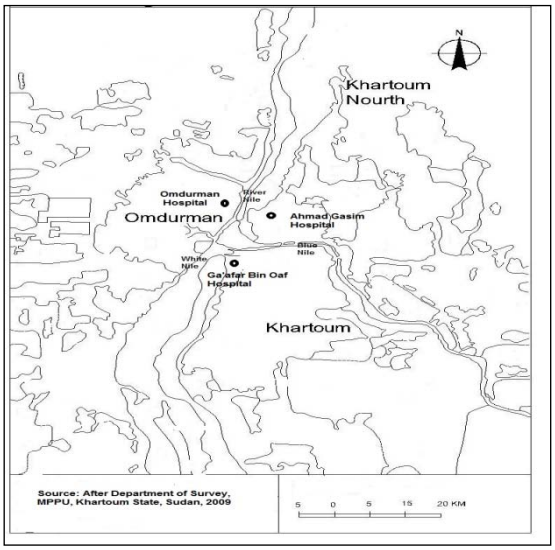

Fig.1. location of the three hospitals under study in Khartoum State

Results

Symptoms of anemia and night blindness

Physical symptoms of anemia are loss of appetite (87.7%), paleness (93.5%), exhaust, eating clay (29%) and snow (2.9%). The symptoms of night blindness are night blindness (12%); xerophthalmia (20%); Pinot spots (52%); karatomalacia (12%), and Cornea ulceration (4%). Hemoglobin measurement for children suffering night blindness (Table1) revealed that children aged 1-3 year old have less hemoglobin concentration compared to those aged less than one year and 3-5 years old who have equal concentration of hemoglobin. This means that children aged 1-3 year old suffers Iron deficiency anemia compared to the two other two groups. This contrasts children suffering anemia, where children aged 1-3 and 3-5 year old are almost have equal concentration of hemoglobin which exceeds that for children aged less than one year old who might differ

significantly than the previous two age groups. This means that, children -1 year old are more anemic compared to those aged 1-3, and 3-5 year old. The general striking feature of distribution of night blindness and anemia among these three age groups is that, each age group has acquired ⅓ of incidence of a disease and the differences might be quite minor. The distribution of children suffering night blindness by sex by percent of hemoglobin concentration (Table 1) depicts males to have higher level than females, which is also applicable to anemia. However, the differences might not be significant. Children suffering anemia and night blindness distributed among different age groups have very low percent of hemoglobin concentration below 60% standard, confirming for prevalence of Iron deficiency anemia.

Table 1: Hemoglobin range measurement (%) among childrensuffering anemia and night blindness by age and by sex

Age / sex	Night blindness		Anemia	
	frequency	%	frequency	%
-1 year	3	37	31	32.2
1-3years	18	34.8	73	38.8
3-5 years	4	37	9	39.1
Males	60	43.5	15	10.9
Female	53	38.4	10	7.2
Total	113	81.9	25	18.1

Anthropometric measurements

Table 2 depicts state of malnutrition as indicative by weight of children. Acute malnutrition prevails with significant difference than the other three types of malnutrition shown in the table. The difference between normal and simple types of malnutrition is quite small. Acute malnutrition is a reflection of low nutritional status which makes children vulnerable to childhood diseases. The distribution of rate of malnutrition by age groups of these children suffering anemia and night blindness (Table 3), identified the highest rate among those aged 1-3 year old, followed by -1 year old and lastly by those aged 3-5 year old. This means that acute malnutrition remarkably prevails among children aged 1-3 year old, and significantly differ than the other two age groups, and furthermore, the difference between children aged -1 year old and children aged 3-5 year old is more than doubled. The distribution of malnutrition by sex by age distinguishes males first and then females. Females and males aged 1-3 year are most suffering. However, females are generally less malnourished than males with difference of 8.6% between them (Table 3).

Table 2: malnutrition among children less than 5 year old in Khartoum State

Malnutrition state	frequency	%
Normal	11	8.0
simple	13	9.4
Medium	27	19.6
Acute	87	63.0
total	13	100.0

Table 3: Malnutrition by sex by age

Age / sex	sex				total	
	Males		Females		frequency	%
	frequency	%	frequency	%		
-1 year	18	13	16	11.6	34	24.6
1-3years	47	34.1	43	31.2	90	65.3
3-5 years	10	7.2	4	2.9	14	10.1
total	75	54.3	63	45.7	138	100

Nutritional status of mothers during pregnancy and lactation

Table 4 depicts types of food intake during pregnancy and lactation. During pregnancy, mothers used to consume vegetables, fruits, milk, cereals, meat, and legumes abundantly. They also depend on porridge with sauce; salad and yogurt which are connected with likes and dislikes of pregnant women. Lactating mothers largely depend on vegetables, legumes, meat, cereals, milk, and fruits + sweet porridge which are nutritionally valuable providing protein, energy, iron, minerals, and vitamins. There is no noticeable difference in food types during pregnancy and lactation, except the introduction of sweet porridge. Sweet porridge is a mixture of cereals, sugar, oil, and ghee which activates producing much milk for lactating children. Traditional porridge is made by boiling cereals (*Dura* or *Dukhn*), and usually taken with sauce or milk. Sauce is a mixture of vegetables, meat, oil, and spices. In addition, cereals are fermented and cooked to produce traditional bread (*Kisra*).

Table 5 depicts that, the majority of mothers did not take preventive or curative doses of Vitamin A during pregnancy. This situation is somehow reversed concerning Iron and Fevol. Folic acid recorded the worst position among these four protective elements. This makes mothers and new born infants vulnerable to many childhood diseases. However, this situation might be milder when putting into consideration that 61% of the mothers have been vaccinated, 32% partially vaccinated, and only 7% were not vaccinated.

Table 4: types of foods during pregnancy and lactation (%)

Types of foods	Pregnancy (%)	Lactation (%)
Porridge with sauce	20.3	0.0
Salad	10.9	0.0
Salad with yogurt	9.4	0.0
Vegetables, legumes, meat, cereals, milk, and fruits	56.4	18.1
Vegetables, legumes, meat, cereals, milk, and fruits+ sweet porridge	0.0	81.9
total	100	100

Table 5: Preventive and curative elements taken during pregnancy among mothers of children suffering anemia and night blindness in Khartoum State

Do you take these elements?	Vitamin A				Iron		others			
	preventive		Curative		Curative		Folic Acid		Fevol	
	frequency	%	frequency	%	frequency	%	frequency	%	frequency	%
Yes	16	11.6	4	2.9	47	34.1	2	2.9	29	21
No	118	85.5	118	85.5	91	65.9	134	97.1	109	79.0
total	134	97.1	122	88.4	138	100	138	100	138	100

Nutritional budget of children suffering anemia and night blindness

The majority of households depend on fathers (63.8%) for food provisioning, while few households depend on mothers (10.1%), or relatives (26.1%). The majority of the mothers (61.6%) perceive that breast feeding is important and prevents childhood diseases, while some others (38.4%) ignore that. However, 97.1% of the mothers used to breast feed their sick children after three days following their delivery. The average period of breast feeding is eleven months. Mothers who did not breast feed their children; have attributed that to death of a mother (25%), infection of mother with tuberculosis or psychiatric diseases (50%), or the child being sick (25%).

During the early 6 months of a new born baby, 89.9% of the mothers used to breast feed their children and give supplementary food, while few mothers (7.2%) depend solely on breast feeding, and still very few mothers (2.9%) wholly depend on supplementary food. During the second half of the first year of a child (6 - 12 months), very few mothers (0.41%) depend on breast feeding as the main source of feeding their children, while 87.7% of them combine breast feeding with supplementary food, and 10.9% give their children supplementary food only. This means that, the majority of mothers did not change their behavioral pattern of feeding their children throughout the first year of a child life. However, children prefer biscuits (14.3%), soft drinks (25.4%), and chips (12.3%), juice (9.4%), cakes (5.8%), and sweets (8.6%) as supplementary food types. This indicates to shift from traditional food types to read made food among urban households. The majority of children (63.8%) take three meals a day, 21.9% take four meals a day, 2.9% take more than four meals a day, and 11.6% take two meals a day. More numbers of meals does not necessarily mean more amounts of food given to a child as mothers have used to distribute a child meal within a day

hours. The majority of the households' members shares the same dish (84.8%), or eats separately (15.2%).

Table 6 depicts average daily intake of energy, protein, iron, and vitamin A among children suffering anemia and night blindness. From the table, children aged less than one year old ranked first in energy intake compared to other two groups of 1-3, and 4-6 year old. Taking two age groups of children together, children aged -1 year old + 4 - 6 year old ranked first and followed by those aged -1 + 1- 3 year, with very small difference between them. The general average intake of energy for the three age groups reveals low energy (calories) intake among children aged less than five year old in Khartoum State.

Taking daily protein intake by age group of these sick children, children aged less than 1 year old ranked first, followed by 4-6 year old, and lastly 1- 3 year old. Taking two age groups together, had ranked children aged -1 year old + 4-6 year old first, and those aged -1 + 1- 3 year old second, while children aged 1-3 + 4-6 came lastly. The general average intake of protein for the three age groups reveals low protein intake among children aged less than five year old in Khartoum State. Moreover, ranking daily intake of iron by age groups of these sick children puts children aged -1 year old first, 4-6 year second, and 1-3 year old last. There is slight difference in daily iron intake when two age groups of children are taken together. This is more particular to children in the age groups of -1 + 1- 3 and 1-3 + 4-6 year old. The general average of daily iron intake depicts very low level among these children. This picture is also seen when daily intake of Vitamin A is taken into consideration.

Average daily intake of energy, protein, iron, and vitamin A by age groups of children suffering anemia and night blindness had identified children aged less than one year as the most advantageous group compared to the other two groups. In addition, the general average of each of these nutrients is far below the recommended level for children to remain healthy in Arica and Sudan.

Table 6: average daily intake of energy, protein, iron, vitamin A by age among children suffering anemia and night blindness

Age groups	No.	Energy (calorie)	Protein (g)	Iron (milligram)	Vitamin A (microgram)
- 1	50	11277.7	326.5	53.6	1239.7
1-3	153	8542.3	248.7	40.0	858.0
4-6	106	9756.6	279.4	45.7	979.7
-1 + 1- 3	66	5476.0	155.5	25.7	534.4
-1 + 4-6	74	5484.3	159.7	26.5	638.9
1-3 + 4-6	176	4900.6	140.0	22.7	462.8
-1 + 1-3 +4-6	76	3715.4	106.7	17.5	366.4

Table 7 depicts average hemoglobin measurement by age groups of children by daily intake of animal and plant protein. Highest measurement of hemoglobin among children aged less than one year old is coincided with highest levels of animal and plant protein intake. This is similarly seen among children aged 4-6 year old. Taking two age groups together had ranked children aged -1 + 4 - 6 year old first, and followed by children aged -1 + 1-3 year old children, with very small difference

between them. Increasing hemoglobin is associated with increasing protein, confirming for better nutritional status of these children. However, the general average of hemoglobin, as well as the general average of both types of protein is far below the recommended levels for children to remain healthy. The fact here is that, an increase in consumption of legumes will reduce Iron absorption due to Fianite and Vitamin C which reduces blood hemoglobin.

Table 7: average hemoglobin measurement (%) and daily intake of animal and plant protein among children suffering anemia and night blindness by age groups

Age groups	No.	hemoglobin	Animal protein	Plant protein
- 1	50	39.57	111.40	215.20
1-3	153	31.60	93.85	154.90
4-6	106	33.65	98.29	181.10
-1 + 1- 3	66	19.00	48.69	106.90
-1 + 4-6	74	19.13	52.41	107.40
1-3 + 4-6	176	16.62	49.27	90.74
-1 + 1-3 +4-6	76	12.40	33.81	72.92

Discussion

The investigation of nutritional status of children suffering anemia and night blindness in Khartoum State suggests low hemoglobin rate; inadequate food intake and prevalence of malnutrition by age and sex with major and minor differences. Males suffering anemia and night blindness are more malnourished compared to females. This agrees with the fact that, generally children suffer night blindness between second and fifth year of childhood, with more emphasis to males than females, but differs concerning anemia which prevails more between 6 to 8 months of a childhood, but with more emphasis to males than females (Hassan et al., 2002). The high rate of hemoglobin concentration among children aged less than 1 year old might be attributed to more care given to a lactating mother in Sudanese culture which effectively supports neonatal period and early childhood, where relatives could supply with nutritional food types such as sweet porridge. Children aged 1-3 year old have less hemoglobin concentration and suffers Iron deficiency anemia compared to the two other two groups. This might be attributed to average short period of parities and to poverty which make the majority of Sudanese to afford living costs in situations of accelerating financial inflation. However, prevalence of breast feeding in the study area is attributed to the awareness of mothers to its nutritional value to a newborn child, and to the inherited Islamic culture which enhances mothers to breast feed their children for two complete years. It might be also attributed to the fact the majority of urban households are incapable to purchase ready made food for their children where 70 to 80% of urban population live below the poverty line (Hamid, 2000),

and also many of the mothers are mainly housewives who have devoted themselves to child bearing. However, this is supported by the fact that, during pregnancy and lactation, mothers used to consume vegetables, fruits, milk, cereals, meat, and legumes abundantly compared to less amounts of these food types during lactation.

Prevalence of low weight and malnutrition among children less than 5 years old in Khartoum State (Table 2) is almost similar to the 50 % cited by FAO and WFP for pre-2001 studies for North Kordofan state (FAO/WFP, 2006). However, it was higher than the most recent report Sudan household health survey of 42.9% (SHHA, 2006). The result was also higher than all previous studies carried out in Sudan, although it is similar to that by Al Jaloudi for children less than five years old living in poor urban Khartoum state (Al Jaloudi, 2000). In addition, the difference in malnutrition is possibly due to geographic reasons. In Khartoum State, squatter areas have expanded rapidly in recent decades, occupied by poorest people who are generally facing inadequate food intake and unhygienic residential environment (Alredaisy and Davies, 2003, Babiker and Alredaisy, 1997).

Comparing macronutrients daily intake in the study area (Table 6) with the study by Ministry of Agriculture and Forestry of Sudan (FSU, 2005) puts the study area below by that there are less protein, carbohydrates and lower energy intakes. There are less animal protein; vitamins, minerals consumed and abundant cereal are consumed. In the study area, fat and carbohydrates (calories) consumed were lower than the recommended values (Katch, 1983) and for population in Africa which is 2041.7 calories (Latham, 1997). This study agrees with Mohammed's study in Al Shigla area in east Khartoum State, which indicated to imbalanced intake of food types where legumes and cereals are abundantly consumed while meat, fish and chickens are less consumed among surveyed households (Mohamed, 1999). It also agrees with Ali's study in north state of Sudan where cereals are the main source for poor households although cereals are deficient in vitamin A, and 41% of the sample suffers vitamin A deficiency (Ali, 2005). Energy obtained by higher protein and carbohydrates intakes was more than double the value obtained by excess fat intake in this study (FSU, 2005). Cereals highly contribute to energy and protein intake in the study area, a situation similar to rural Philippines where 361g/person/day are consumed there (Florentino, 1996). Animal protein sources such as meat and milk provide less than the recommended value which is 55.3g (FSU, 2005).

Conclusion and Recommendations

The general conclusions of this study are as follows:

1- Children aged less than five year old living in Khartoum State are suffering anemia and night blindness.
2- Malnutrition and underweight are prevalent in Khartoum State.
3- Promotion of community and child nutrition is a necessity in the study area.

Based on that, some suggestions could be presented. Firstly, breast feeding should be enhanced from delivery up to six months of a child age, and should be accompanied by supplementary feeding thereafter up to the completion of two years of a child age. Secondly, more care should be devoted to qualitative and quantitative complementary feeding. Thirdly, introduction of balance diets rich in vitamin A, and Iron when a child completes six months of age, and during pregnancy and lactation is a necessity. Fourthly, nutrition education should be introduced and enhanced among mothers to accept knowledge about good child feeding. Fifthly, urban poor should be supported by appropriate socioeconomic development programs to curb financial inflation which adversely depriving this segment of the society.

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