CORRELATION OF NUTRITIONAL STATUS OF MOTHERS AND THEIR CHILDREN AGED 6-60 MONTHS

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ABSTRACT

Objectives: **This study was conducted on 152 mother-child pairs; to look for the relationship of maternal nutritional status and iron status with that of their children.**

Methods: **Anthropometric data were obtained for mothers and their children and applied to appropriate charts to estimate weight for length Z score, weight for age Z score and height for age Z score for children, and body mass index was estimated for each mother. Hemoglobin, mean corpuscular volume, serum iron, total iron binding capacity and transferrin saturation percentage were measured for 75 mother-child pairs.**

Results: **Concerning children; 30 (19.8%) have moderate and severe wasting, 44 (28.9%) have moderate and severe underweight and 28 (18.4%) were with moderate and severe stunting. Nine mothers (6%) were with underweight and protein-calorie malnutrition (body mass index ≤ 19 kg/m^2), while 62 (40.7%) were obese. There was a significant negative association between the age of the child and his/her hemoglobin level, mean corpuscular volume (P-value <0.05), serum iron and transferrin saturation percentage (P-value <0.01). The study has revealed also that there was a significant positive association between the hematological parameters of children with the hematological parameters of their mothers, P value <0.01.**

Conclusion: **The study didn't reveal a significant association between the mothers' and the children's nutritional status parameters. However, there was a highly significant association between the mothers' and the children's hematological parameters.**

INTRODUCTION

Women of child-bearing age, infants and young children are in the most nutritionally-vulnerable stages of the life cycle.[1] It is essential to link maternal health with child health and nutrition strategies. [2] Maternal malnutrition increases the risk of intrauterine growth retardation and low birth weight, and it reduces stores of some nutrients that infants need for growth and development. Intrauterine growth retardation and low birth weight increase the risks of undernutrition, and of neonatal and infant mortality. [3] Many babies are born with low birth weight and micronutrient deficiencies. Poor feeding practices during the first two years of life have immediate and often long-term negative consequences on growth and development. [4] Statistical analysis showed that current maternal weight, current maternal body mass index and infant birth weight were significant risk factors for current child underweight status.[5] Measurement of iron status is unreliable in the newborn, and maternal iron status frequently shows no correlation with neonatal iron status. However, in later infancy, infants of iron-deficient women have been shown to have poorer iron status. [6] A study from Zimbabwe has shown that maternal anemia and low birth weight are significant predictors of low total body iron in infants at 6, 9, and 12 months of age being more than three times higher in infants in the lowest total body iron quartile compared with those in the highest quartile. [7] No relationship was found between the iron status of mothers and their babies at birth. However, iron stores at birth did affect later iron status, cord ferritin being significantly related to ferritin at 6 months and 1 year but not to hemoglobin at these ages. No relationship was found between hemoglobin iron at birth and subsequent iron status. [8] This study was carried out to determine the relationship between maternal nutritional status with that of their children, the effect parental socio-demographic variables on the nutritional status of their children, and the relationship between maternal body iron status and that of their children.

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SUBJECTS AND METHODS

This is a cross-sectional study which was carried out on children and their mothers who attended two primary health care centers in Basrah city (Al-Razi and Al-Basrah primary health care centers). One hundred fifty two mother-child apparently healthy pairs were selected over a three-month period (from the first of March till the first of June 2006), the children ages ranged from 6 to 60 months (mean age 22.7±16.1months). Information were obtained from mothers through a direct interview using simple and clear language. A special questionnaire was filled out for each mother-child pair included in the study.

The following information were obtained:

Mother's data: name, age, parity, residence, employment, current marital status, and parental education levels. In addition, information that give an indirect clue to the economic status of the family were obtained including crowding index (≤3 person/room: not crowded, >3 person/room: crowded), and whether they live in owned or rented house.

Pregnant mothers or mothers with chronic diseases were excluded.

Mothers' weight and height were obtained; height was obtained without shoes. Body mass index *was calculated using the following formula:*

Body mass index (BMI) = Body weight (in kg)/ [Height (in m)] ^{2}

The obtained value was expressed as kg/ m^2.

Body mass index was classified as follows; <17 kg/m^2 protein calorie malnutrition, 17-19 kg/m^2 underweight, 19.1-27.3 kg/ m^2 accepted weight, 27.4-32.2 kg/m^2 mildly obese, 32.3-44 kg/m^2 severely obese and > 44 kg/ m^2 morbidly obese. [9]

Child's data include: name, age, sex, weight, length or height, size at birth (as perceived by the mother) and expressed as; small, average and large, birth order, birth interval, feeding method of the child in the present time as follows [breast feeding alone, formula feeding alone, breast feeding with added food, formula feeding with added food, mixed (breast and formula) feeding with added food and solid and semisolid food only].

The mothers were asked if their children had diarrhea or fever within two weeks before interview. Any child with congenital anomaly or with chronic disease was excluded.

The child anthropometric data (weight, length or height) were applied to appropriate charts; weight for length Z score, weight for age Z score, and height for age Z score which were estimated according to CDC/WHO normalized references. [10]

Obesity and overweight in children was defined as weight-for-height Z-scores as recommended by WHO/NCHS reference curves as follows: [11]

- ***> 2 SD obese.***
- ***> 1 SD overweight.***
- ***≤ 1 SD to ≥ -2SD normal.***
- ***< -2 SD wasted.***

All measurements were taken by the same person for all mothers and children.

The importance and details of the study were explained to the mothers before recruitment in the study, an informed consent was obtained before blood sampling.

Blood samples were taken from 75 mother-child pairs (49.3%) to do the following laboratory tests; hemoglobin, mean corpuscular volume (estimated by automated cell counter - COULTER® A^c.T diff™ Analyzer), serum iron and total iron binding capacity (estimated by colorimetric methods using kit Reference no. SI 257 and SI 255 from Ranox Laboratories. U.K) and calculation of transferrin saturation percentage.

The transferrin saturation percentage of each mother and child was calculated using the following formula:-

Transferrin saturation percentage = [serum iron (μmol/ l) / total iron binding capacity (μmol/ l)] x 100.

The obtained value was expressed as percentage. Maternal anemia (low hemoglobin) is defined as hemoglobin <120 g/l and child anemia (low hemoglobin) if hemoglobin <110 g/l . [12] For both the child, the mean corpuscular volume was classified as follows: 70-100 fL normal, low if <70 fL. For the mother, the mean corpuscular volume was regarded normal if ranges 80-100 and low if <80. [12] For transferrin saturation percentage was classified as follows: low if <10%, while 10%-16% was considered to be an intermediate zone with overlapping of deficient and normal individuals and if >16% was considered as normal transferrin saturation percentage.[12] For both mothers and their children the result of serum iron was regarded as normal if the value is within 10.7-31.3 µmol/l and low serum iron if the value is <10.7 µmol/ l. [13]

Statistical analysis

Data were analyzed using SPSS software. A two tailed P value <0.05 was regarded as significant. Logistic regression analysis was done for all variables to look for any independent association with child's nutritional and hematological parameters.

RESULTS

Selected demographic and clinical characteristics of the studied children

Age and sex distribution of the studied children

A total 152 mother-child pairs were included in the study. Concerning children, 77 were males (50.7%) and 75 were females (49.3%); their ages ranged from 6-60 months (mean ± SD was 22.7±16), 68.4% of them were ≤ 24 months.

Selected clinical and nutritional variables

One hundred-thirty four (88.1%) of the studied children had average size at birth. Forty-six (30.3%) of the children were breast fed with added food, 44% were weaned and on solid and semisolid diet only. Fourteen (9.2%) of the children had history of diarrhea, and 25.7% had history of fever within two weeks before interview, **Table-1**.

Table 1. Distribution of selected clinical and nutritional variables among the studied children

Variable	No. %
Birth order	
1	57 (37.5)
2-3	52 (34.3)
4-5	30 (19.7)
≥6	13 (8.5)
Birth interval (month)	
1st baby	57 (37.5)
<24	22 (14.5)
24-35	34 (22.5)
36-47	12 (7.9)
≥48	27 (17.8)
Size at birth	
Small	17 (11.2)
Average	134 (88.1)
Large	1 (0.7)
Feeding method	
Breast feeding with added food	46 (30.3)
Formula feeding with added food	38 (25)
Mixed(breast and formula) feeding with added food	1 (0.7)
Solid and semisolid diet only	67 (44)
Children with history of diarrhea within two weeks before interview	14 (9.2)
Children with history of fever within two weeks before interview	39 (25.7)

Nutritional status

Wasting; out of 152 children; 61(40.1%) had normal weight for height measurements, 61(40.1%) with mild wasting, 25(16.4%) with moderate wasting and 5(3.4%) with severe wasting. Out of 30(19.7%) children with moderate and severe wasting, out of them, 9(30%) were on breast feeding with added food, 5(16.7%) were on formula feeding with added food and 16(53.3%) were on solid and semisolid food.

Underweight; 57(37.5%) of children had normal weight for age measurements, 51(33.6%) with mild underweight, 38(25%) with moderate underweight and 6(3.9%) with severe underweight.

Stunting; 86(56.6%) of the children were stunted; 58(38.2%) with mild stunting, 24(15.8%) with moderate stunting, 4(2.6%) with severe stunting. Out of 28(18.4%) children with moderate and severe stunting, 8(28.6%) were on breast feeding with added food, 4(14.3%) were on formula feeding with added food and 16(57.1%) were on solid and semisolid food**, Table-2**.

Table 2. Distribution of the studied children according to nutritional status

Classification	Wasting	Underweight	Stunting
	No. (%)	**No. (%)**	**No. (%)**
Normal Nutritional status	61 (40.1)	57 (37.5)	66 (43.4)
Malnutrition			
Mild	61(40.1)	51(33.6)	58(38.2)
Moderate	25 (16.4)	38 (25.0)	24 (15.8)
Severe	5 (3.4)	6 (3.9)	4 (2.6)
Total	152 (100)	152 (100)	152 (100)

Maternal socio-demographic characteristics

Table-3 reveals that 144(94.7%) live in urban areas, 112(73.7%) live in owned house and 79(52%) live in crowded house. Out of the 152 children, 25(16.4%) of them belong to employed mothers and 127(83.5%) to non-employed mothers. From the 25 children of the employed mothers 16(64%) were wasted, 12(48%) were underweight and 11(44%) were stunted.Concerning non-employed mothers 75(59%) of their children were wasted, 83(65.3%) were underweight and 75(59%) were stunted.

One hundred- twelve (73.7%) children were living in owned houses and 40(26.3%) were living in rented houses. From the 112 children who were living in owned houses, 71(63.4%) were wasted, 75(67%) were underweight and 68(60.7%) were stunted. For children who were living in rented houses, 20(50%) were wasted, 20(50%) were underweight and 18(45%) were stunted.

Table 3. Distribution of selected parental socio-demographic variables

Selected socio-demographic variables	No. %
Place of residence	
Urban	144 (94.7)
Rural	8 (5.3)
Education of the mother	
Illiterate	29 (19.1)
Primary education	69 (45.4)
Secondary education	26 (17.1)
Higher education	28 (18.4)
Education of the father	
Illiterate	19 (12.5)
Primary education	63 (41.5)
Secondary education	30 (19.7)
Higher education	40 (26.3)
Live in owned house	
Yes	112 (73.7)
No	40 (26.3)
Crowding index	
Live in crowded house	79 (52)
Live in non-crowded house	73 (48)
Employment of the mother	
Employed	25 (16.4)
Not employed	127 (83.6)
Mother's age (year)	
<20	26 (17.1)
21-30	76 (50)
31-40	41 (27)
≥41	9 (5.9)
Mother's parity	
1-2	78 (51.3)
3-4	43 (28.3)
≥5	31 (20.4)

Only 36(23.7%) children were living in non-crowded houses and 116(67.3%) were living in crowded houses. From the children who were living in non-crowded houses, 23(63.9%) were wasted, 19(52.7%) were underweight and 19(52.7%) were stunted. In regard to children who were living in crowded houses, 68(58.6%) were wasted, 76(65.5) were underweight and 67(57.7%) were stunted, **Table-4**.

Table 4. Distribution of children in relation to nutritional status and selected social variables.

Variable	No. (%)	Wt/ht	Wt/age	Ht/age
Live in owned house				
Yes	112 (73.7)	71(63.4)	75 (67)	68(60.7)
No	40 (26.3)	20 (50)	20 (50)	18 (45)
Crowding index				
Live in crowded house	116(67.3)	68 (58.9)	76 (65.5)	67 (57.7)
Live in non-crowded house	36 (23.7)	23(63.9)	19(52.7)	19 (52.7)
Employment of the mother				
Employed	25 (16.4)	6(64)	12 (48)	11 (44)
Not employed	127 (83.6)	75 (59)	83 (65.3)	75 (59)

Maternal nutritional status

The weight of the mothers included in the study ranged from 40-110 kg (68.7±14.6 kg), maternal height ranged from 144-171 cm (166 ±5 cm), while the body mass index ranged from 16.65 - 48.89 kg /m^2 (26.8±5.3 kg /m^2).

Classification of mothers concerning body mass index has revealed that; out of 152 mothers, 53.3% were with accepted weight, 0.7% with protein energy malnutrition, 5.3% of them were underweight, 40.7% of women were obese; of them 28.3% were mildly obese, 11.8% were severely obese, and 0.7% was morbidly obese, **Table-5**.

Table 5. Distribution of the studied mothers according to nutritional status

Nutritional status	No. (%)
Protein-calorie malnutrition	1 (0.7)
Underweight	8 (5.3)
Accepted weight	81 (53.3)
Mildly obese	43 (28.2)
Severely obese	18 (11.8)
Morbidly obese	1 (0.7)
Total	152 (100)

Hematological parameters

Hematological parameters (hemoglobin, mean corpuscular volume, serum iron, total iron binding capacity and transferrin saturation percentage) for the mothers and their children.

Out of the 75 mother-child pairs, 18(24%) mothers and 45(60%) children were anemic, 9(12%) mothers and 30(40%) children were with low MCV, 66(88%) mothers and 45(60%) children were with normal MCV. Twenty-eight mothers (37.3%) and 51 children (68%) have low serum iron.

Correlation analysis

The association of different clinical and hematological variables with the age of studied children is presented in **Table-6.** It reveals that as child age increases his Hb and MCV decrease (significant negative association, P<0.05). In addition, there was a highly significant negative association of children age with transferrin saturation percent and serum iron, P<0.01. On the other hand, there was no significant association between child age and his nutritional status parameters.

Table 6. Correlation between selected clinical and hematological variables and age of studied children

Selected children variables	Correlation coefficient	P value
Wt/ht	0.031	NS
Wt/age	-0.092	NS
Ht/age	-0.1	NS
Child Hb	-0.195	< 0.05
Child MCV	-0.205	< 0.05
Child serum iron	-0.221	< 0.01
Child transferrin saturation percentage	-0.222	< 0.01

The association results of hematological parameters of children included in the study with their nutritional status did not reveal a significant association. In addition there was no significant association between children's nutritional status parameters and their mothers' age, mothers' body mass index and parental education level, **Table-7**. However, there was a highly significant positive association between the different hematological parameters of the studied mothers and of their children, **Table-8**.

Table 7. Correlation of hematological and socio-demographic variables with nutritional status of children

Variable	WT/HT		WT/AGE		HT/AGE	
	Correlation coefficient	P value	Correlation coefficient	P value	Correlation coefficient	P value
Hematological Parameters						
Hb	-0.012	NS	0.076	NS	0.002	NS
MCV	-0.001	NS	0.077	NS	-0.002	NS
Serum iron	0.047	NS	0.102	NS	0.064	NS
TIBC	-0.01	NS	0.085	NS	0.015	NS
Transferrin saturation %	0.04	NS	0.086	NS	0.046	NS
Sociodemographic variables						
Mother age	0.142	NS	0.092	NS	0.022	NS
Mother education level	0.07	NS	0.017	NS	0.045	NS
Father education level	0.013	NS	0.13	NS	0.114	NS
Maternal Nutritional status						
BMI	0.097	NS	0.142	NS	0.075	NS

Table 8. Correlation between the hematological parameters of the studied mothers and of their children

Hematological parameters	Correlation coefficient	P value
Hemoglobin (gm/l)	0.987	<0.01
MCV (fL)	0.987	<0.01
Serum iron (µmol/l)	0.836	<0.01
TIBC (µmol/l)	0.915	<0.01
Transferrin saturation percentage	0.786	<0.01

DISCUSSION

A more recent study in Basrah in 2007 have shown that (11.1%) of under 5 children were wasted and 14.9% underweight.[14] Higher proportion of malnutrition was seen in this study (19.7% were moderately and severely wasted and 18.4% were moderately and severely stunted). However, these figures are less than reported in a previous study in Basrah city in 2005,[15] which has revealed that 20.7% and 24.5% of children less than 2 years were less than -2 SD of weight for height and height for age respectively. These differences could be attributed to sample size, differences in age of recruited children and improvement in nutritional status in the last few years. The present study didn't show a significant correlation between the nutritional status of the mothers and of their children, a similar finding was obtained by other researchers.[16] On the other hand, other studies had confirmed a significant association between current maternal weight, current maternal body mass index and current child nutritional status. [5,17] This may be explained by that if the families were with insufficient food, all members will become malnourished. Also, malnourished mothers may be vulnerable to illnesses and may be unable to provide adequate care for young children. Although about two thirds of mothers and half of fathers were either illiterate or just literate, the study did not reveal any significant association between paternal education and child's nutritional status. This is in contrast to other studies which have confirmed a significant positive correlation between maternal educations with the nutritional status of their children.[18,19] The interaction of women's workload and health is complex and multifactorial owing to variations in the environment and socio-economic conditions. Within developing countries, women are subjected to different health stresses from economic, domestic, and agricultural work. [20] The present study has revealed that 24% of the studied mothers and 60% of the children were anemic (low hemoglobin value) and 37.3% of the mothers and 68% of the children were with low serum iron. In regard to transferrin saturation percentage, 16% of the mothers and 42.6% of the children have low values. These results were higher than anemia reported among Jordanian children (20.1% of the studied children with hemoglobin <110 g/l). [21] For mothers with anemia, the results were less than reported in Azerbaijan (516 non-pregnant mothers were analyzed, 56.8% of them were with hemoglobin value <120 g/l). [17] Exclusive breast feeding from birth till 6 months of age is the best strategy to protect against the development of iron deficiency anemia. From previous WHO studies, only 5-10% of infants in Iraq were exclusively breastfed. [22] This would partly explain the higher prevalence of iron deficiency anemia among children in this study. Other contributing factors are weaning practices and dietary patterns that may lead to iron deficiency anemia *(e.g. the early introduction of solid food coupled with shorter periods of exclusive breast feeding and delayed introduction of semisolid diet after one year of age and improper selection of dietary items).* [15]

Bread, biscuits and tea may be given as weaning food in infancy, these cereals are not fortified, and they are soaked in tea or milk and are eaten together. The phytates in bread and tannins in tea are inhibitory to iron absorption. Iron in cow's milk is poor in amount and bioavailability,[21] and several foods given as weaning food are based on cow's milk such as yogurt. The results of the study showed that there were significant and highly significant correlations between the age of the studied children with hemoglobin and transferrin saturation percentage of the children respectively, and this is similar to that found among the Jordanian children. [21] In addition there was a highly significant correlation between mothers' hemoglobin and body iron status and of their children, and this is comparable with the results obtained by Miller M F et al [7] and Azizi- Agrari et al.[23] A study from Zimbabwe has shown that maternal anemia is a significant predictor of low total body iron in infant with subsequent anemia at 6, 9 and 12 months.[7] From this study we conclude that Iron deficiency anemia in mothers and their children are highly correlated, so detection of iron deficiency anemia in one of them may lead to diagnose the anemia in the other. However, there was no significant correlation between the mothers' and the children's nutritional status parameters. Other than iron, further investigations should be done to identify the prevalence of deficiency of other micronutrients e.g. (iodine, zinc, selenium, calcium and vitamins like A, C, D, folate) for early detection and treatment of deficiency states. In addition, nutritional education is important to the whole family to improve life quality and for early detection and prevention of illnesses.

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