Risk Factors Associated with Iron Deficiency Among Children Admitted to Paediatric Emergency Unit in Erbil, Iraq

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ABSTRACT

Background and Objectives: Iron deficiency is the most prevalent and common micronutrient deficiency in the developing world today**.** The aim is to determine the iron status among 1-5 years old children admitted to emergency department for different reasons and to determine the risk factors associated with iron deficiency in these children.
Methods: a cross sectional study was carried out on a total of 106 children aged 1-5 years attended the emergency department of Raparin teaching hospital for children in Erbil from 16th of May to 16th of August 2007 were invited to participate in the study, parent were interviewed for potential risk factors of iron deficiency, blood were taken for analysis of hemoglobin, serum iron, total iron binding capacity and transferrin saturation after a verbal consent. Iron deficiency was defined as serum iron <50 microgram/dl and/or transferrin saturation (TS)<16%.
Results: iron deficiency was noted in 51.9% and 48.1% according to serum iron and transferrin saturation respectively. Male have more risk to have lower TS<16% as compared with female (OR 0.400, 95% CI 0.182-0.879) Age and tea ingestion were significant independent predictor of iron deficiency, family income associated significantly with low serum iron while pica, frequency of meat ingestion, number of sibling and weight percentile have non significant relation with neither low serum iron nor low transferrin saturation
Conclusions: : iron deficiency is important health problem in this population of children, prevalence of iron deficiency found in 1-2 year age group in this study was alarming, this suggest the need for greater efforts of prevention.

INTRODUCTION:

Iron deficiency is the most common preventable nutritional deficiency in the world especially among infants & young children in developing countries.[1] This is a concern since evidence is accumulated that iron depletion with or without anemia has detrimental effect on the normal growth & psychomotor development of children. [2-5] Development in first 2 years of life may be particular vulnerable to iron deficiency & this is the time when the most important changes in neuronal multiplication take place, this period also coincide with the peak prevalence of iron deficiency.[1,6,7] According to current WHO estimates most of the worlds population may have iron deficiency & at least 1/3(approximately 2 billions) have anemia due to iron deficiency[2] in developing countries however, the prevalence of anemia reaches & in some countries exceed 50% in one year old children. This high prevalence accounted for by the combination of limited iron stores at birth, timing & type of complementary food introduction & frequency of infection.[8] Serum iron, transport iron (measured by transferin saturation) & other haematologic

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describe the degree of iron deficiency. Iron deficiency without anemia develop as the iron store depleted & begin to impair hemoglobin synthesis, iron deficiency anemia result when the iron supply insufficient to maintain normal level of hemoglobin.[9] Many factors contributing to iron depletion & IDA in children have been identified as follows, age, consumption of red meat & history of pica. [2]

PATIENTS AND METHODS:

Study area and study population

This cross sectional study were carried out from 16th of May to16th of August 2007 at Raparin teaching hospital for children (a referral hospital serving all pediatric patient referred from clinics and all primary health care centers) in Erbil at northern part of Iraq. The study population consisted of 184 children aged admitted to emergency department due to various causes selected randomly (early morning of every working days of a week). Exclusion criteria were children whose age below one year or above five years, patient needing frequent blood transfusion or had history of thalassemia. Following verbal consent, information on demographical data were obtained from parents using a structured questionnaire which developed from reviewing of literature concerning risk factor for IDA like frequency of meat ingestion, ingestion of tea, pica, socioeconomic status, number of siblings (less than 4 or 4 or more). [10] Weight of each child were recorded and plotted against WHO child growth standards [11]and patients divided into 2 groups <15 & =>15 percentile.

Laboratory assessment

Early-morning venous blood samples were obtained from each child for biochemical and haematological screening tests. Professional staff perform venipuncture using two type of tubes one for hemoglobin estimation by Hb meter (Hb-250 / optima/ Japan) instrument using Drapkin solution and compared with standard. The blood was collected in the second tube without EDTA & kept at room temperature for 2 hr where it was allowed to clot, tests for serum iron and total iron binding capacity using Randoux kit and the result was read by spectrophotometry (Cecil CE2021) 2000 series , Transferrin saturation was calculated by s.iron / TIBC multiplied by100. In places where infectious diseases are common, serum ferritin is not a useful indicator because inflammation leads to a rise in the concentration of serum ferritin as a result of the acute phase response to disease [12] ; therefore we did not use serum ferritin estimation. Hemoglobin value <11 gm/dl was used as a cut off point for diagnosis of anemia according to WHO(1-5year age group). Levels of SI < 50 µg/dL and TIBC > 400 µg/dL were adopted as indicative of deficiency. The transferrin saturation percentage (%TSat) was obtained from the ratio between the SI and TIBC concentrations, with values < 16% considered deficient [12 ,13]

Statistical analysis

Data analyzing and calculation of *p* value was done using spss version 11.5 software, Pearson chi-square test and correlation used to examine relationship between iron parameter and demographical and risk factor variables. Pvalue ≤0.05 was considered statistically significant.

RESULT:

Parents of 184 patients aged from 1-5 years were questionnaired, excluded from study 78 cases that were lost to the study due to problem related to collection, processing & analysis of biological material.

One hundred and six children were included comprising 46male (43.4%) and 60 female (56.6%), Fifty six patients (52.8%) had anemia with hemoglobin less than 11 gm/dl (mean hemoglobin was 10.6 ±1.74 gm/dl), 10±1.97 and 11.1±1.37 for male and female population respectively. The prevalence of iron deficiency varied according to the indicator studied being 55 patient (51.9%), 51 (48.1%) and 24

total iron binding capacity >400 respectively as shown in table(1). It's important to note that only 32 patient 30.2% had both low serum iron and low hemoglobin, and 35patient (33%) had both low hemoglobin and low transferin saturation. According to age, patients were grouped into four age groups as shown in table (2) Hemoglobin was significantly lower in younger age group (12-24 month), this greater vulnerability to iron deficiency in children of lower age was also observed when the behavior of transferin saturation and serum iron were investigated showing lower values in children of younger age group when compared with those observed for children in the other age groups, although without statistical significance (p >0.05). Tables 3 and 4 shows the effects of the individually analyzed explanatory variable (factors) on the response variables. Odd ratio demonstrate that male patients exhibited a significantly greater chance of being iron deficient (TS<16%) patients with OR= 0.400(95%CI 0.182-0.879) Through risk analysis male has two time more risk than females to have <16% transferin saturation). Tea ingestion has significant influence on all parameter. Table (3) shows that 78.8% of those with low family income (<300000ID) have low serum iron. 68% of children with positive history of pica have low serum iron although it was not significant statistically. There was no significant relation between iron deficiency parameter and some variables like number of sibling, frequency of meat ingestion and weight percentile. The association between hemoglobin and biochemical parameter of transferinemia was examined by comparing the correlation between these measures (table 5). This showed that TS had highly significant correlation with serum iron and negatively correlated with TIBC in addition to significant correlation with hemoglobin, however hemoglobin poorly correlated with both serum iron and TIBC.

Table 1: Mean ±S.D of iron parameter in 106 pediatric patients

Indices	Mean ± S.D	Cutoff point	% <cutoff point
Hemoglobin	10.6±1.74	11gm/dl	52.8
Serum iron	51.66±31.7	50 µg/dL	51.9
TIBC	326.02±143.9	400 µg/dL	22.6
TS	18.88±14.90	16%	48.1

Table 2: Distribution of iron parameter in relation to age groups

	Age groups in months					
Parameter	**12-24**	**25-36**	**37-48**	**49-60**	**Total**	**P value**
Serum iron						
<50	32(58.2%)	12(21.8%)	8(14.5%)	3(5.5%)	55(100%)	0.224
=>50	23(45.1%)	11(21.6%)	8(15.7%)	9(17.6%)	51(100%)	
Hemoglobin						
<11	39 (69.6%)	10(17.9%)	3(5.4%)	4(7.1%)	56(100%)	0.001
=>11	16(32.0%)	13(26.0%)	13(26.0%)	8(16.0%)	50(100%)	
TS						
<16%	32(62.7%)	9(17.6%)	5(9.8%)	5(9.8%)	51(100%)	
=>16%	23(41.8%)	14(25.5%)	11(20.0%)	7(12.7%)	55(100%)	0.172
TIBC						
= <400	43(52.4%)	18(22.0%)	14(17.1%)	7(8.5%)	82(100%)	0.327
>400	12(50.0%)	5 (20.8%)	2 (8.3%)	5(20.8%)	24(100%)	

Table 3: Risk factor for low serum iron in 106 pediatric patients

Variable	Total No.	Serum iron<50microgram*		P value	Odd Ratio	95% Confidence Interval
		No.	%			
Gender						
Male	46	24	52.2	0.959	0.980	(0.454-2.114)
Female	60	31	51.7			
Tea ingestion						
Yes	72	45	62.5	0.001	0.250	(0.104-0.602)
No	34	10	29.4			
Pica						
Yes	25	17	68	0.065	0.416	(0.161-1.072)
No	81	38	46.9			
Family income						
<300000 I.D.	33	26	78.8			
300000-1 million	69	28	40.6	0.001		
>1 million	4	1	25			
Meat ingestion						
<2t/wk	50	24	48	0.449	0.744	(0.346-1.6)
=>2t/wk	56	31	55.4			
No. of sibling						
<4	74	42	56.8	0.127	1.918	(0.826-4.453)
=>4	32	13	40.6			
Weight percentile						
<15	43	26	60.5	0.144	1.793	(0.816-3.939)
=>15	63	29	46.0			

*** 55 patient have serum iron <50 microgram**

Table 4: Risk factors associated with low transferrin saturation

Variable	Total No.	TS <16%*		P value	Odd Ratio	95% Confidence Interval
		No.	%			
Gender				0.021	0.400	(0.182-0.879)
Male	46	28	60.9			
Female	60	23	38.3			
Tea ingestion				0.026	0.383	(0.163-0.90)
Yes	72	40	55.6			
No	34	11	32.4			
Pica					0.816	(0.332-2.002)
Yes	25	13	52	0.656		
No	81	38	46.9			
Family income						
<300000 I.D.	33	19	57.6	0.186		
300000-1 million	69	29	42			
>1 million	4	3	75			
Variable	**Total No.**	**TS 16%* No**	**%**	**P value**	**Odd Ratio**	**95% Confidence Interval**
Meat ingestion						
<2t/wk	50	25	50	0.713	1.154	(0.538-2.476)
=>2t/wk	56	26	46.4			
No. of sibling						
<4	74	38	51.4	0.310	1.543	(0.666-3.573)
=>4	32	13	40.6			
Weight percentile						
<15	43	16	37.2	0.063	0.474	(0.214-1.048)
=>15	63	35	55.6			

*** 51 patient have low transferrin saturation <16%**

Table 5: Matrix of correlation between iron associated parameter in children aged 1-5 years old who were admitted to Raparin teaching hospital for children

	Hemoglobin	Serum iron	TIBC	TS
Hemoglobin	-------	0.111	-0.092	0.247*
Serum iron	0.111	-------	-0.025	0.549**
TIBC	-0.092	-0.025	-------	-0.291**
TS	0.247*	0.549**	-0.291**	--------

*** Correlation is significant at 0.05 level**
**** Correlation is significant at 0.01 level**

DISCUSSION:

Iron deficiency and IDA have been reported as public health problem by countries of Mediterranean region for past several decades, current information available in region shows prevalence between 15% and 73% in preschool children[14], it varies widely between countries depending on definition used.[15] transferrinemia is seriously compromised in the study population. Iron deficiency were seen in 51.9%, 22.6% and 48.1% of patients according to the standards used in this study respectively, these results might explain the high prevalence of anemia 60.8% that was found in a study done in Erbil which use only hemoglobin level [16], these results are consistent with that obtained in a study done in brazil in which 62.0% had lower levels of SI and around 60.0% low% TSat [17] and in Pakistan in which 57.8% have low Tsat[18] ,our result also resemble a study done in Canada among pediatric patient in emergency unit who found 57% have possible iron deficiency[19] however it disagreed with that recorded in Iran in which the prevalence of iron deficiency was 19.7% this might be due to iron supplements, given to the pregnant mothers and their children in Fars by the Health Care Centers, free of charge[20] . The extreme variability, in terms of magnitude, of the iron deficiency and assessment parameters, when analyzed in isolation, results in the issue of the need to use more than one parameter and so offer a wide spectrum that includes transferrinemia and anemia. , From this point of view, (the inclusion of hematological parameters that assess erythrocyte morphology (MCV and RDW) and mean corpuscular hemoglobin concentration (MCHC) would be of fundamental importance for correct interpretation of the biochemical indicators). [17] These parameter not included in this study due to unavailability of Coulter machine in the hospital at time of study we analyzed different factors we higher in children 12-24 months old; and decreased as age increased (Table No.2). This result corresponds to the findings of other studies that suggest that it might be due to an increase in iron intake from different foods as age increases. [21, 22] Weaning, complementary foods and exposure to the family unit's eating patterns were the most important changes that occur in child feeding regimens in this age group.[23] Tea is a very popular dietary custom in Muslim countries and usually served with or after each meal [24], in this study tea ingestion exerted an influence on all iron parameter tested which was statistically significant (table No. 3 and 4), the same trend was observed in another study carried on in Belgium who found that there was a negative association between tea consumption and iron status among individual with marginal iron status. [25] Iron deficiency without a relation were higher among boys (in frequency) than in girls; with statistically significant difference only with Tsat a result similar to the findings of many other studies (Table 3,4).[26] The mechanism of the gender difference is unknown[20]The same result obtained by al hosani et al in abudhabi[27] , and by Parasha in Pakistan[28] Pica, the compulsive consumption of non nutritive substances occur variably in patient with iron deficiency[15], the soil contained compound that bind iron in GIT exacerbating deficiency.[29] In this study 68% of those with positive history of pica had low serum iron and 52% of them had low Tsat. This is consistent with study done by alrahim in Baghdad who found that 88% of patient had pica have low serum iron[30], and another study done by Crosby W.H. who found that pica occurs in 58% of patient with iron deficiency anemia.[31] Other factors like number of sibling, weight percentile and frequency of meat ingestion have no significant effect on iron deficiency state. This agrees with results obtained by other studies.[2,15, 21] The significant correlation between the parameters that assess transferrinemia was observed; the inverse

theoretically be explained, since, when circulating mineral levels are reduced, there is an increase in the concentration of transferrin in serum, assessed by TIBC. On the other hand, the direct relationship observed between SI and %TSat is also obvious, as its inverse relationship with TIBC. This finding is plausible since %TSat is a parameter arrived at from the relationship between SI and TIBC. This association between iron parameter and hemoglobin was also observed by Viera et al in study carried on children under 5 year old [17] In conclusion iron deficiency is important health problem in this population of children, abnormal transfirinemia was observed with rate of deficiency range from 51.9% according to serum iron <50 to 22.6% according to TIBC >400. so this indicate the need of using other laboratory tests like free erythrocyte protoporphyrin "which was not available in the hospital laboratories in Iraq at time of the study " to overcome the effect of infection on the results of tests. Age and tea ingestion were significant independent predictor of iron deficiency. The high prevalence of anemia among preschool children in underdeveloped countries has motivated the implementation of policies to combat

RECOMMENDATIONS

iron deficiency[12].

-The high prevalence of iron deficiency found in 1-2 year age group in this study is alarming, this suggest the need for greater efforts at the prevention. The practice plan is to offer screening to all children coming for immunization in the second year of life in public health center.

-Improving nutritional therapy and education programme from public health authorities of this region may help to decrease the incidence of such hematological health risk.

-Routine administration of oral iron especially to those babies with prolonged

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breast feeding to prevent IDA.

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