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RISK FACTORS OF IRON DEFICIENCY ANEMIA IN CHILDREN UNDER FIVE YEARS IN MOSUL CITY-IRAQ

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ABSTRACT
Background: under five years Anemia is most common hematological disorder in children in the globe, it is one of the major causes of death among children under five years in Iraq and the world, we do this study to assess the risk factors of iron deficiency anemia among children under five years. **Aim of the study:** is to evaluate risk factors of iron deficiency anemia in children under five years in Mosul city. **Methods:** We examine the risk factors of anemia in children under five years in Ibn-sina teaching hospital and Mosul general hospital in Mosul. This facility based retrospective case control study recruited 240 children (120 cases and 120 controls) aged under 5 years (6 to 59 months). Simple random sampling technique was used to select mothers attending the two hospitals for treating their children. Data were collected using semi structured questionnaire. **Result:** The results showed that most important risk factors of IDA are; male gender(M:F=2.07:1), age 7-24 months(45.8%), residence in rural areas is an important factor, low SECS, exclusive breast feeding for more than 6 months, late introduction of complementary food, poor dietary diversity has strong association with IDA in children. The study recommends that there is an urgent need to assess the nutritional status of preschool-age children and the mothers before and in pregnancy. **Recommendations:** IDA is a serious health problem in infant and young children under 5 years, it has serious effects on child growth and development, attention is advised for infants and young children at a higher risk of developing iron deficiency for early detection and controlling of IDA in this age group.

KEYWORDS: Iron deficiency anemia; Nutritional; Risk-factors; children under five years.

INTRODUCTION

Iron deficiency (ID): is a state in which there is insufficient iron to maintain the normal physiological function of blood and tissues, such as the brain and muscles, the more severe stages of ID are associated with anemia.[1]

Iron-deficiency anemia (IDA): is defined as hemoglobin concentration below two standard deviations (–2SD) of the distribution mean for hemoglobin in an otherwise normal population of the same sex and age who are living at the same altitude.[1]

Iron deficiency, and specifically iron deficiency anemia, remains one of the most severe and important nutritional deficiencies in the world today.[2]

IDA among young children is multifactorial,[3] IDA can result from inadequate iron intake, decrease iron absorption, increase iron demand,[4] most important risk factors include Demographic, Socioeconomic and Nutritional factors.

Regarding child age, before 24 months of age, rapid growth coincident with frequently inadequate intake of dietary iron places children at the highest risk of any age group for ID. In full-term infants, the iron stores can meet the iron requirements until ages four to six months, and IDA generally does not occur until approximately nine months of age. After 24 months of age, the growth rate of children slows and the diet becomes more diversified, the risk for ID drops. However after 36 months of age, dietary iron and iron status are usually adequate.[5]

Males infants are more risky than females, the higher IDA risk in males infants are due to higher pre- and post-natal growth rate, an increased fetal erythropoietic activity resulting in a low iron storage state.[6]

Children whose mothers older than 30 years are less likely to be anemic compared to those less than 30 years.[7] Residence in rural areas is among the most important risk factors for developing an IDA, the prevalence of anemia is higher in rural areas than in urban areas.[8]

Routine maternal iron supplementation is a vital mean in correcting the global problem of iron deficiency and preventing its negative effects.[9]

The nutritional risk factors include; micronutrient deficiencies (iron, folate, zinc and vitamin A, vitamin B12, vitamin C), dietary diversity, type of breast feeding, cow's milk consumption, age of introduction of complementary food, receiving iron and multivitamins supplementation, micronutrient deficiency is considered one of the main causes of anemia.[10]

The dietary diversity score (DDS) is a recommended valid dietary assessment indicator that has been shown to reflect micronutrient intake among young children, increased dietary diversity is associated with a higher likelihood of meeting children's recommended nutrient intake levels.[11]

Breast milk generally is low in iron, since iron store in breast milk can only sustain the child from birth to 6 months.[12]

However after 6 months of age, obtaining enough iron through breastfeeding becomes difficult, continued breastfeeding was directly associated with poor dietary diversity score and reduced hemoglobin concentration.[13]

Anemia diagnosis is classified as mild (Hb=10.0-10.9gm/dl), moderate (Hb= 7.0-9.9 gm/dl), severe (Hb<7.0gm/dl), and normal (Hb >= 11.0gm/dl) Hb levels concentration for children aged 6 to 59 months.[14]

In spite of IDA being preventable it has been caused a lot of morbidity and mortality in children under five years.[15] Moreover, the effects of iron deficiency anemia in infancy and early childhood are not likely to be corrected by subsequent iron therapy.[1] IDA has adverse effects on children, especially in the first two years of life, such as behavioral delay, reduced cognitive development (impaired learning and decreased school achievement), low immunity and low growth weight.[16]

The aim of the present study is to evaluate risk factors of iron deficiency anemia in children under five years in Mosul city, because childhood ID and IDA have a significant impact on life-long health. To detect IDA at an early age and subsequent preventive measures can help the child grow into a healthy adult.

Administrative agreement

Before commencement of the study, approvals were officially obtained from Mosul Training Center for the Arab Council for Health Specializations through a seminar. Also approvals obtained from Iraqi Ministry of Health / Nineveh Health Directorate / Center for Training and Human Development / to facilitate data collection from hospitals that were to be involved in this study.

Ethical considerations: Ethical agreement has taken from children's mothers. Children's mothers have been informed of the goals, objectives and methodology of the study before starting.

METHOD AND MATERIAL

The study was carried out in pediatric departments in Ibn-sena teaching hospital and Mosul general hospital in Mosul city, which is one of the major Iraqi provinces. As the Ibn-sena teaching hospital is the major hospital receiving pediatric patients in east Mosul and the other in west Mosul, so we can evaluate the major risk factors of IDA in Mosul city.

The study was a facility-based retrospective case control study, conducted to determine the associated risk factors of anemia among children under five years in Mosul city. The sample size for the study was 240 children aged less than 5 years (6 to 59) months, 120 cases and 120 controls and their mothers who resided in Mosul city were randomly selected. A pretested semi structured questionnaire using face-to face interview was used to obtain data from mothers on sociodemographic characteristics, dietary diversity and feeding information of child, Hb was estimated using CBC, while child present in pediatric department in these hospitals.

Study period was 7 months from 1st of January 2021 until 1st of July 2021.

Case definition: According to Hb concentration, the children were classified as cases (anemic) Hb<11g/dl, or controls(not anemic) Hb≥11.0g/dl, using the WHO cut-off for Hb concentration.[14]

inclusion criteria: Any child under five years attended Ibn sena hospital and Mosul general hospital who was anemic (Hb<11gm/dl) enrolled in the study as case after ethical agreement had taken from his mother.

exclusion criteria: Children who qualified to partake in the study but were seriously ill and required medical care were excluded. Children whose mothers did not consent to participate in the study were also excluded. Children whose mothers not present also excluded because the present person doesn't know the exact history. Children with hereditary blood diseases: thalassemia, sickle cell

anemia and (G6PD) glucose 6 phosphate dehydrogenase deficiency excluded from this study.

Data analysis: Unique codes were assigned to participants and were used for the data entry. Data were entered into Microsoft Excel16.0.13901.20198. The data was cleaned and exported to IBM SPSS Statistics 22 for analysis. Simple frequencies and percentages were used for categorical variables. Statistical significance was considered based on p-value of <0.05. Data were analyzed and presented as the frequency in tables and figures as appropriate. Pearson's chi-square test and was used to find the association between variables.

RESULTS

After collecting data orally by a face to face interview using a standardized questionnaire, the studied sample was including 50% cases and 50% controls, data were analyzed as; More than two thirds of the studied child were aged between 7 and 24 months, the largest age group of IDA cases (91.4%) was 7-24 months, while the lowest age group of IDA cases (1.7%) was <= 6 months. Males form (67.1%) of anaemic cases, females were (32.5%) of the cases. Females were (51.6%) of the controls while males were(48.3%) of controls. Majority (27.2%) of the mothers were aged between 20 and 27 years followed by 28-34 years (25.9%). Most of mothers had 1-2 children.

Table.1 Distribution of the studied sample according to demographic characteristics.

Demographic characteristic	Groups	Iron deficiency anemia frequency			Chi-square	P-value
		Cases(%)	Control(%)	Total (%)		
Child Age (months)	<= 6 month 7-24 month 25-41 month 42+ month	3(1.7%) 110(91.4%) 2(1.7%) 5(4.2%)	1(0.8%) 59(49.2%) 45(37.5%) 15(12.5%)	4(1.6%) 169(70.4%) 47(19.6%) 20(8.3%)	60.731	0.000
Gender	Male Female	81(67.1%) 39(32.5%)	58(48.3%) 62(51.6%)	139(57.2) 101(41.6)	9.043	0.002
Maternal age (years)	<=20 20 -27 28 – 35 36+	29(16.9%) 31(18%) 31(18%) 29(16.9%)	23(19%) 35(28.9%) 32(26.4%) 30(24.8%)	52(21.4%) 66(27.2%) 63(25.9%) 59(24.3%)	0.968	0.809
Parity	1-2 3-4 >4	51(42.9%) 45(37.1%) 24(20.0%)	62(49.3%) 36(32.1%) 22(18.6%)	113(47.1%) 81(33.8%) 46(19.0%)	2.158	0.340

Majority of children in the study(63%) were from rural areas and most of children suffering from IDA (48.8%) were from rural areas. Most (51%) of mothers in the study belonged to intermediate economic status (SES). Majority (42.4%) of mothers of children with IDA didn't have regular ANC visits or iron supplementation during pregnancy. Most of mothers in the study(27.6%) had secondary level of education.

Table.2 Distribution of the studied sample according to socioeconomic characteristics.

socioeconomic characteristic	Groups	Iron deficiency anemia frequency			Chi-square	P-value
		Cases(%)	Control(%)	Total (%)		
Residence	Rural Urban	84(48.8%) 36(20.3%)	69(57%) 51(42.1%)	153(63%) 86(35.4%)	4.057	0.044
Socio-economic status	low Intermediate high	70(40.7%) 42(24.4%) 8(4.7%)	13(10.7%) 82(67.8%) 25(20.7%)	83(34.2%) 124(51%) 33(13.6%)	60.805	0.000
ANC and iron supplementation during pregnancy	No YES	73(42.4%) 47(27.3%)	25(20.7%) 95(78.5%)	98(40.3%) 142(58.4%)	39.736	0.000
Education level of the mother	uneducated primary secondary collage or institute	28(16.3%) 41(23.8%) 32(18.6%) 19(11%)	19(15.7%) 22(18.2%) 35(28.9%) 44(36.4%)	47(19.3%) 63(25.9%) 67(27.6%) 63(25.9%)	17.509	0.001

Most of children had exclusive breast feeding (46.7%). Majority of children (56.7%) who had IDA where on exclusive breast feeding, while majority of controls (42.5%) where on mixed feeding. According to the present study children who were on exclusive breast feeding 2.259 times more likely to have anemia compared to controls.

Table.3: Effect of nutritional factors on iron deficiency anemia.

Nutritional risk factor	Group	IDA			0dds ratio	95% C.I	
		Case(%)	Control(%)	Total(%)		Lower	Upper
Type of feeding	Exclusive breast feeding mixed feeding formula feeding	68(56.7%) 30(25%) 22(18.3%)	44(36.7%) 51(42.5%) 25(20.8%)	112(46.7%) 81(33.8%) 47(19.6%)	2.259 0.421 0.812	1.346 0.244 0.430	3.791 0.729 1.531
Total(%)		120(100%)	120(100%)	240(100%)			

Most of children started complementary food at 10 month of age or more (50.8%). Majority of (66.7%) IDA cases had starting complementary food late (10+ months).According to the present study, children with late introduction of complementary food have 3.714 times more risk of IDA compared to controls.

Table .4 Effect of age of introduction of complementary feeding on IDA.

Nutritional risk factor	Group	IDA			0dds ratio	95% C.I	
		Case(%)	Control(%)	Total(%)		Lower	Upper
Age of introduction of complementary food	<=6 months 7-9 months 10+ months	15(12.5%) 25(20.8%) 80(66.7%)	30(25%) 42(40%) 48(35%)	45(18.8%) 67 (30.4%) 128(50.8%)	0.429 0.333 3.714	0.217 0.188 2.278	0.487 0.588 6.333
Total		120(100%)	120(100%)	240(100%)			

Most of children had good dietary diversity(53.8%), most of them from controls (77.5%). Most of children with IDA had poor dietary diversity (70.3%). According to our study children with poor dietary diversity have 8.037 times risk of IDA compared to controls.

Table.5 Effect of Dietary diversity on IDA.

Nutritional risk factor	Groups	IDA			Odds	95%CI	
		Case(%)	Control(%)	Total(%)		Lower	Upper
Dietary diversity	Poor Good	84(70.3%) 36(30%)	27(22.5%) 93(77.5%)	111(46.3%) 129(53.8%)	8.037	4.501	14.350
Total(%)		120(100%)	120(100%)	240(100%)			

Most of children with iron deficiency anemia (53.3%) were not receiving iron supplementation in the last 2 months. According to this study, lack of iron supplementation increase risk of IDA by 1.351 time.

Table 6: Effect of Receiving iron supplementation or multivitamins in the last 2 months IDA. Months.

Nutritional risk factor	Groups	Case(%)	Control(%)	Total(%)	Odds	95%CI	
						Lower	Upper
Receiving iron supplementation in the last 2 months	Not receive Receive	64(53.3%) 56(46.7%)	55(45.8%) 65(54.2%)	119(49.6%) 121(50.3%)	1.351	0.813	2.244
Total		120(100%)	120(100%)	240(100%)			

DISCUSSION

Our study shows that, the prevalence of anemia is low at =<6 month age group, while prevalence of IDA is highest in children 7-24 months old and after 24 month the risk of IDA drops again, this result corresponds to the findings of other study that suggest that it might be due to the growth rate of children slows and the diet becomes more diversified and an increase in iron intake from different foods as age increase.[17]

In this study there was gender variation in prevalence of IDA in children, IDA was more prevalent in boys than in girls (M:F=2.07:1). Similar to studies conducted in, Iraq[18] and in Southeast Asia.[6] Other study[19] in India analyze the higher prevalence of anemia in male children may be due to the prevailing custom of caring more for the male child who were being brought more frequently to hospital for treatment.

Regarding children whose mothers were aged 20 -27 year and 28 – 35were had higher prevalence (12.9%), while children whose mother=< 20 year or >= 40 year had lower prevalence (12.08%), though results were not significant. The findings of this study agree to the results obtained in a study conducted by Kweku et al,[7] In our study there was no strong association between parity.

Our study found that children with IDA in rural areas had higher frequency rate than urban areas (48.8%) & (20.3%) respectively. Most of children with IDA lives in rural areas, this because the in adequate health care centers, large family size, low SECS for most rural areas residents, this accepted with studies in Ghana[7], Ethiopia.[20]

In our study higher prevalence (29.1%) of anemia was found in children with lower SECS followed by children of intermediate SECS (17.5%) and lastly high SECS(3.3%), this study accepted with studies in Ghana[7], Ethiopia. [20]

Children whose mothers had regular ANC visits and iron supplementation during pregnancy were 0.169 times less likely to have anemia compared with those who did not, this result was statistically significant [p-value <0.001]. These findings similar to what was found by Logan et al. in their study.[21]

Regarding type of breast feeding, in our study most of anemic children where on exclusive breast feeding (56.7%), This result accepted with Tanzania study[22] shows that breastfeeding associated with a high percentage of IDA (99.7). Childs who don't take iron and vitamin supplements who were suffering from anemia, their number was 64(53.3%), this result is compatible with study,[23] where It appears that children who did not take iron or vitamins within two months were more susceptible to anemia by percent (89.8).

According to age of introduction of complementary food in most anemic children(66.7%)there is late introduction of complementary food 10+ months, these children are 3.810 times more likely to have anemia as compared to children in whom there was early introduction of complementary food =< 6 months, this result was statistically significant [p-value <0.001], these results similar to study[22], which reveals that early introduction of nutritious complementary foods, highly reduced the prevalence rate of anemia among the children.

In our study poor dietary diversity has been linked with anemia, number of child who was anemic and had poor dietary diversity was 84(70%), and children with poor dietary diversity were 8.037 times more likely to have anemia as compared to those children with good dietary diversity, this result was significant [p-value<0.001], this is accepted with other study[18] done in Iraq, Basra show that children who had poor dietary diversity were 3 times more likely to have anemia as compared to those with good dietary diversity (p<0.001). Dietary diversity helps to measure the overall quality and nutrient adequacy of the diet that may influence blood formation.[24]

CONCLUSION

Most important risk factors of IDA are; male gender(M:F=2.07:1), age 7-24 months(45.8%), residence in rural areas is an important factor, low SECS, exclusive breast feeding for more than 6 months, late introduction of complementary food, poor dietary diversity has strong association with IDA in children. The study recommends that there is an urgent need to assess the nutritional status of preschool-age children and the mothers before and in pregnancy.

Recommendations

A large proportion of children with IDA were not followed-up as many clinicians do not consider IDA to be a real health issue. Childhood ID and IDA have a significant impact on life-long health. It should be detected at an early age and subsequent preventive measures can help the child grow into a healthy adult.

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