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Research Article

Comparison of Prevalence and Etiology of Iron Deficiency Anaemia in Well-Nourished vs Protein Energy Malnutrition Children in Suburb Population of Lahore, a Case Control Study

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Abstract

Protein energy malnutrition and iron deficiency anaemia are both quite common in third world countries and Pakistan is no exception. This study was carried out to compare the prevalence of iron deficiency anaemia in well-nourished and severe protein energy malnourished children in suburban area of Lahore and identification of common predisposing factors associated with iron deficiency anaemia in children. This was a double blinded case-controlled study. All children age 6 months to 5 years presenting in hospital OPD/Emergency were included in this study. They were divided into two groups {controls-well-nourished (Z-score -2-+2)} and {cases-malnourished (Z-score: > -2)} based on WHO Z-score charts. Children with thalassemia, sickle cell disease, chronic illness (renal, liver) were excluded from the study. Parents were interviewed, kids examined and investigated (CBC, peripheral smear, serum iron and total iron binding capacity). Important informations (history, examination and laboratory findings) were recorded. Children with hemoglobin level less than 11gm/dl were considered as anaemic and further classified as mild, moderate and severe anaemia based on hemoglobin level as per WHO guidelines [1]. All anaemic children were prescribed appropriate medication (oral iron hydroxide polymaltose @ 6 mg/kg (elemental iron). This study was carried out at pediatric department Avicenna medical college during period of October 2017-March 2018. Data were analyzed using SPSS v20 and chi square test. Results showed that iron deficiency anaemia was common in both groups, although moderate-severe anaemia was more common in malnourished children (55.4%). Moreover, poverty and illiteracy (34.5%) were most common etiological factors identified. Statistical analysis showed these results are highly significant as P value was 0.000.

Conclusion: Iron deficiency anaemia is as common in well-nourished children as in malnourished children although underlying etiology may be quite variable. Poverty, illiteracy, maternal food fad and careless attitude were main underlying causes in our study. Universal iron fortification (flour) and regular iron supplementation to children through basic health units and school health services should be done on regular basis to correct the iron deficiency anaemia and related health problems.

Keywords: *Iron Deficiency Anaemia; Protein Energy Malnutrition; Non-Governmental Organization*

Introduction

Iron is very important in maintaining many body functions, including the production of hemoglobin, the molecule in your blood that carries oxygen. Iron is also necessary to maintain healthy cells, skin, hair, and nails. Iron deficiency and depleted iron stores at 1 year may contribute to worse fine motor developmental scores at 6 years, while low mean corpuscular volume and hemoglobin at 6 years might affect subsequent expression and gross motor scores negatively [1]. We decided to conduct a study to assess the prevalence of iron deficiency anemia in well-nourished children vs malnourished children (Z-score <-2) and to identify causative factors associated with iron deficiency anemia in suburban area of Lahore. Most correlational studies have found associations between iron-deficiency anemia

and poor cognitive and motor development and behavioral problems. Longitudinal studies consistently indicate that children anemic in infancy continue to have poorer cognition, school achievement, and more behavior problems into middle childhood [2]. Iron deficiency is widespread in infants and young children, especially in developing countries. In human, there is compelling evidence that 6- to 24-month-old infants with iron-deficiency anemia are at risk for poorer cognitive, motor, social-emotional, and neurophysiologic development in the short- and long-term outcome. In contrast to inconsistent developmental effects of iron therapy for iron-deficient infants, recent large, randomized trials of iron supplementation in developing countries uniformly show benefits of iron, especially on motor development and social-emotional behavior. In an affluent society, iron deficiency and depleted iron stores at 1 year may contribute to worse fine motor developmental scores at 6 years, while low mean corpuscular volume and hemoglobin at 6 years might affect subsequent expression and gross motor scores negatively [3]. The importance of iron deficiency as a public health problem is based ultimately on the seriousness of its consequences on health. Iron plays an essential role in immunosurveillance, because of its growth-promoting and differentiation-inducing properties for immune cells and its interference with cell-mediated immune effector pathways and cytokines activities [4,5].

Malnutrition refers to deficiencies, excesses, or imbalances in a person's intake of energy and nutrients. Every country in the world is affected by one or more forms of malnutrition. In 2016, an estimated 155 million children under the age of 5 years were suffering from stunting, while 41 million were overweight or obese [6-8]. Optimizing nutrition early in life including the 1000 days from conception ensures the best possible start in life, with long-term benefits. Poverty amplifies the risk of malnutrition. On 1 April 2016, the United Nations (UN) General Assembly proclaimed 2016 - 2025 the United Nations Decade of Action on Nutrition. (WHO fact sheet May [6-8] Micronutrient-related malnutrition is one of important subtype of undernutrition. Iodine, Zinc, vitamin A and D, and iron are the most important micronutrient whose deficiencies represents a major threat to the health and development of populations worldwide, particularly children. (WHO-fact sheet May 2017) [6-8].

We decided to conduct a study with the aim of the study to assess the prevalence of iron deficiency anemia in well-nourished children vs malnourished children (Z-score <-2) and to identify causative factors associated with iron deficiency anemia in suburban area of Lahore. The study was carried out in department of pediatrics at Avicenna Medical College. The anaemic children were prescribed medication (oral iron) for a period of three months.

Material and Methods

This study is a double blinded case-controlled study carried out at pediatric department Avicenna medical college, Lahore, Pakistan. during the period from October 2017 to March 2018.

Aims and Objective

1. To compare the prevalence of iron deficiency anaemia in well-nourished and severe protein energy malnourished children in suburban area of Lahore.
2. To identify the common predisposing factors associated with iron deficiency anaemia in children.
3. To make recommendation for universal food fortification and iron supplementation in children at school or Basic health unit.

Inclusion Criteria: All children presenting in hospital from 6 months to 5 years presenting in hospital OPD/Emergency (well-nourished and malnourished) were included in this study. They were divided into two groups controls (well-nourished) and cases (malnourished (Z-score: > -2) based on WHO Z-score charts.

Exclusion Criteria: Children with thalassemia, sickle cell disease, chronic illness (renal, liver) were excluded from the study.

Parents were interviewed, kids examined and investigated (CBC, peripheral smear, serum iron and TIBC). Important informations (history, examination and laboratory findings) were recorded. Children with hemoglobin level less than 11 gm/dl were considered as anaemic and further classified as mild, moderate and severe anaemia based on hemoglobin level as per WHO guidelines [9].

Population (Age group)	No Anaemia	Mild Anaemia	Moderate Anaemia	Severe Anaemia
Children 6 - 59 months of age	110 or higher	100 - 109	70 - 99	Lower than 70
Children 5 - 11 years of age	115 or higher	110 - 114	80 - 109	Lower than 80
Children 12 - 14 years of age	120 or higher	110 - 119	80 - 109	Lower than 80

Table: *Hemoglobin levels to diagnose anaemia at sea level (g/l) ± (WHO/NMH/NHD/MNM/11.1.*

Six hundred children were enrolled in the study who fulfilled inclusion criteria. They were divided into two groups, cases (n = 287) and control (n = 313) after randomization using SPSS V20. Children with weight between -2 to +2 (WHO Z-score) were taken as controls and children with weight more than -2 (WHO Z-score) were taken as cases. All children were seen by pediatrician and after recording history underwent a complete physical examination before enrollment and during each follow up. Laboratory test including CBC, Serum iron and total iron binding protein (TIBC) were carried out to establish the iron deficiency anaemia. Children with hemoglobin less than 11 gm/dl were considered as anaemic as per WHO criteria [1]. During the trial, a pediatrician recorded the results (clinical and laboratory) using designed research proforma sheet in all children of both groups.

Data analysis: It was based on an intention-to-treat approach. All children included are reported in the results. Chi-square test was used to evaluate the result of our study. Level of statistical significance was set < 0.05 (type 1 error) and analyses were done with SPSS v20.

Results: Six hundred children were included in the study 47.8% (n = 287) as cases and 52% (n = 313) as control using randomization (Table 1). General differences in study groups (case and control) like age, gender was statistically insignificant with a p value of 0.471 and 0.992 respectively. Population cohort analysis was statistically significant (P-value 0.000) as shown in figure 1 and table 2.

No	Parameters	Variable	Frequency	Percent	Valid percent	Cumulative Percent
1	Age	0 - 3 years	296	49.3	49.3	49.3
		3 - 6 years	304	50.6	50.7	100
2	Sex	Male	251	41.8	41.8	41.8
		Female	349	58.1	58.2	100
3	Groups	Malnourished	287	47.8	47.8	100
		Well-nourished	313	52.1	52.2	52.2
4	Population Cohort	Urban	49	8.2	8.2	8.2
		Suburban	251	41.8	41.8	50
		Rural	300	49.9	50	100
5	Maternal Education	Primary	281	46.8	46.8	46.8
		Intermediate	62	10.3	10.3	57.2
		Graduate	9	1.5	1.5	58.7
		Postgraduate	6	1	1	59.7
		Illiterate	242	40.3	40.3	100
16	Causes of IDA	Illiteracy	148	24.6	24.7	24.7
		Food Fads	73	12.1	12.2	36.9
		Poverty	166	27.6	27.7	64.6
		Careless attitudes	46	7.7	7.7	72.3
		Diarrhea	16	2.7	2.7	75
		Respiratory Infection	5	0.8	0.8	75.8
		Multiple factors	145	24.1	24.2	100
7	Anaemia prevalence	Anaemic	542	90.2	90.3	90.3
		Non-anaemic	58	9.7	9.7	100
8	Severity of anaemia	Mild	310	51.6	51.7	51.7
		Moderate	208	34.6	34.7	86.3
		Severe	24	4	4	90.3
		Unsafe	7	3.5	3.5	3.5

Table 1

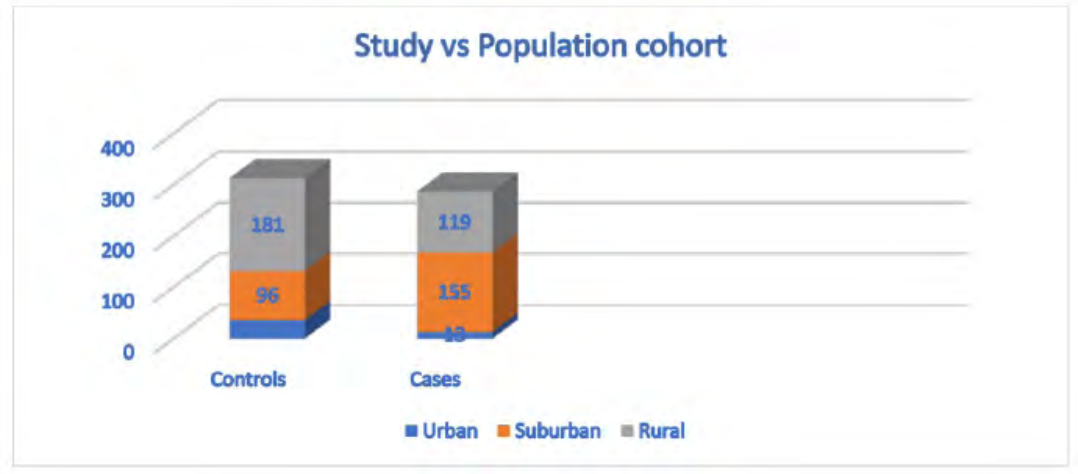

Fig:1

Gender distribution showed 42% (n = 120)/42% (n = 131) were male and 58% (n = 167)/58% (n = 152) female child in the case and control groups respectively and this again was statically insignificant as P value 0.992. Age distribution analysis showed 51%/48% children were enrolled in group-1 (0.6-3 years, n = 146/150) and 49%/52% children were enrolled in group-2 (3 - 6 years, n = 141/163) in cases and control group respectively, but this difference was also not statistically significant (p value = 0.471).

As for population cohort is concerned 3.67% (n = 36) belongs to urban population, 30.6%(n = 96) suburban and 57.8% (n = 181) from rural population in control group while the proportion of urban, suburban and rural population in case group are 4% (n = 13), 54% (n = 155) and 41.4% (n = 119) respectively. Statistical analysis shows P value of 0.000, hence statistically significant. Hence most of the patients belongs to suburban and rural population (Table 2). As for the etiological factor of iron deficiency anaemia are concerned, common etiological factors identified were poverty (27.6%, n = 166), illiteracy (24.6%, n = 148), multiple factors (24.1%, n = 145) and maternal food fads (12.1%, n = 73) and careless attitude (7%, n = 46) towards feeding children.

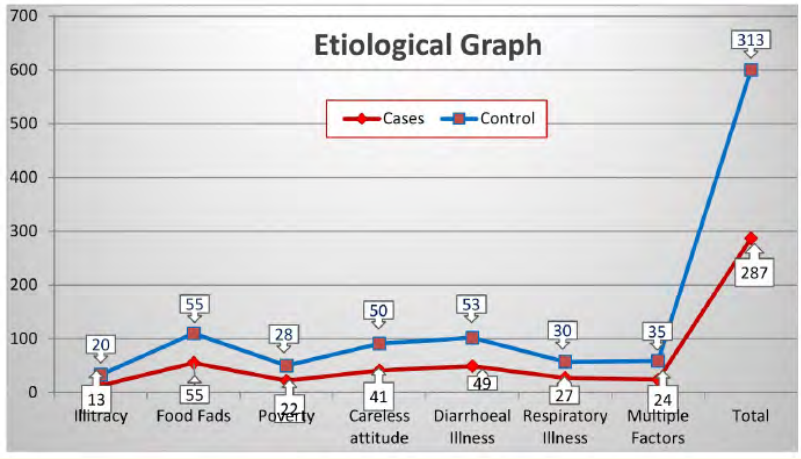

Fig: 2 *Etiology of Iron deficiency anemia (Cases and Controls)*

Statistical analysis showed that in well nourished (control group), poverty (34.5%, n = 108) was the most common cause followed by multiple causes (28.4%, n = 89), maternal food fads (16.9%, n = 53) and careless attitude (8.6%, n = 27) towards feeding, while in malnourished (cases) group illiteracy (33.1%,n = 90), poverty (20.2%, n = 58) and multiple factors (19.5%, n = 56) were the three most common causes identified in our study. Statistical analysis showed that these results are significant (p value 0.000). When we analysis our data for prevalence and severity of anaemia in our study cohort. Prevalence of iron deficiency anaemia was 85% (n = 268) and 95% (n = 274) in control and cases group respectively. While 14% (n = 45) and 4% (n = 13) were non anaemic in control and cases group respectively. Statistical analysis showed these results are significant (p value 0.000) (Table 2). As for the prevalence and severity of Iron deficiency anaemia is concerned, our analysis showed that iron deficiency anaemia is present in both well-nourished and malnourished groups (85.6% and 95.4%) (n = 268, n = 274) respectively, while 14.3% (n = 45) in well-nourished group and 4% (n = 13) in malnourished groups were non-anaemic. Significant difference noted was moderate to severe anaemia is more common in malnourished (cases) groups 55.4% (n = 159) and 7% (n = 22) as compared to well-nourished groups, 30% (n = 94) and 0.6% (n = 2) respectively. While mild iron deficiency anaemia was more common in well-nourished group (69% (n = 216) compared to 32.7% (n = 94) in malnourished groups. Again, this difference in prevalence and severity of Iron deficiency anaemia (IDA) was statistically significant as evidence by p value 0.000 (Figure 3).

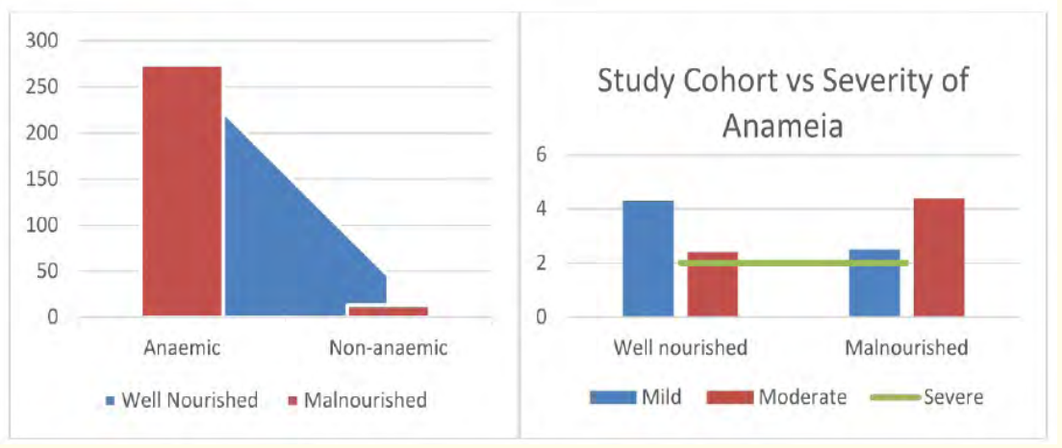

Fig: 3 *Prevalence and Severity of Iron Deficiency anemia in Study cohort*

When we compare Iron deficiency anaemia (IDA) prevalence, severity and etiological factors with reference to population cohort (Figure 3), our analysis suggest results were statistically insignificant (p value > 0.005) as evidences by p value of 0.056,0.019 and 0.021 respectively (Table 2).

No	Table-2	Value	Df	Asymp Significance
1	Age difference	0.520	1	0.471
2	Gender difference	.000	1	0.992
3	Population cohort	36.419	2	0.000
4	Etiology of IDA	45.034	6	0.000
5	Etiology VS population cohort	23.956	12	0.021
6	Prevalence of IDA	16.626	1	0.000
7	Prevalence VS population cohort	5.760	2	0.056
8	Severity of IDA	141.924	3	0.000
9	Severity(IDA) VS population cohort	15.223	6	0.019

Table-2: *Chi Square Test*

Discussion

Our results showed that iron deficiency anemia is as common in well-nourished groups as in malnourished groups. Although mild IDA was more common in well-nourished group but moderate to severe IDA was more common in malnourished group. Results of this study also showed the difference in etiology, prevalence and severity of anemia in study groups (well-nourished and malnourished) were quite significant statistically. In children with some degree of malnutrition, in addition to the mineral deficiency, there is also a calorie and protein deficiency [7]. Osório., *et al*. also found a higher prevalence of anemia in malnourished children aged between 6 and 59 months in Pernambuco, Brazil [10].

Common factors identified as etiological factors were poverty, illiteracy, maternal food fads and careless attitude in both well-nourished and malnourished groups. The results of our study are same as in previous studies done earlier. Iron deficiency anemia due to nutritional deficiency is not just a disease of developing countries, but it can also be seen in developed countries. Worldwide, over 40% of children who have iron deficiency anemia are frequently associated with infections [11]. Studies also showed that malnutrition (under and overnutrition) is associated with iron deficiency anemia. Toddlers who are overweight and not in day care are at high risk for iron deficiency [1].

In view of significant impact of iron deficiency anemia on cognitive and neurodevelopment and immune system, a national wide programme of iron fortification should be implemented. Several studies also support this. Iron-deficient and anaemic children can benefit from supplementation. However, supplementation of those who are not iron deficient might be harmful [3]. Ferrous bis-glycinate chelate is the iron of choice for the treatment of infants with iron-deficiency anemia because of its high bioavailability and good regulation [12]. Population-based interventions can efficiently and effectively reduce anemia and practically eliminate iron deficiency anemia and moderate to heavy soil transmitted helminth infections, maintaining them below the level of public health concern [13]. In children aged 4 - 23 months, daily iron supplementation effectively reduces anaemia. However, the adverse effect profile of iron supplements and effects on development and growth are uncertain [6].

Pediatricians are not always aware of the magnitude and social impact of the iron deficiency anaemia in our population. There is a fundamental need for pediatricians, health department, media, NGO, s and institutions engaged in pediatric health care to be actively involved in the decision-making process for creating awareness and take collective and wise decision to develop an effective strategy, based on an understanding of the known benefits of treatment and prevention of iron deficiency anemia in children center study.

Conclusion

This study showed that Iron deficiency anaemia in quite common in both well-nourished as well as malnourished groups contrary to popular belief that IDA is more common in malnourished children. Poverty, illiteracy, maternal food fads, careless attitude and multiple factors were common identified causes which can be corrected by combine efforts of pediatrician, health educators, media participation and governmental combined efforts.

Recommendations

1. We also suggest a large scale multicenter RCT study (nationwide)needs to be conducted to verify the results and identify risk factors and magnitude of iron deficiency anemia.
2. We also suggest for universal food fortification and iron supplementation in children at school or Basic health unit.

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