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Original Article

Frequency of Iron Deficiency Anemia and its Association with Persistent Diarrhea, Weight and Parasitic Infestation in Children, 1-2 Years of Age in Semi-Rural Area of District Sialkot, Pakistan

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ABSTRACT

Iron deficiency anemia (IDA) is a common health problem in Pakistan and persistent diarrhea under two years of age is one of its major reasons. **Objectives:** To determine the frequency of IDA among children 1-2 years of age and to find its association with persistent diarrhea and parasitic infestation. **Methods:** In this hospital-based study, 345 children 1-2 years of age visiting OPD of Tehsil Headquarter Hospital, with persistent diarrhea were included. Socio-demographic characteristics of children and their parents collected with the questionnaire while total body iron stores determined by checking Hemoglobin (Hb), Serum Ferritin and Total Iron Binding Capacity (TIBC) in the blood while parasitic infestation was determined by Ova and Cyst in the stool samples. Chi-square test was used to test association. **Results:** Out of total children, 55.9% children were bottle fed, weaning was started among 97.7% children at the age of 6 months, 44.9% had weight <8 kg, 53.0% children were anemic, had TIBC >450 µg/dl and serum ferritin level <7 ng/ml. The association of IDA with age, gender, mode of feeding, food allergies and vaccination history were significant while it was insignificant with persistent diarrhea and parasitic infestation. **Conclusions:** Study concluded that IDA was very frequent among children in less than 2 years of age and among contributing factors, lack of beast-feeding and diarrhea are important. Correlation was significant between IDA with age and feeding mode while association was insignificant with persistent diarrhea and parasitic infestation.

INTRODUCTION

In IDA (iron deficiency anemia) in which hemoglobin synthesis within bone marrow is limited resulting in low hemoglobin in blood is a leading public health issues and is prevalent in both industrialized and developing countries [1]. Any person with serum ferritin <12 ng/ml and with Hb levels less than 11g/dl is declared as iron deficient. Prevalence of IDA in developing and developed countries is 50- 60% and 10-20%, respectively. It is a 3rd significant cause for disability and among thirteen major risk determinants regarding disability adjusted life years. Majority of the IDA burden is found in resource poor areas of Asia and Africa [2, 3]. The global prevalence of anemia among children 6 to 59 months old is 43 % while half is associated with IDA. According to WHO global database on anemia, 50.9% of Pakistani children were found to be anemic. Pakistan shows different IDA prevalence rates 34%, 73% and 41% [4-6]. Iron deficiency anemia has adverse impacts on mental growth leading to poor educational accomplishments and work capability reducing the earning capability and damaging the country financial growth in coming future. In addition to that, it also enhances the chances of complications and death caused by contagious disease [7, 8]. The associated diarrhea results in loss of appetite, significant weight loss, vomiting,

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blood passage and fever. The ensuing outpouring of the plasma, blood, mucous and serum proteins enhances fecal volume and liquid content. Prolonged diarrhea could lead to anemia in children [9]. A study carried out among refugee Palestinian children demonstrated that diarrhea episode was related to an enhanced risk of IDA. While another study suggested that anemia was a significant cause for diarrheal disease. So, this relationship is reciprocal. It is probable that diarrhea enhances the development of anemia while anemia in reciprocate, enhances the diarrhea [2, 9]. In still another study, infections caused by parasites are held responsible for diarrheal diseases [10]. As individual tests commonly used for finding iron status in the body have some limitations because of their reduced specificity or sensitivity, therefore, various iron status markers when combine provide optimum evaluation regarding iron status [11]. Although complete blood count indicate low levels of Hb but Serum ferritin reflects total body iron stores [4]. Current study aim was to determine the frequency of diarrhea and the resultant IDA by assessment of hemoglobin, serum ferritin and TIBC in blood and to find the association of iron deficiency anemia with persistent diarrhea, low weight and parasitic infestation.

METHODS

It was cross-sectional hospital-based study. The study was carried out in Pediatric Department of Tehsil Head Quarter Hospital, Daska, District Sialkot. Nonprobability convenient sampling was used. Sample size was 345. It was calculated by following formula using prevalence of iron deficiency anemia i.e. 34% in Pakistan with confidence level 95% and absolute precision of 5% by following formula:

$$n = \frac{Z^2 xp(1-p)}{d^2}$$

All patients 1-2 years of age with persistent diarrhea with grade II or more stool and whose parents/attendants were willing to participate were included in the study. Patients with co-morbid conditions like cardiac, renal disease, pneumonia, meningitis, sepsis with abdominal distension and malnutrition were not included. The mother/attendant, accompanying child was interviewed by the researcher with the help of a semi-structured questionnaire to know the demographic and socioeconomic characteristics of respondents and duration of breast feeding. Questionnaire was pretested and modified before the start of interviews. Weight of child was noted with the help of weighing machine to know failure to thrive (grow). Blood sample of the child was taken for assessment of Hemoglobin (Hb), Serum Ferritin and TIBC to know the level of TBI stores. Stool samples were taken for the assessment of Ova and Cyst to find out worm infestation. Iron-deficiency anemia (IDA) was labeled when the serum ferritin level and hemoglobin level was <12 ng/ml and <11 g/dl, respectively [12]. Parasite infestation is considered when stool test was positive for ova or cyst [13]. Diarrhea was labelled when there was passage of three or more loose or liquid stools per day and persistent Diarrhea when there was acute episodes of diarrhea that lasted for 14 days or longer [14]. Grading of stools was done as follows: [15]. Grade I with normal formed stools. Grade II with soft stools. Grade III with liquid stools taking shape of the container. Grade IV with watery stools with flakes, appears opaque in glass container. Grade V with watery stools with few flakes, appears translucent in container. Data were entered, cleaned and analyzed in SPSS version 20.0. Indirect variable was iron deficiency anemia and direct variables included age, monthly income, mother's education, family type, mode of feeding, weaning, worm infestation, weight of child and anemia.

RESULTS

Socio-demographic characteristics (Table 1) showed that among 345 children, 176 (51.0%) were 1-year old. The mean age of the children was 1.341 ± 0.38 years. More than half 203 (58.8%) were male and 142(41.2%) were females. Majority 295 (85.5%) had family monthly income up to Rs. 20,000, 245(71.0%) mothers were housewives / unemployed, 108 (31.3%) mothers studied up to grade 10 while 55 (16.0%) mothers were illiterate while 231 (67.0%) of children were living in extended family system. Only 89 (25.8%) were on breast feeding, in majority 337 (97.7%), weaning was started at the age of 6 months. Majority 291 (84.4%) was fully vaccinated.

Age	Frequency (%)
1 year	176(51)
1.5 years (13-18 months)	103(29.9)
2 years (19-24 months)	66(19.1)
Mean ± SD	1.341 ± 0.38
Gender	
Male	203(58.8)
Female	142(41.2)
Mean ± SD	20000.40 ± 6645.30
Family monthly income in Pak rupee	
Up to 20,000	295 (85.5)
>20,000	50(14.5)
Occupation of mother	
Professional	17(4.9)
Housewife/unemployed	245(71)
Skilled worker	83(24.1)
Education of mother	
Postgraduate	6(1.7)
Graduate	25(7.2)
Intermediate	31(9)

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Up to grade 10	108(31.3)
Up to grade 8	87(25.2)
Up to grade 5	33(9.6)
Illiterate	55(16)
Family type	
Nuclear	114(33)
Extended	231(67)
Mode of feeding	
Breast feeding	89(25.8)
Bottle feeding	193(55.9)
Both	63(18.3)
Weaning started	
4 months	8(2.3)
6 months	337(97.7)
Vaccination history	
Fully vaccinated	291(84.4)
Partially vaccinated	29(8.4)
Unvaccinated	25(7.2)
Weight	
<8 kg	155(44.9)
8-10 kg	177(51.3)
11-12 kg	13(3.8)

Table 1: Socio-demographic characteristics of children

Regarding associated signs/symptoms and hydration status (Table 2), majority 263 (76.2%) had fever, followed by vomiting in 149 (43.2%). blood in stool in 35 (10.1%) and cough in 16 (4.6%). Hydration status showed that mild dehydration was observed in 271 (78.6%) while severe dehydration in 13 (3.8%) children. In addition to that weight loss was noted in 36 (10.4%) children.

Symptoms associated with diarrhea	Frequency (%)
Fever	263(76.2)
Vomiting	149(43.2)
Cough	16(4.6)
Blood in stool on history	35(10.1)
Dehydration	271(78.6)
Physical examination	
Pallor	169(49)
Hydration status	
No dehydration	74(21.4)
Some dehydration	258(74.8)
Severe dehydration	13(3.8)
Weight loss	36(10.4)

Table 2: Symptoms associated with diarrhea

According to lab investigations (Table 3), more than half 183 (53.0%) children were anemic (hemoglobin <11 g/dl), 183 (53.0%) had TIBC >450 µg/dl and 162 (47.0%) children had TIBC ≤450 µg/dl (normal). Serum ferritin level <7 ng/ml was noted in 183 (53.0%), Only 3 (0.9%) children had worm infestation on stool examination. Result showed that out of 176 children, prevalence of iron deficiency anemia who were 1 year old was. Similarly, it was 17.1% and 13% in children 1-1.6 years and 2 years old, respectively.

Lab investigations	Frequency (%)
Hemoglobin	
<11 g/dl (anemia)	183(53)
>11 g/dl (normal)	162(47)
Total iron binding capacity	
>450 µg/dl	183(53)
<450 µg/dl (normal)	162(47)
Serum ferritin level	
<7 ng/ml	183(53)
>7 ng/ml (normal: 7-140)	162(47)
Worm infestation (stool examination)	3(0.9)
Anemia	
1 Year	79(22.9)
1-< 1.6 years	59(17.1)
1.6 - 2 Years	45(13)

Table 3: Lab investigations in patients

Association of IDA with different variables (Table 4) showed that p –value .003 was significant with age while it was insignificant (.391,.172, .903, .588,.348 and .635) in income of family, education of mother and type of family, weaning age, weight and parasitic infestation, respectively. However, it was significant (p-value .028, food allergy (p-value .000) with mode of feeding and food allergy, respectively.

Variables	Characteristics	Iron deficiency anemia (IDA) (%)	p-value
Age	≤1	79(22.9%)	.003
	13-18 months	59(17.1%)	
	19-24 months	45(13.0%)	
Income	Up to Rs 20,000	149(43.2%)	.391
Education of mother	Literate	153(44.3%)	.172
Type of family	Extended	122(35.3%)	.903
Mode of feeding	Breast feeding	37(10.7%)	.028
	Bottle feeding	107(31.0%)	
Weaning started	4 months	5(1.4%)	.588
	6 months	178(51.6%)	
Food allergy	Yes	147(42.6%)	.000
Weight	<8 kg	85 (24.6%)	.348
Parasitic infestation	Yes	2 (0.6%)	.635

Table 4: Association of IDA with different variables

DISCUSSION

Iron deficiency anemia is a leading health problem among children in both industrialized and developing countries. Current study revealed that more than half of the children (51.0%) were one-year old, result matched with study conducted by Maroof *et al.*, who reported that (74.9%) were one year old while only one fourth (25.1%) children were up to 2 years old [16]. Regarding male to female ratio, male children were effected more than female but Ahmad *et al.*, reported in their study that most of the children were females. Similarly, Abdel-Rasoul *et al.*, also confirmed in their study that female children were more (51.3%) than

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male children (48.7%). Reason of this difference might be conservative society in their study areas. People usually do not care female children in most of the communities [11] High family monthly income is usually reflected by improved child health as it indirectly prevents children from numerous infectious diseases including anemia and diarrhea. This study also revealed that significant majority of children had family monthly income up-to PKR 20,000 per month (Table-1) while the results of a study undertaken by Ahmad *et al.*, did not favor this. Reason of this discrepancy is that present study was carried out in semi-urban area where most of the people were poor [17]. Like family monthly income, education, profession of mother and family type were also linked with child health. This study showed that most of the mothers were literate, a result matched with Dagnew *et al.*, study. This study also showed that majority of mothers were housewives while Dagnew *et al.*, reported that almost 44.8% mothers were employed. Reason again was that study area in the present study was located in semi urban and rural area where women are mostly house wife. It is culture of rural society that women were generally discouraged to go out of the house and work [18]. Role of extended family system is also important because it is mostly observed that children who belonged to extended family system did not get better care. Present study indicated that almost three fourth of the children were living in extended family system. Similar results were reported by Din and fellows who confirmed that 63 % children were living in extended family system [19]. Breast feeding is very beneficial for children as it protects them from several diseases. It was very encouraging to note that almost half of the children were bottle fed but a study carried out by Dagnew *et al.*, elucidated that only 16.7% children were breast fed. Reason of this could be that culture of the study area is conservative where women in the lactating stage are encouraged to feed their children from breast milk. In addition to that poor socioeconomic conditions compelled them not to purchase costly formula milk. Weaning is the most significant transitional period for babies because they start tasting and eating of food during this period. In the present study, weaning was started at 6 months among majority of children. Dagnew *et al.*, also confirmed that among majority (71.2%) weaning was started at 6 months [18]. Vaccination status of children was also assessed and found that most of the children were fully vaccinated. Similar results were published by Wangusi *et al.*, [8]. It is due to the fact that Extended Program of Immunization in the study area is working amicably. As far as history of diarrhea is concerned, study showed that all children were admitted to hospital when the duration of diarrhea was more than 14 days and the numbers of stools were 8-12 per day. Similar results were published by Qadri *et al.*, who highlighted that duration of diarrhea in children was 14 days with > 6 stool daily [20]. Results of this study are comparable with other studies regarding dehydration, fever and vomiting associated with diarrhea [21, 22]. This study indicated that almost half (47.0%) children had normal Hb, TIBC and Serum Ferritin levels, a finding better than the study undertaken by Chandyo *et al.*, who reported that 43.0% children had normal level of Hb and serum ferritin. However, a study carried out by Darlan and colleagues highlighted that more than half (58.3%) of the children had normal TIBC level [23, 24]. In this study, very few (0.9%) children had worm infestation on stool examination while the study done by Javaid *et al.*, confirmed that 17.2% children were found positive for worm infestation on stool examination. Reason of this discrepancy might be due to non-availability of proper stool samples in the present study. It was very appalling to note that in this study that Iron Deficiency Anemia (IDA) was prevalent in almost half (53.0%) children but the study reported that only 25.6% children had IDA. Another study undertaken by Darlan and colleagues elucidated that iron deficiency anemia was prevalent in only 7.6% children. Decreased level of IDA in these studies might be due to better nutritional status of children [24, 25]. When the association between socio-demographic characteristics and IDA was assessed, study found significant with age and gender ($p < 0.05$) while insignificant association found with monthly income, mother occupation, mother education and family type ($p > 0.05$). However, study carried out by Abdel-Rasoul and his partners showed significant association ($p < 0.05$) with mother education but insignificant association with child gender ($p > 0.05$). Results of another study performed by Howard *et al.*, showed significant association with child age, gender and mother education ($p < 0.05$) [11, 9]. It is also worth mention here that association between nutritional history and IDA in the present study was insignificant with mode of feeding and time of weaning. A study carried out by Woldie and coworkers also found insignificant association between time of weaning started and IDA [7]. Similarly in this study, significant association was observed with vaccination status ($p < 0.05$), but a study carried out by Murye *et al.*, showed insignificant association with vaccination ($p > 0.05$) [21]. Study further disclosed that there was no significant association regarding persistent diarrhea, weight of child, parasitic infestation and iron deficiency anemia ($p > 0.05$). Similar results were reported by Darlan and colleagues [24].

CONCLUSIONS

Iron Deficiency Anemia was prevalent among more than

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half of the children correlation was significant between IDA with age and feeding mode while association was insignificant with persistent diarrhea, low weight and parasitic infestation. Further studies are needed on large scale regarding same topic.

Conflicts of Interest

The authors declare no conflict of interest.

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