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Study of clinical profile and severity of iron deficiency anaemia among children aged 5-10 years at urban multispeciality hospital

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Abstract:
Background*: Iron deficiency anemia is most common nutritional disorder in the world with higher prevalence in developing countries than developed countries. Study of the prevalence of iron deficiency anaemia will be useful if picture of the risk factors that contribute to the development of anaemia are also studied. Iron deficiency anaemia accounts for significant morbidity and mortality. There are numerous countries lacking national prevalence data in school going age group. Also, most survey data including National Family and Health Survey 4 in India, are related to the three population groups: preschool age children, pregnant women and non-pregnant women of reproductive age. Hence to determine the clinical profile and severity of iron deficiency anaemia among children aged 5-10 years, we conducted a study in a urban multispeciality hospital.*
Materials and Methods*: Total 200 children of 5-10 years of age attending B.A.R.C. Hospital , satisfying study criteria were selected , after informed and written consent from Parents / Guardians.Detailed history regarding age, gender, contact details , socio economic status , type of diet as well as symptoms profile was taken . Complete anthropometric data (Weight , Height , Body mass index) was noted and General and Systemic examination was done . Complete blood count (CBC) of all children included in the study was done to identify children having anaemia as per WHO criteria. Serum Iron , ferritin and Total iron binding capacity (TIBC), peripheral blood smears and stool for parasite infestation was done in all anaemic children .*
Results*: The overall prevalence of IDA was found to be 6.5 % (13/200) in children aged 5-10 years in B.A.R.C. population . There was significant association of age with occurrence of IDA (p=0.034). IDA was found to be highest i.e.16.7% among children in age group of 5-5.11 years. . Prevalence of IDA was more (11.7%) in girls than (3.3%) in boys. 76.9 % children had mild (Hb =10-11.5 g/dl) anaemia ,23.1 % children had moderate anaemia (Hb = 7- 10 g/dl) and no child in our study population had severe anaemia However 12 % percent children were found to be having Iron deficiency state. Anemia was highest (66.7%) in children with Kuppuswami class III. No association was found between IDA and BMI. Occasional consumption of fruits and green leafy vegetables was associated with IDA.*
Conclusion: *There was a low prevalence of Iron deficiency anaemia in our community. However significant number of children were having iron deficiency state. These children need close follow up to prevent development of IDA. Nutritional education of these children could prevent Iron deficiency anaemia .*

Key Word*: Iron deficiency anaemia , anaemia , prevalence , 5-10 years.*

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I. Introduction

Anaemia is defined as reduction of hemoglobin concentration or RBC volume below range of values occurring in healthy persons.(1) Anaemia is caused by wide variety of causes but iron deficiency is the most significant contributor. Iron deficiency and iron deficiency anaemia are the global health problems and common medical conditions seen in clinical practice. Iron deficiency anemia is most common nutritional disorder in the world with higher prevalence in developing countries than developed countries.(1) Prevalence of iron deficiency anaemia in South east Asia region is 2-6 %.(2) According to WHO survey 2008, prevalence of anaemia in school age children is 25.4% and half of these are iron deficiency anaemia.(3) Study of the prevalence of iron deficiency anaemia will be useful if picture of the risk factors that contribute to the development of anaemia are also studied. Inadequate nutritional iron intake, generalized malnutrition or low iron bioavailability of diet , increased iron requirement due to rapid growth and poor access to health services are the possible causes of Iron deficiency anaemia.

Iron deficiency anaemia results in impaired cognitive performance, behavioral and motor development, coordination, language development, and scholastic achievement, as well as increased morbidity from infectious diseases. Iron deficiency anaemia accounts for significant morbidity and mortality. There are numerous countries lacking national prevalence data in school going age group .Also, most survey data including National Family and Health Survey 4 in India, are related to the three population groups: preschool age children, pregnant women and non-pregnant women of reproductive age (4). Hence we conducted this study to determine clinical profile and severity of iron deficiency anaemia among children aged 5-10 in urban multispeciality hospital.

II. Material And Methods

Study Site: Department of Pediatrics in BARC hospital
Study population: Children of age 5-10 years attending BARC hospital
Study design: A Prospective, Cross sectional, Observational study
Sample size: 200
Sample size calculation: Sample size= t2 x(p x q)/c2 t=confidence interval (1.95), p=expected proportion of cases, q=1-p C is the precision (5) percent P is taken from study done by Dr. Sahana et al at Bangalore in urban community (5) Sample size = {1.95 x 1.95 x 0.139 x 0.861} ÷ (0.05)2 Total Sample Size = 183(~200)
Time frame to address the Study : JUNE / 2017 TO JUNE / 2018
Inclusion Criteria Children of either sex from age group 5-10 years attending urban multispeciality hospital.
Exclusion Criteria
a) Those who are suffering from acute or chronic illness
b) Known cases of hemolytic anaemia.
C) Known cases of iron Deficiency anaemia
d) Cases with early menarche < 10 years

Procedure methodology

B.A.R.C. Hospital is a 390 bedded multispeciality hospital, at Anushaktinagar Mumbai- 94. It provides health care facilities to all the employees of DAE and their dependant family members residing in Anushaktinagar under the Contributory Health Service Scheme (CHSS). In our study, we selected children aged 5 – 10 years attending B.A.R.C. Hospital for routine health checkup. These children and their parents were addressed briefly about the study and its importance. After taking informed consent, they were subjected to history, relevant clinical examination and blood tests. Data was collected using pre- designed and pretested study proforma.

LIST OF VARIABLES
Age – Determined by date of birth and expressed in completed years .
Contact details were noted including contact number and CHSS Number .
Menstrual history was taken from females to exclude cases of early menarche .
Dietary history regarding type of diet consumed (vegetarian or non-vegetarian) and consumption of fruits and green leafy vegetables (frequently i.e. thrice or more than thrice weekly or occasionally i.e. twice or less than twice weekly) was recorded.
Socio economic status: Assessed by using Kuppuswami's socio-economic status scale - a revision of economic parameter for 2016 . Study population was divided into Upper (class I), Upper middle (class II) , Lower middle (class III) , There were no children belonging to Upper lower (class IV) or Lower class (class V).
Symptoms: Symptoms like weakness , fatigue , irritability , lack of concentration ,exercise intolerance , Pica , passage of worms in stool ,weight loss was recorded in pre designed and pretested proforma.
Weight – Weight was measured with participants wearing light clothes and without shoes on electronic weighing machine which was calibrated regularly.
Height – Height was measured to the nearest 0.1 cm by stadiometer.
BMI – Body mass index (BMI) was calculated by formula BMI = Weight (KG) / Height (M)2 After calculating BMI, we determined nutritional status of children as Underweight (BMI < 5^{TH} centile), normal (5^{th} to 85^{th} centile), Overweight (85^{th} to 95^{th} centile) and Obesity (> 95^{th} centile).
Pallor: All children were examined for presence or absence of pallor and also for presence of other signs of anaemia like knuckle hyperpigmentation, koilonychia, platynychia, glossitis, etc.
Hemoglobin, hematocrit, red cell count and RBC indices, RDW, platelet count was obtained by analyzing blood in the Coulter machine (SYSMEX XS -1000)

Serum Ferritin levels was obtained by analyzing serum sample in Architect plus Immunoassay system. Serum Iron and TIBC levels were estimated using chromogen test and colorometric analysis with Konelab prime 30i .
Mentzer index, Shine and Lal Index were calculated using formula Mentzer Index Shine and Lal Index = = MCV / RBC count MCV2 X MCH X 0.01. Stool sample was analysed for parasite detection in microbiology lab.

Statistical analysis
1) Descriptive and inferential statistical analysis was carried out in the present study.
2) Results of continuous variables were presented as Mean ± SD and results of categorical variables were presented in Number (%).
3) Significance was assessed at 5 % level of significance. ($p < 0.05$)
4) Chi-square/ Fisher Exact test was used to find the significance of study parameters on categorical scale between two or more groups.
5) One way ANOVA test was used to determine significant difference between means of two or more independent groups.
6) Microsoft word and Excel was used to generate graphs, tables etc. was analyzed using SPSS version 20 (SPSS

III. Result

Iron deficiency anaemia was calculated by low serum ferritin (<15) and if serum ferritin was normal, both transferrin and serum iron were observed and if low (i.e. transferrin <16, and serum iron <50), which was noted in 13 of 19 anaemic children. Thus, the prevalence of iron deficiency anaemia among the anaemic children was 68.4% and prevalence among all children (n=200) in the study was 6.5%.

Hematological and iron indices in study population (n=200)

Sr. no.	Indices	Value
1.	Hemoglobin (gm%)	12.6±1
2.	MCV	75.9±5.7
3.	MCH	25.6±2.4
4.	MCHC	33.6±1.8
5.	RBC count	5±0.4
6.	RDW	13.6±1.3

Prevalence of anemia

Prevalence of anemia (Hb<11.5 gm%)	Frequency	Percentage
Yes	19	9.5
No	181	90.5
Total	200	100

Prevalence of iron deficiency anemia
Iron indices in anemic children (n=19)

Iron indices indicating iron deficiency	Frequency	Prevalence of anemia according to iron index
Mentzer index (>13)	13	68.4
Shine and Lal index (>1530)	3	15.8
Sr. ferritin (<15)	7	36.8
Sr. iron (<50)	12	63.2
TIBC (>450)	-	-
Transferrin saturation (<16%)	9	47.4

Iron deficiency anemia was calculated by both low serum iron (<50) and low serum ferritin (<15), which was noted in 6 of 19 anemic children. Thus, the prevalence of iron deficiency anemia among the anemic children was 31.6% and prevalence among all children (n=200) in the study was 3%.
Age-wise prevalence of IDA

Age range	Frequency of children with anemia	Prevalence of anemia
5-5.9 (n=42)	3	7.1
6-6.9 (n=39)	-	-
7-7.9 (n=38)	3	7.9
8-8.9 (n=34)	-	-
9-9.9 (n=47)	-	-

Gender-wise prevalence of IDA

BMI category	Frequency	Percentage
Female (n=77)	4	5.2
Male (n=123)	2	1.6

Severity of anemia in IDA children

Severity of anemia	Frequency	Percentage
Mild (10-11.9 gm%) [n=15]	5	33.3
Moderate (7-9.9 gm%) [n=4]	1	25

Comparison of hematological indices in IDA, non-ID anemic, and non-anemic

Sr. no.	Indices	IDA (n=6)	Non-ID anemic (n=13)	Non-anemic (n=181)	P value (one-way ANOVA)
1.	Hemoglobin (gm%)	10.6±0.5	10.5±1	12.8±0.8	<0.001
2.	MCV	68.7±6	68.1±8.3	76.7±4.9	<0.001
3.	MCH	21.9±2.8	22±3.6	26±1.9	<0.001
4.	MCHC	31.8±1.9	32.1±2	33.7±1.7	<0.001
5.	RBC count	4.9±0.5	4.8±0.6	5±0.4	0.618
6.	RDW	15.4±1.5	15.3±2	13.5±1.1	<0.001

One-way ANOVA revealed that there was significant differences in the hemoglobin, MCV, MCH, MCHCH and RDW between the three groups. Post hoc analysis was done using Tukey's test to assess the differences between the two groups.

It was observed that the hemoglobin in the IDA and non-IDA were similar (p=0.972), but were significantly lower than the non-anemic population (p<0.001).

Similarly, the MCV in the IDA and non-IDA were similar (p=0.972), but were significantly lower than the non-anemic population (p<0.001).

MCH in the IDA and non-IDA were similar (p=0.991), but were significantly lower than the non-anemic population (p<0.001).

MCHC in the IDA and non-IDA were similar (p=0.913), but were significantly lower than the non-anemic population (p=0.004).

RDW in the IDA and non-IDA were similar (p=0.990), but were significantly lower than the non-anemic population (p<0.001).

Iron stores in IDA and non-IDA as per gender

Type of anemia	Sr. iron in females	Sr. iron in males	P value (unpaired t test)
IDA (females – 4, males - 2)	32.3±10.9	36.5±17.7	0.724
Non-IDA (females – 9, males - 4)	62.7±26.1	39.5±21.6	0.151

The iron stores in children with IDA as well as non-IDA was comparable in both genders.

Association of Socioeconomic status with IDA

Presence of IDA	Kuppuswami scale score			Total
	1	2	3	
Yes	0 (0%)	5 (3.6%)	1 (16.7%)	6 (3%)
No	57 (100%)	132 (96.4%)	5 (83.3%)	194 (97%)
Total	57 (100%)	137 (100%)	6 (100%)	200 (100%)

Chi square could not be performed as one of the values in the cell was '0'.

Gender-wise comparison of nutritional status of children in IDA and non-IDA

Type of anemia	BMI in females	BMI in males	P value (unpaired t test)
IDA (females – 4, males - 2)	15.9±1.4	14.8±2.1	0.461
Non-IDA (females – 9, males - 4)	16.7±3.5	15.3±2.5	0.489

The BMI in males and females were comparable in both IDA as well as non-IDA children.

Comparison of nutritional status of children with IDA, non-IDA and non-anemic groups

Variable	IDA (n=6)	Non-ID anemic (n=13)	Non-anemic (n=181)	P value (one-way ANOVA)
BMI (kg/m^2)	15.5±1.5	16.3±3.2	15.7±2.3	0.693

One-way ANOVA demonstrated that the BMI in the three groups was comparable.

Association of type of diet with gender in IDA children

Type of diet	Females	Males	Total
Vegetarian	4 (100%)	0 (0%)	4 (66.7%)
Non-vegetarian	0 (0%)	2 (100%)	2 (33.3%)
Total	4 (100%)	2 (100%)	6 (100%)

Chi square test cannot be applied as one of value in the cells is'0'.

Association of consumption of fruits and vegetables with gender in IDA children

Consumption of fruits and vegetables	Females	Males	Total
Frequently	0 (0%)	2 (100%)	2 (33.3%)
Occasionally	4 (100%)	0 (0%)	4 (66.7%)
Total	4 (100%)	2 (100%)	6 (100%)

Chi square test cannot be applied as one of value in the cells is'0'.

Symptoms of children with IDA

Complaints	Frequency*	Percentage*
Weakness	4	66.7
Fatigue	4	66.7
Irritability	4	66.7
Lack of concentration	3	50
Exercise intolerance	-	-
PICA	-	-
Worms in stool	-	-

*frequencies and percentages are mutually exclusive of each other

Presence of pallor in IDA, non-IDA and non-anemic children

Presence of Pallor	Groups			Total
	IDA	Non-IDA	Non-anemic	
Yes	6 (100%)	13 (100%)	40 (22.1%)	59 (29.5%)
No	0 (100%)	0 (100%)	141 (77.9%)	141 (70.5%)
Total	6 (100%)	13 (100%)	181 (100%)	200 (100%)

Chi square test cannot be applied as one of value in the cells is'0'. It was observed that all patients in the IDA and non-IDA groups had pallor.

Peripheral smear findings in IDA children

All children with IDA showed microcytosis and hypochromic on peripheral smear.

Mentzer and Shine and Lal indices in IDA children

The mean Mentzer index in IDA children was 14.1±2.7.

The mean Shine and Lal index in IDA children was 1046.7±299.7.

Association of consumption of iron supplements in infancy with IDA

Consumption of iron supplements in infancy	IDA	Non-IDA and non-anemic	Total
Yes	2 (33.3%)	82 (42.3%)	84 (42%)
No	4 (66.7%)	112 (57.7%)	116 (58%)
Total	6 (100%)	194 (100%)	200 (100%)

Fishers exact test demonstrated that there was no association (p=1) of consumption of iron supplements in infancy and presence of IDA in the children.

IV. Discussion

The overall prevalence of IDA was found to be 6.5 % in children aged 5-10 years in B.A.R.C. population. Out of which 16.7 % were in 5-5.11 years age group , 2.6 % were in 6-6.11 years age group, 7.9 % in 7-7.11 years age group, 2.9 % in age group of 8-8.11 years whereas 2.1 % in age group 9-9.11 years . IDA was found to be highest i.e.16.7% among children in the age group of 5-5.11 years. Prevalence of IDA was more (11.7%) in girls than (3.3%) in boys.

76.9 % children had mild (Hb =10-11.5 g/dl) anaemia (IDA), 23.1 % children had moderate anaemia (Hb = 7- 10 g/dl) and no child in our study population had severe anaemia. However 12 % percent children were found to be having Iron deficiency state (Children with normal Hemoglobin but with low MCV, MCH for age and high RDW).

68% children belong to upper middle (II) class followed by 28.5 % to upper (I) Class and 3 children belonged to lower middle socio economic class (III) according to kuppuswami socioeconomic scale. IDA was highest (66.7%) in children with Kuppuswami class III.

In this study, mean BMI was 15.8+2.3 kg/m2. Low BMI, Normal BMI, overweight and obesity was found in 2%, 68%, 19.5% and 10% children respectively. There was no association of BMI with IDA in our study. Frequent intake of fruits and green leafy vegetables was associated with low prevalence of IDA.

Among children with IDA, Weakness and fatigue were predominant symptoms. Pica and worm infestation were least common symptoms. Pallor was a predominant manifestation of IDA, which was noted in all children with anaemia. Similarly, microcytic hypochromic picture and anisocytosis in peripheral blood smear was a finding noted in all children with IDA. The mean hemoglobin, MCV, MCH, RBC count were low in children with IDA as compared to normal children. Mean serum iron stores were comparable in both males and females with IDA. Mentzer index was a sensitive parameter to diagnose IDA . Shine & Lal index was a less sensitive parameter than Mentzer index.

V. Conclusion

There was a low prevalence of Iron deficiency anaemia in our community. However significant number of children were having iron deficiency state. These children need close follow up to prevent development of IDA. Nutritional education of these children could prevent Iron deficiency anaemia

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