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Prevalence of Iron Deficiency Anaemia among Adolescent Patients of Mau, Atari – Rural Luck now, U.P., India.

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Abstract:
Objective: *Present study is designed to assess the* ***prevalence of anaemia among adolescent*** *out patients of Mau, Ataria village, a rural area of Lucknow, situated about 33 kms from Lucknow.* ***Design:*** *Retrospective analysis of CBC reports of adolescents of out-patient department (O.P.D.), investigated at laboratory of Pathology department of HIMS, Mau, Ataria, U.P., India, among 3462 patients investigated for CBC from 01st January, 2018 to 30th June, 2018.*
Material and Methods:*CBC was on automated haematology analyzer (Bene Sphera, 3 – part Haematology analyzer- H33, Avantor Performance Materials, LLC, 3477 Corporate Parkway, United States) and print out of reports done by internal printer of the analyzer. Anaemia was diagnosed on the basis of Hb, RBC Count, MCV, MCH, MCHC values.*
Observation and Results: *Total adolescent patients' CBC reports analyzed were* ***258 [118 Males (45.74%) & 140 Females (54.26%)]*** *out of* ***total 3462*** *patients' CBC reports* ***(7.45%).*** *On the basis of Hb estimation, prevalence of anaemia was* ***196/258 (75.97%).*** *Maximum number of anaemic adolescents were* ***45/63 (20 Males & 25 Females)*** *in the age group of* ***18 years.*** *We noted* ***abnormal PCV in 233/258 (90.31%), MCV in 108/258 (41.86%), MCH in 108/258 (41.86%)*** *and* ***MCHC in 55/258 (21.32%).***
Conclusion: Our present study *shows* ***75.97% prevalence of IDA*** *based on Hb values among* ***adolescent*** *OPD patients investigated at laboratory of Pathology Department of HIMS, Mau, Ataria, U.P., India.* ***Prevalence ofIDA*** *was* ***more*** *in* ***adolescent males 95/119 (79.83%)*** *than* ***adolescent females 101/140 (72.66%).***
Keywords: *Adolescents, Anaemia, Haemoglobin (Hb), Iron Deficiency Anaemia (IDA), Packed Cell Volume (PCV), Mean Cell Volume (MCV), Mean Cell Haemoglobin (MCH), Mean Cell Haemoglobin Concentration (MCHC), Red Blood Cell (RBC) Count, Total Leukocyte Count (TLC).*

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I. Introduction

In India, in rural population, malnourishment is a common problem.**Anaemia,** especially, **'Iron Deficiency Anaemia (IDA)'** is very common. Prevalence of anaemia in India is higher than among many countries in the world [1].

Anaemia is very common in Indian subcontinent. The National Family Health Survey – 3 (NFHS-3) data suggests that anaemia is widely prevalent among all age groups and its prevalence is particularly high among the most vulnerable especially 56% among adolescent girls (15 – 19 years of age); 30% among adolescent boys (15 – 19 years of age) [2].

Adolescence has been defined by World Health Organization as the period of life spanning the ages between 10 and 19 years [3].In India, adolescents above age of 18 years are considered adults, so they are not included in

Adolescent group. However, in present study we have included them in view of they forming largest population among adolescents [63/258 (24.42%)].

In India, malnourishment is a common health hazard. Anaemia, especially **"Iron Deficiency Anaemia (IDA)"** is quite common. Nutritional anaemia is a major public health problem in India, and is primarily due to iron deficiency [1]. Prevalence of anaemia is higherin rural areas because of poor food intake and unhygienic conditions.

IDA is a formidable health challenge in developing countries and remains persistently high despite national programs to control this deficiency [2, 4]

Prevalence of Iron Deficiency Anaemia among Adolescent Boys and Girls:

As per NFHS -3 and National Nutritional Monitoring Bureau Survey, prevalence of anaemia among adolescent boys (Hb < 13 gm/dL), and girls (Hb < 12 gm/dL) is alarmingly high. Over 55% adolescent girls are anaemic. Prevalence of anaemia among girls between 15 to 19 years is 55.8%, whereas prevalence of anaemia among adolescent boys of 15 to 19 years is 30.2% [1].

II. Material and Methods

Present retrospective analysis study was done at HIMS, Mau, Ataria, U.P., India. The institutional approval was taken.

Study Design: The retrospective analysis of CBC reports of 258 adolescents (118 males and 140 females)out of total 3462 O.P.D. patients investigated for CBC at laboratory of Pathology department of HIMS, Mau, Ataria, U.P., India from 01.01.2018 to 30.06.2018. Venous blood was collected and examined for CBC. Name, age, sex etc. Needed were recorded by laboratory technicians. **IDA** was defined as per NFHS-3 and National Monitoring Bureau Survey based on Hb levels in adolescents. The cut off value for determination of IDA is:

- Blood Hb concentration: < 13 gm/dL in males &< 12 gm/dL in females [1, 2].
- Blood MCH: < 27 pg [Normal MCH = 27 to 33 (30 ± 3) pg] [5].
- Blood MCHC: < 31% {Normal MCHC = 31 to 35 (33 ± 2)% [5].
- Blood MCV: < 82 fL [Normal MCV = 82 to 98 (90 ± 8) fL] [5].
- RBC Count: < 3.9 10^{12}/L [3.9 to 4.9 10 ^{12}/L] [6]
- TLC: Low: < 3.9 10^9/L, High: >13.0 10^9/L[Normal = 3.9 to 13.0 10^9/L. [7].

Iron deficiency is commonest in India. In IDA, due to Hb synthesis deficiency, RBCs are microcytic (low MCV) and hypochromic (low MCHC). **Blood sample Collection and Examination:** Blood sample of 5 mL was collected from each in patient O.P.D. by vein puncture into Ethylene di-amine tetra-acetic acid (EDTA) sterile bulb for CBC investigations. The blood samples were analyzed for Hb, RBC Count, TLC, Platelet count and Haematocrit. The EDTA blood sample was tested and analyzed by pathologist usingautomated haematology analyzer (Bene Sphera, 3 –part Haematology analyzer- H33, Avantor Performance Materials, LLC, 3477 Corporate Parkway, United States) and print out of reports done by internal printer of the analyzer.

Statistical Analysis: The data was obtained from instrument analysis for all blood samples. It was tabulated as shown in **Tables 1 to 11** and **analyzed statistically.**

Table 1: Total Adolescent CBC Patients:

Total Ptsn$_T$	Ad**n$_A$	%	M $ n$_{AM}$	%	F#n$_{AF}$	%
3462	258	7.45%	118	45.74%	140	54.26%

Total Patients = n_T; **Ad = Adolescents; $: Adolescent Males = n_{AM}; # : Adolescent Females = n_{AF}

Table 2: Age and Sex Distribution of Adolescents

Sr.No.	Age(Yrs)	Total n$_A$	%	M n$_{AM}$	%	F n$_{AF}$	%	Remarks
1	10	23	8.47	10	43.48	13	56.52	
2	11	11	4.26	10	90.91	1	9.09	Lowest no. of Ad.
3	12	32	12.40	16	50.00	16	50.00	
4	13	15	5.81	9	60.00	6	40.00	
5	14	20	7.75	10	50.00	10	50.00	
6	15	27	10.47	11	40.74	16	59.26	
7	16	26	10.08	7	26.92	19	73.08	
8	17	41	15.89	17	41.46	24	58.54	
9	18	63	24.42	28	44.44	35	55.56	Highest no. of Ad
Total		258	100.00	118	45.74	140	54.26	

Table 3: Haemoglobin [Hb (gm/dL]* of Adolescents

Pts	M n$_{AM}$ = 118				F n$_{AF}$ = 140				Total Ad = (M +F) =n$_A$ = 258			
n$_A$	N	%	,13	%	N	%	< 12	%	N	%	Anemic	%
258	25	21.19	93	78.81	34	24.29	106	75.71	59	22.87	199	77.13

*** Haemoglobin (gm/dL):**

a) Normal: M ≥ 13; F ≥ 12.

b) In IDA: M < 13; F< 12. Highest Hb Value: M = 15.4 gm/dL; F = 14.7 gm/dL. Lowest values: M = 2.9 gm/dL; F = 3.2 gm/dL.

Table 4 - A: Agewise Distribution of Anaemic Adolescents (Males)

Age (Yrs)	Total n_A	%	M n_{AM}	%	N	%	Max*. Hb (gm/ dL)	Min#. Hb (gm/ dL)	Anae-mic	%
10	23	8.92	10	43.48	1	10.00	13.4	9.0	9	90.00
11	11	4.26	10	90.91	0	00.00	0	4.7	10	90.9
12	32	12.49	16	50.00	1	6.25	13.4	4.7	15	93.75
13	15	5.81	9	60.00	2	22.22	13.7	7.0	7	77.78
14	20	7.75	10	50.00	1	10.00	13.4	5.4	9	90.00
15	27	10.47	11	40.74	3	27.27	14.8	10.3	8	72.73
16	26	10.08	7	26.92	1	14.29	14.7	8.7	6	85.71
17	41	15.89	17	41.46	6	35.29	15.4	2.9	11	64.71
18	63	24.42	29	46.03	9	31.03	15.3	6.9	20	68.97
Total	258	118	140		24	20.33			95	79.83

***Max. = Maximum; # Min. = Minimum.**

Table 4 - B: Agewise Distribution of Anaemic Adolescents (Females)

Age (Yrs)	Total n_A	%	Fn_{AF}	%	N	%	Max.Hb (gm/dL)	Min. Hb (gm/ dL)	Anae-mic	%
10	23	8.92	13	56.52	2	15.38	14.7	5.2	11	84.62
11	11	4.26	1	9.09	1	9.10	12.1	00.00	0	00.00
12	32	12.49	16	50.00	1	6.25	12.5	5.9	15	93.75
13	15	5.81	6	40.00	1	16.67	12.0	3.2	5	83.33
14	20	7.75	10	50.00	4	40.00	12.9	6.5	6	60.00
15	27	10.47	16	59.26	6	37.5	14.4	4.1	10	62.5
16	26	10.08	19	73.68	5	26.32	13.7	3.2	14	73.68
17	41	15.89	24	58.54	9	37.5	13.6	5.7	15	62.5
18	63	24.42	34	53.97	9	26.47	14.2	5.8	25	73.53
Total	258	118	140		38	27.14			101	72.66

Total Anaemic Patients: 196/258 = 75.97%.

Table 5: Packed Cell Volume (PCV)* of Adolescents

Patients	Males (M)n_{AM}= 118				Females (F) n_{AF} = 140				Total (M + F) n_A=258			
n_A	N	%	<40%	%	N	%	<40%	%	N	%	<40%	%
258	18	15.25	100	84.75	7	5.00	133	95.00	25	9.69	233	90.31

***PCV Values: a) Normal = 40 % b) Abnormal = < 40 %**
Highest PCV Value: M = 48.6 %; F = 43.7%. Lowest PCV Value: M = 9.4 %; F = 10.1%

Table 6: Mean Cell Volume [(MCV)* fL] of Adolescents

Patients	Males (M) n_{AM}= 118				Females (F) n_{AF} = 140				Total (M + F) n_A=258			
n_A	N	%	<82fL	%	N	%	<82fL	%	N	%	<82fL	%
258	70	59.32	48	40.68	80	57.14	60	42.86	150	58.14	108	41.86

***MCV (fL): a) Normal = 82 to 98 (90 ± 8) fL; b) Abnormal < 82 fL.**
Highest MCV Value: M = 111.6 fL; F = 135.8 fL. Lowest MCV value: M = 57.3; F = 54.4 fL

Table 7: Mean Cell Haemoglobin [(MCH)* pg] of Adolescents

Patients	Males (M) n_{AM}= 118				Females (F) n_{AF} = 140				Total (M + F) n_A=258			
n_A	N	%	<27pg	%	N	%	<27pg	%	N	%	<27pg	%
258	80	67.80	38	32.20	70	50.0	70	50.0	150	58.14	108	41.86

***MCH Value: a) Normal =27 to 33 (30 ± 3) pg. b) Abnormal <27 pg.**
Highest MCH value: M = 70.9 pg; F = 41.9 pg. Lowest MCH value: M = 15.9 pg; F = 13.7 pg

Table 8: Mean Cell Haemoglobin Concentration [(MCHC)* %] of Adolescents

Pts	Males (M) n_{AM}= 118				Females (F) n_{AF} = 140				Total (M + F) n_A=258			
n_A	N	%	<31%	%	N	%	<31%	%	N	%	<31%	%
258	103	87.29	15	12.71	100	71.43	40	28.57	203	78.68	55	21.32

***MCHC Value: a) Normal = 31 to 35 (33 ± 2) %. B) Abnormal <31 %.**
Highest MCHC Value: M = 37.9%; F = 43 %. Lowest MCHC Value: M =27.3 %; F = 14.7 %

Table 9 -A: Red Blood Cell (RBC)* Count (10^{12}/L) of Adolescents

Pts	Males (M) n_{AM}= 118				Females (F) n_{AF} = 140				Total (M + F) n_A=258			
n_A	N	%	Low	%	N	%	Low	%	N	%	Low	%
258	71	60.17	32	27.12	73	52.14	62	44.00	144	55.82	94	36.43

- **6 to12 yrs: Normal: 4.6 (10^{12}/L) to 4.0 (10^{12}/L). [6]**
- **12 to 18 yrs: M: 4.9 (10^{12}/L) to 4.5 (10^{12}/L) F: 4.6 (10^{12}/L) to 4.1(10^{12}/L)).**
- **Lowest RBC Count: M = 1.73 (10^{12}/L) & F = 0.74 (10^{12}/L).**

Table 9 -B: Red Blood Cell (RBC)* Count (10^{12}/L) of Adolescents

Pts	Males (M) n_{AM}= 118				Females (F) n_{AF} = 140				Total (M + F) n_A=258			
n_A	N	%	High	%	N	%	High	%	N	%	High	%
258	71	60.17	15	12.71	73	52.14	5	3.57	144	55.82	20	7.75

***High RBC Count: M = 6.39 (10^{12}/L) F = 5.70 (10^{12}/L)**

Table 10-A: Total Leukocyte Count (TLC)* of Adolescents

Pts	Males (M) n_{AM}= 118				Females (F) n_{AF} = 140				Total (M + F) n_A=258			
n_A	Normal	%	Low	%	Normal	%	Low	%	Normal	%	Low	%
258	100	84.75	1	0.84	113	80.71	5	3.57	213	82.56	6	2.33

*** TLC Value: a) Normal = 3.9 to 13.0 (10^9/L) b) High = > 13.00 (10^9/L) c) Low= < 3.9 (10^9/L) [7]**

Table 10-B: Total Leukocyte Count (TLC)* of Adolescents

Pts	Males (M) n_{AM}= 118				Females (F) n_{AF} = 140				Total (M + F) n_A=258			
n_A	Normal	%	High	%	Normal	%	High	%	Normal	%	High	%
258	100	84.75	17	14.41	113	80.71	22	15.72	213	82.56	39	15.11

Table 11: Prevalence of IDA in Adolescents

Parameter	n	Normal n %		Anemia/< Normal n %		Highest value	Lowest value
Hb gm/dL	258	59	22.87	199	77.13	14.3 gm/dL	3.2 gm/dL
PCV %	258	25	9.69	233	90.31	48.6 %	9.4 %
MCV fL	258	150	58.14	108	41.86	135.8 fL	54.4 fL
MCH pg	258	150	58.14	108	41.86	70.9 pg	13.7 pg
MCHC %	258	203	78.68	55	21.32	37.9 %	14.7 %
RBC Count: 10^{12}/L	258	144	55.82	99	36.43	6.39 10^{12}/L	0.74 10^{12}/L
TLC	258	213	82.56	6	2.33	50.60 10^9/L	0.26 10^9/L

III. Results In Our Present Study

Table 1shows that out of total 3462 patients investigated for CBC, adolescent patients were 258 (7.45%). Total adolescent males were 118/258 (45.74%) and total adolescent females were 140/258 (54.26%).

Table 2 shows age wise distribution of adolescents. In age group of 11 tears, minimum number of adolescent patients 11 (4.26%) 10 males and 1 female were there. Whereas in age group of 18 years, maximum number of adolescent patients were there 63/258 (24.42%) out of which adolescent males were 28/63 (44.44%) and adolescent females were 35/63 (55.56%).

Table 3 shows that on the basis of Hb estimation, 93/118 (78.81%) adolescent males were anaemic (< 13 gm/dL) and 106/140 (75.71%) adolescent females were anaemic. An average of 199/258 (77.13%) adolescent males and females were anaemic which is on much higher side than our previous study (70.5%) [8] and also other studies.

Table 4of "Age wise Distribution of Anaemia" shows that in age group of 12 years, maximum percentage of adolescent males 15/16 (93.75%)and females 15/16 (93.75%) were there. Adolescents in the age group of 18 years were included in this analytical study because in this group we found maximum number adolescents 63 (29 males and 34 females) i.e. 24.42% of total adolescents investigated.

Table 5 shows PCV values of adolescents. 100/118 (84.75%) adolescent males and 133/140 (95.0%) adolescent females and average 233/258 (90.31%) adolescent males + females were having abnormal PCV (< 40%).

Table 6 shows MCV values of adolescents. 48/118 (40.68%) adolescent males and 60/140 (42.86%) adolescent females and Combined result was 108/258 (41.86%) adolescent males + females were having abnormal MCV (<82 fL).

Table 7 shows MCH value of adolescents. 38/118 (32.20%) adolescent males and 70/140 (50%) adolescent females and 108/258 (41.86%) combined adolescent males + females had abnormal MCH (< 27 pg).

Table 8 shows MCHC of adolescents. 15/118 of adolescent males and 40/140 (28.57%) and 55/258 (21.32%) combined adolescent males + females had abnormal MCHC values (< 31%).

Table 9 shows RBC Count of adolescents. In adolescent males 71/118 (60.17%) were normal; 32/118 (27.12%) were with low RBC Count (< 3.9 10^{12} /L) and 15/118 (12.71%) were with high RBC Count (> 4.9 10^{12} /L). In adolescent females 73/140 (52.14%) were normal, 62/140 (44.29%) were with low RBC Count (< 3.9 10^{12} /L) and 5/140 (3.57%) were with high RBC Count (>4.9 10^{12} /L). Combined results of RBC Count of adolescent males + females showed 144/258 (55.82%) were normal, 94/258 (36.43%) had low RBC Count and 20/258 (7.55%) had high RBC Count.

Table 10 shows TLC of adolescents. In male adolescents 100/118 (84.75%) were normal; 1/118 (0.84%) was with low TLC and 17/118 (14.41%) were with high TLC. In female adolescents 113/140 (80.71%) were normal; 5/140 (3.57%) had low TLC and 22/140 (15.72%) had high TLC. The combined result of TLC of adolescent males + females showed 213/258 (82.56%) were normal; 6/258 (2.33%) had low TLC and 39/258 had high TLC (15.11%) had high TLC.

Table 11 shows summarized results of our present study.

IV. Discussion

This study was done to do retrospective analysis of IDA incidence in adolescent population of males an females of Mau, Ataria – rural areas of Lucknow, U.P., India. In developing countries, it is estimated that anaemia affects about 2000 million people[9].Earlier studies on anaemia in India and different parts of the world mainly involved females [10]. In this study, we studied prevalence of IDA in adolescent population (males + females) of rural areas of Lucknow.

V. Conclusion

It is common finding that anaemia occurs in undernourished children from poor socio-economic status [11-14].On the basis of CBC reports/Hb levels of these patients, diagnosis of IDA was made and they are treated accordingly. Due to deficiency of Hb synthesis, RBCS are microcytic (low MCV, normal MCV = 90 ± 8 fL) and hypochromic (low MCHC, normal MCHC = 33 ± 2 %). The national Family Health Survey – 3 (NFHS- 3) report suggests prevalence of anaemia as 30% among adolescent boys and 56% among adolescent girls (15 -19 years). In contrast to this, our present analysis shows the prevalence of anaemia (hypochromic and microcytic) among O.P.D. adolescent males and females in age group of 10 years to 18 years based on Hb is 75.97%, MCV is 41.86% and MCH is 41.86%. However, on the basis of MCHC, 21.32% adolescent males + females were found anaemic. Our previous studies showed that prevalence of anaemia (hypochromic and hypovolemic) among adolescents (boys and girls) based on Hb, MCH, MCV
& MCHC findings were:

i. 70.50%, 48.24%, 37.65% & 11.76% respectively [8] and
ii. 61.54%, 28.21%, 34.62% & 1.28% respectively [14].

In our present study, we observed that in adolescent patients, incidence of anaemia was higher, on the basis of both Hb (75.97%) and MCHC (21.32%) compared to our previous 2 studies and NFHS – 3 report.

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