Haemoglobin Level in Children of a Northern District of Bangladesh

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Summary:

Objective: To find out the reference level of haemoglobin and other haematological parameters(PCV, MCV, MCH, MCHC, S. Iron and S. Ferritin) of the children of Northern area of Bangladesh and to see the relation of socio demographic features and other haematological parameters with haemoglobin level.

Methodology: Observational cross sectional study.

Setting: Outpatient department of Rangpur Medical College and outpatient department of eight Upozilla Health Complexes of northern Bangladesh.

Patients:300 clinically healthy 1yr. to 14yr. age children.

Outcome measures: Mean Hb. level in age groups and influence of sex, age, economic status, parental education, nutrition and serum iron on level of Hb. PCV, MCV, MCH, MCHC, S. Iron and S. Ferritin was estimated to see the confounders and if they are affecting Hb. level significantly.

Results: Mean haemoglobin among study population was 11.4gm/dl(SD;1.07). Haemoglobin was normally distributed among the study population. Mean haemoglobin among age groups differed significantly. No significant difference in mean haemoglobin was observed among two sex groups.

Mean haemoglibin level corresponded well with WHO defined haemoglobin level in the same age group of children.

Conclusion: Reference level of mean Hb. in the studied population is 11.4gm/dl(SD;1.07). Age affects the Hb. level but sex does't. Hb. level in this population is comparable with WHO reference value for this age.

Key ward: Reference level of haemoglobin, haemoglobin level in children, mean haemoglobin, racial difference in haemoglobin.

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Introduction:

In preschool age 47.4% are suffering from iron deficiency anaemia. Prevalence in Asia is 65.5%[1]. In Bangladesh prevalence in preschool age is 47% according to 2001 survey[2]. To define anaemia WHO cut off value of haemoglobin is being used. But it is well known that normal level of haemoglobin in a population varies with age,gender, altitude, race and ethnicity. Lower level of haemoglobin has been observed in children of Asian and African origin in comparison with American and European origin[3,4,5]. Weihang et al concluded in their study that blood values differ by age ,sex and race. It was obvious that there was significant difference of Hb, PCV, MCV, MCH, MCHC values between white and blacks in all ages[(6)]. Normal haemoglobin level should be defined for each particular group of population in order to see the prevalence of anaemia in the particular population group. We have to know the haematological parameters in our children for better understanding of their normal growth and nutrition status.

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Methodology:

Study was conducted in Rangpur district of Bangladesh. Children of 1 yr. to 14 yr. attending the out patient departments of Rangpur Medical College and eight upazilla health complexes were included in this study. Systematic random sampling was done. Chronic and recurrent illness and any inflammatory condition was excluded by history and clinical examination. Anaemia was screened out clinically. Nutrition status was determined by anthropometry and Z score of height for age and weight for age. Venous blood sample was collected and Hb., PCV, MCV, MCH, MCHC, S.Iron and S.Ferritin were estimated. Haemoglobin was done by cyanmethaemoglobin method and other haematological parameters were estimated by fully automated haematology analyzer; Sysmex XT – 1800i, Japan and Immulite – 1000 analyzer USA. Peripheral blood film

was scaned by qualified haematologist to exclude the possibility of congenital haemolytic anaemia. Study was done during the period of January'08 to December'08. Sample size was 250 to give 95% confidence interval of 0.04 with standard error of 1.96. It was rounded upward to 300 to reduce sample error.

Result:

Age of the study population ranges from 1.4 yr. to 14 yr. Mean age was 7 yr. with SD;±3.12yr. Demography of the study population is as follows.

Table-I

Demography of study population

Parameters	No(%)
Age group:	
1 – 4 yrs.	58(19.3)
4 – 9 yrs.	156(52)
9 – 14 yrs.	86(28.7)
Sex:	
Male	165(55)
Female	135(45)
Maternal education:	
Illiterate	112(37.3)
Primary	106(35.3)
Secondary	64(21.3)
Higher secondary	18(6)
Occupation of the parents:	
Labourer	133(44.3)
Service	70(23.3)
Business	82(27.3)
Other	15(5)
Total monthly family income(Taka):	
Range	1500 – 30000
Mean(SD)	5357.33(±3675.797)
Per capita monthly income(Taka*):	
< 1000	136(45.3)
1000 – 2000	120(40)
2000 – 3000	31(10.3)
>3000	13(4.3)

*1$=70Tk.

Z score(Weight for age): Mean Z score was -2.3457, SD=+5.45.

Hb. was distributed normally with no skew ness. Hb. level and other haematological parameters are given bellow(Table II). Haematological parameters were normal in comparison to their reference value, which indicates that the studied population was not anaemic.

Table-II

Haematological parameters

Parameters	Mean value(SD)
Hb(gm/dl)	11.4±1.07
PCV(%)	36.324±3.31
MCV(fl)	79.134±.29
MCH (pg)	24.82±2.59
MCHC(gm)	31.29±1.85
S.Iron (µ/dl)	59.72±32.94
S.Ferritin(ng/dl)	59.4±52.79

In this population haemoglobin is distributed normally(Fig:1). There was no skewness. There was no significant difference in haemoglobin level between the male and female groups(P = 0.65). Mean haemoglobin distribution in different age group differed significantly(P = .000). Factors those affected mean Hb. level were father's education(P = 0.01), Parental occupation(P = 0.002), total monthly family income(P= 0.014). Z score for weight for age was found to have no significant correlation with haemoglobin level of the study group(r = 0.005, P = 0.927).

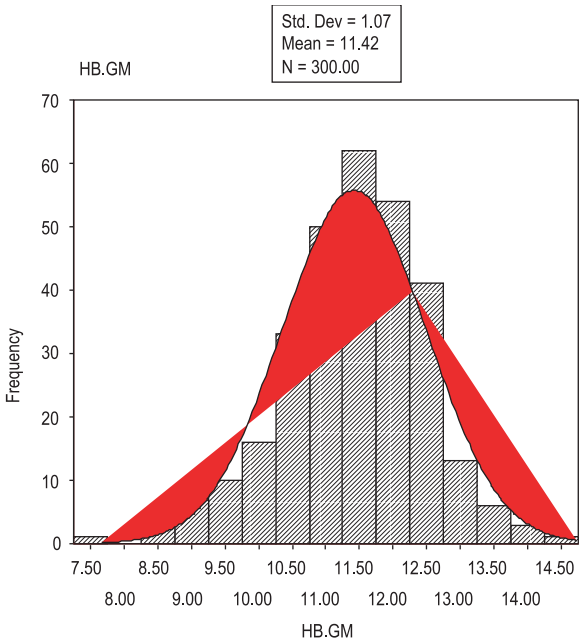

Fig-1: *Distribution of haemoglobin in studied population*

There are high correlations of haemoglobin in the studied population with PCV, MCV, MCH, MCHC, S.Iron, but no correlation was found with S.Frritin. These are shown in Table-III.

Table-III

Correlation of Hb with other Haematological Parameters

Parameters	Pearson Correlation(r)	2-tailed significance(P)
PCV	0.884	0.000
MCV	0.476	0.000
MCH	0.591	0.000
MCHC	0.198	0.001
S.Iron	0.242	0.000
S.Ferritin	0.017	0.776

Discussion:

WHO defined Hb. cut off level is being used for our children. This cut off is based on the studies, mostly done in western children[1,2]. There is lack of adequate representative information regarding the haemoglobin level in south east asian region and socio demographic and nutritional factors influencing the haemoglobin level in children of our country and South East Asia. There is a unique study done by Faruk et al. in different socio demographic group of adolescent school boys in Dhaka city which estimated haemoglobin level in these groups and compared the influence of education of parents, occupation of parents, percapita income, nature of food consumed, nutrition status etc[7]. Present study was done in a section of children in the northern part of Bangladesh in Rangpur district. The mean age was 6.9±3.12 yrs. This study doesn't provide haematological values bellow 1 yr of age. Children of bellow 1 yr. was not included in the study because haemoglobin stabilizes to normal value at about 1 yr age[8]and normal haemoglobin also appears by this age[9].

It was found that the mean haemoglobin among the study population was 11.417gm/dl(SD;±1.07). The rang was 7.5gm/dl to 14. 7gm/dl. Percntile values are; 5th percentile= 9.5gm/dl, 25th percentile=10.8gm/dl, 50th percentile=11.5gm/dl, 75th percentile=12.1gm/dl and 95th percentile was 13.1gm/dl. Haemoglobin was found to be normally distributed in the study population. Median and mode was same(11.5gm). There was no skewness. WHO recommended lowest cutoff value for haemoglobin in children at sea level are: 11gm/dl for 6month to 59 month., 11.5gm/dl for 5yrs. to 11yrs. and 12gm/dl for 12 to 14yrs[1,2]. in comparison to that, the mean Hb. in this study in different age group are; 10.73gm/dl(±0.99) for 1 to 4 yrs., 11.33gm/dl(±0.98)

For 4 to 9 yrs. and 12.03gm/dl(±0.94) for 9 to 14 yrs. age. It indicates that mean haemoglobin is almost same as compared with WHO cut off value except for 1 to 4 yr age group which is lower in this study. In another study Frag et al. observed lower value in younger age group of children[7]. This difference is probably physiological. Nutrition seems doesn't have anything to do with this difference. Because in all age group mean Z-score for wt. for age was -2SD. More over it was found that there was no significant correlation between mean haemoglobin and mean Z-score for wt. for age(r=0.005, P=0.927). There was no observed significant difference in Hb. distribution in different sex groups in the study population. There was also no significant difference in mean haemoglobin among male and female children in different age groups. In this study mean haemoglobin for male children was, 11.4gm/dl(±1.13) and that for female children was, 11.43(±0.99). Mann and WhitneyU test shows no significant difference of mean haemoglobin between two sexes(P=0.836). Hawkins et al. has shown in their study that sex difference in mean haemoglobin becomes apparent after 20 yrs of age[10].WHO also has not recommended any different value for male and female children[1]. However there is significant age specific variation in mean haemoglobin.Significant difference was observed in mean haemoglobin among different age groups(P=0.01). This was noted in other studies also[11,12,13,14].Age difference and age group variation is well documented by WHO and other studies[1,15]. Other factors influencing mean haemoglobin were family income, occupation of the parent, education of the parents and nutrition status. There was significant correlation between haemoglobin level and age(r=0.478, P=0.01). Iron status and nutritional status could be low in young children group. Mayer et al. observed that young children are vulnerable to anaemia, and nutritional anaemia is the most common cause[16]. Ahmed et al. in their study in Dhaka city in Bangladesh implicated pattern of foods as a significant factor for low hemoglobin in adolescent school boys[7]. How ever

Duggan et al. found no correlation between biochemical iron status and protein energy nutritional status[14]. However other studies support the view that deficient iron intake is important contributor for low haemoglobin in infancy and early childhood[17,18]. In the studied population haemoglobin was normally distributed and there was no skewness. This indicates that haemoglobin values found in this study are normal for the studied population.

The WHO cut off value for haematocrit below which anaemia is considered to be present in children are as follows[1];

Age group	Haematocrit
6mo. to 59mo.	0.33
5yr. to 11 yr.	0.34
12yr. to 14yr.	0.36

In the present study mean PCV was 36.24%(SD;±3.31). In age groups in comparison to WHO cut off the mean PCV were: 1 to 4yr.; 34.35%(±3), 4 to 9 yr.; 36.03(±3.04), and 9 to 14 yr.;38(±3.05). This indicates that the children studied were not anaemic even as per WHO standard. More over there was a positive correlation found between Hb. level and PCV(r= .884, P= .000). So,the haemoglobin value found in this group can be taken as normal. Mean value for MCV was 79.13fl(SD;±8.2fl), which is much above the lowest value (72fl) bellow which haemoglobin falls bellow the lowest cut for anaemia[18]. Domellof et al. has suggested – 2SD cut off value for MCV as 73 – 71 fl. in infants who are fed with iron fortified formula and ferritin > 10ng/L[19]. In the present study MCV is much higher than these values. It can be presumed that the population studied is having normal MCV, so haemoglobin level found was the normal value of that population. Mean corpuscular haemoglobin (MCH) remains higher bellow 6mo. of age. It falls progressively to reach it's nadir at 21 to 24 month of age. Duggan et al. found mean MCH in Asian healthy children at different age groups as follows[14]; at 3 – <6mo = 25.7, 6 - <9mo. = 24.1, 9 - <12 mo. = 23.7and at about 21 - <24 mo. = 21.9pg. The authors implicated it to the deficient iron intake. In the present study mean MCH was 24.82pg(SD; ±2.59) which is quiet higher than the Dggan's study and comparable to the value at 3 - <mo. age group. This fact also support the assumption that the children of this study are not iron deficient. Age wise distribution of normal mean corpuscular haemoglobin concentration(MCHC) is[9]; 3mo. to yr. = 30 – 36 gm/dl.RBC, 2yr. to 18 yr. = 31 – 37 gm/dl.RBC. Mean MCHC in this study was 31.29gm±1.84gm/dl.RBC. So, it is obvious that distribution of MCHC in this study is within normal limit. Mean MCHC was positively correlated with haemoglobin level(r = 0.198, P = 0.001). Serum iron was found to be positively correlated with level of haemoglobin in this study(r = 0.242, P = 0.000) The mean value was 59.72±32.94µgm/dl which was also within normal limit(22 – 184 µgm/dl)[11]. However iron depletion state is better reflected by serum ferritin level. WHO cut off value for serum ferritin is 15ngm/dl. Bellow this level iron store is considered to be depleted[1]. In the present study mean serum ferritin level in apparently non infectious children was 59.4ngm/dl. So, it can be assumed that the studied population was not iron depleted.

Conclusion: With all these observations and analysis it can be concluded that the normal mean haemoglobin of the study group of children (1yr to 14 yr. age) is 11.41gm/dl with SD=±1.07. Median value is 11.5gm/dl. Percentile values are; 5^{th} percentile= 9.5gm/dl,50^{th} percentile=11.5gm/dl, 75^{th} percentile=12.1gm/dl and 95^{th} percentile=13.1gm/dl. Haemoglobin is distributed normally in the studied population. No significant difference in mean haemoglobin between two sexes was observed. There was significant difference in mean haemoglobin between different age groups. Socio demographic factors that affect haemoglobin in a positive way are; total monthly income of the family, parental literacy and occupation of the parents. Important factor that was found to have no significant correlation with haemoglobin level was weight for age Z score. Haemoglobin distribution among 1yr. to 14 yr. age group of children was almost same as WHO set level.

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