ORIGINAL ARTICLE

Magnitude and severity of anemia, its clinico-pathological types and the burden of iron deficiency in adolescent boys: Is weekly iron supplementation a step in the right direction

Monalisha Sahu [1], Ranjan Das [2], Anita Nangia [3]

[1] Senior Resident, [2,3]Professor Departments of Community Medicine & Pathology, Lady Hardinge Medical College & Associated Hospitals, Shaheed Bhagat Singh Marg, New Delhi- 110001, India

Abstract | Introduction | Methodology | Results | Conclusion | References | Citation | Tables / Figures

Corresponding Author

Address for Correspondence: Monalisha Sahu, University College of Medical Sciences & Guru Teg Bahadur Hospital, Delhi-110095
E Mail ID: drmonalisha@outlook.com

Citation

Sahu M, Das R, Nangia A. Magnitude and severity of anemia, its clinico-pathological types and the burden of iron deficiency in adolescent boys: Is weekly iron supplementation a step in the right direction. Indian J Comm Health. 2014;26, Suppl S2:326-332

Source of Funding : Nil **Conflict of Interest:** None declared

Abstract

Background: Iron-deficiency anaemia is a major global public health problem affecting all stages of life cycle. Adolescent boys are also vulnerable to it owing to their growth spurt and inadequate dietary intakes. Assessment of anaemia and quantification of the burden of iron-deficiency anemia in them has been less studied. Knowledge of these aspects at the local level may help public health functionaries take appropriate decisions. **Objectives:** i) To assess the magnitude and severity of anaemia in adolescent boys residing in a peri-urban community of Delhi, ii) To identify the clinico-pathological type of anemia and among adolescent boys residing in a South Delhi locality iii) To estimate the burden of iron deficiency in them. **Materials and Methods:** A Community-based cross sectional study was conducted in 250 adolescent boys at Mehrauli in South Delhi in 2012. Hemoglobin estimation was done by Hemocue method, severity of anaemia assessed as per WHO criteria. To assess the clinico-pathological type of anaemia peripheral smears were prepared and stained with Wright Giemsa stain for assessing red-cell morphology. Serum ferritin estimation by MAb ELISA was done to confirm Iron deficiency. Statistical analysis: SPSS ver 12 and Epi Info ver 7 softwares were used for data entry and analysis. Mean and SD was calculated for quantitative variables while qualitative variables were compared by percentages. Chi-square test and ANOVA was used for checking statistical significance in observed differences. **Results:** Pallor was seen in 14.6%. Prevalence of anaemia was 16.4% with proportion of mild, moderate and severe anemia being 66.7%, 31.2% and 2.1% respectively. Mean haemoglobin concentration was 13.03 ±1.18 gm% (min 7.6, max 15.0). Anemia prevalence increased with increase in age (9.6%, 18.4% and 26.0% in early, middle and late adolescence, respectively). Clinico-pathological type of anaemia was microcytic-hypochromic in 50.0%, normocytic-normochromic in 17.5%, megaloblastic in 10.0% and dimorphic in 1.2%. Serum ferritin estimation performed on subjects having smear suggestive of iron deficiency led us to conclude that 16.1% had low serum ferritin levels and iron-deficiency anaemia. Statistically significant association of iron-deficiency anaemia was found with age, nutritional status, passage of worms in stool and lack of in-house toilet. **Conclusion:** Prevalence of anaemia as well as iron deficiency anaemia is low in adolescent boys and therefore is not a public health problem in this section of society. Providing iron supplements may not be warranted to them as is currently being done. More research is needed to identify the cause of such anaemia.

Key Words

Anemia; Adolescent boys; Iron-deficiency anemia; Serum ferritin; Socio-demographic factors

Introduction

Anemia is a global public health problem affecting all stages of the life cycle, and has major consequences for human health as well as social and economic development [1]. There is dearth of information on anemia among adolescent children because traditionally the focus has been on pre-school children and women [2]. Though there are few studies on anemia in adolescent girls [3, 4,] their male counterparts have not been studied even though the condition is known to lead to reduced physical, mental and immune capacity [5]. More recently, iron deficiency has also been linked to structural changes in the brain in addition to the cognitive achievement and mathematical performance of adolescents [6].

In view of above, the efforts of the ministry of Health and Family Welfare in launching a programme for the prevention and control of iron deficiency anemia among adolescent children, boys as well as girls, is laudable [7,8]. Unfortunately, however, there are very few studies documenting the severity of the problem among adolescent boys. Besides, iron deficiency, as the most predominant cause of anemia among adolescent boys has also not been documented. Information on both these aspects becomes especially relevant for justifying the launch of this new programme targeted towards boys.

In view of above and keeping in mind WHO's research recommendations, we conducted this community based pilot study.

Aims & Objectives

1. To assess the magnitude and severity of anaemia in adolescent boys residing in a peri-urban community of Delhi,
2. To identify the clinico-pathological type of anemia and among adolescent boys residing in a South Delhi locality,
3. To estimate the burden of iron deficiency in them.

Material and Methods

This community based cross-sectional study was conducted on adolescent boys 10-19 years residing in Mehrauli, a peri-urban area of South Delhi. One of the wards of Mehrauli, Ward IV, was selected randomly as our study area. A listing of all eligible subjects done before beginning the study identified 761 subjects of whom 250 subjects selected randomly were included in our study (taking 10% prevalence and permissible error of 3% and confidence level of 95%) [Epi Info]. Refusals were motivated to participate; however 8 boys/ their parents (3.2%) did not eventually give consent and had to be replaced by others. Written informed consent was obtained from subjects above 16, while the same was obtained from legal guardians if subject was less than 16 years. Subjects were classified to have iron deficiency anemia (IDA) if haemoglobin concentration was below the WHO recommended cut-offs [9], peripheral smear was suggestive of iron deficiency and serum ferritin level was also low [9]. Hemoglobin estimation was done on the spot using a portable electronic hemoglobinometer. A peripheral blood smear for microscopic examination was prepared for all those subjects who manifested anemia as per WHO recommended cut-offs. Results of the blood smear examination were confirmed by a faculty from Pathology department of LHMC. Subjects whose smears were found to have microcytic-hypochromic anemia, normocytic-normochromic anemia or mixed picture, were visited again and another blood sample was collected for estimation of serum ferritin. Estimation of serum ferritin was done by using Ferritin Blood Test ELISA kit procured by LHMC. WHO recommended cut-offs were used for assessing iron deficiency (serum ferritin < 15 µg/l and < 30 µg/l in the presence of infections)[9]. A brief socio-demographic, medical and nutrient intake history was recorded for all subjects along with a quick clinical examination.

Results

Background characteristics of study subjects: Of the total 250 boys, 72 (28.8%) were 10-13 years, 79 (31.6%) in 14-16 years and 99 (39.6%) were 17-19 years. 40% families belonged to Lower Socio-economic Class while 58% were in Middle class [As per modified Kuppuswamy Scale]. Nuclear households were predominant (72.4%). Eighty-two percent of boys belonged to

Hindu family and 13.6% to Muslim family; subjects belonging to SC/ST families were 18.8% with 26.4% belonging to OBC families. Close to one third (29.6%) of the other's of our subjects had less than 5 years of formal education while 36.8% had over 12 years of schooling. 25.2% of the mothers were either illiterate or just literate. Over half (52.0%) of the fathers were engaged in manual labour while 32.8% were either clerks or shop-keepers or farmers. All

except 8 (96.8%) of subjects were students. Over a third (34.4%) of the subjects were undernourished as per WHO recommended BMI cut-offs for adolescents while 11.6% were overweight.

Hemoglobin concentration, magnitude and severity of anemia: Haemoglobin concentration was found to range from 7.6 to 15.0 gm%. Overall, the mean hemoglobin concentration was 13.03 + 1.18 gm% with the mean among those having anemia being significantly lower (10.9 + 1.06 gm% as compared to 13.45 + 0.63 gm% among those having no anemia; $x2 = 14.77$, $P < 0.001$). Hemoglobin concentration in young, middle and late adolescence was found to be 12.7 + 1.15 gm%, 13.1 + 1.13 and 13.2 + 1.24, respectively. The difference in mean haemoglobin was found to be significant on applying ANOVA [$F(2,247)= 3.09$, $P<0.05$](median values and inter-quartile range is shown in Figure 1).

Clinical anaemia as assessed by pallor was seen in 14.6% of the adolescent boys, whereas the overall prevalence of anemia diagnosed by haemocue method was found to be 16.4%. The Cohen's kappa for aggrement between clinical anaemia and anaemia diagnosed by haemocue method was significant at p value of < 0.5. Prevalence of anemia was found to increase with increasing age; prevalence was 11.4% in early adolescence, 15.5% in middle adolescence and

28.3% in late adolescence. ($\chi2 = 6.415$, $P = 0.04$). Figure 3 depicts the severity of anemia in study subjects of young, middle and late adolescence. Severe anemia was not found in early and middle adolescence, while only one case was seen in late adolescence. Overall, the proportion contributed by mild and moderate anemia was 66.7% and 31.2%, respectively. The mean haemoglobin concentration for mild anaemia was 11.3+0.8 whereas for moderate anaemia it was 10.5+0.9.

Clinico-pathological type of anemia and burden of iron deficiency

Figure 2 shows the clinico-pathological type of anemia and burden of iron deficiency among subjects having manifest anemia. Of the 41 subjects manifesting anemia, 1 subject refused to give blood again as a result of which PBSE could be carried out in 40 subjects only. 50% of the subjects having manifest anemia exhibited microcytic hypochromic anemia (MHA), 22.5% showed mixed picture (MXA) while 17.5% had normocytic normochromic anemia (NNA). The remaining 10% of anemic subjects had megaloblastic anemia (MBA). Blood picture showing RBC morphology like MHA, NNA & MXA were presumptive of Iron deficiency. Therefore, those were assessed for their iron status by doing a serum ferritin estimation for confirming the same. The mean haemoglobin concentration was lowest for those with blood smear showing microcytic hypochromic anaemia (10.5 + 1.18 gm%) whereas it was higher in those showing normocytic normochromic anaemia (11.4 + 0.88 gm%). The overall prevalence of iron deficiency among those having anemia and having MHA or NNA or MXA on BSE was 53.3%. IDA was present in 71.4% of MXA, 66.6% of NNA and 41.2% of MHA.

Statistically significant association of iron-deficiency anaemia was found with age, nutritional status, passage of worms in stool and lack of in-house toilet.

Discussion

The present study yielded relatively low prevalence (16.4%) of anaemia among adolescent boys as compared to the national average of 30% [10]. Many other studies also reported low prevalence of anaemia in adolescent boys e.g. in a cross sectional study conducted by Basu et al[11] the prevalence of anaemia reported was as low as 7.7%. Similarly, in a study by Muthayya et al [12] in Banglore and Goel et al [13] in Shimla prevalence in adolescent boys was found to be 12% & 12.9% respectively. Whereas, Balci et al[14] in Turkey, Ahmad et al[15] in Bangladesh and Agha et al[16] in Islamabad reported prevalence of anaemia to be 1.6%, 7% &17% respectively.

But various other studies conducted in India and other developing countries reported higher prevalence also. SudhaGandhi et al[17] in Kattan Kulathur, Tamil Nadu, Jain et al[18] in Urban Meerut, Hydere et al[19] in Bangladesh and Hettiarchi et al[20] in Sri Lanka reported prevalence of anaemia to be 35.5%, 42.8%, 69%, and 49.5% respectively. Shahbuddin et al [21] in Bangladesh reported anaemia in adolescent boys as high as 94%. These differences may be due to difference in age groups studied, different study settings and difference in cut-off values and diagnostic methods for anaemia.

Prevalence of anemia was found to be 11.4% in early adolescence, 15.5% in middle adolescence and 28.3% in late adolescence Prevalence increased with increase in age. This can be explained by pubertal spurt in males and increased requirement of nutrients for growth. Similar trend was seen in the study by Anand et al [22] in rural Delhi, where it was

reported to be 27.8% in 12-14 yrs and 41.3% in 15-18 yrs age group of adolescent boys. But in another study by Yerpude et al[23] in slum area of Andhra Pradesh the trend was reverse as prevalence was found to be 40.1%, 35.2% and 25% in the age groups of 10-13 yrs, 14-16 yrs and 17-19 yrs respectively.

Overall, the proportion contributed by mild, moderate and severe anemia was 66.7% and 31.2% and 2.1% respectively majority contributed by mild and moderate anaemia. Similar results were seen in the study conducted by Yerpude et al [23] in Andhra Pradesh (54.72 % Mild anaemia, 33.96% Moderate anaemia, 11.32% severe anaemia) and Gupta et al [24] in Meerut (95.0% Mild anaemia 3.3% Moderate anaemia, 1.7% severe anaemia)

50% of the subjects exhibited microcytic hypochromic anemia, 22.5% showed mixed picture while 17.5% had normocytic normochromic anemia. In study by Verma et al [25] in Ludhiana

Punjab also the commonest blood picture was microcytic hypochromic (55.4%) followed by normocytic normochronic in 37.5% and dimorphic picture in 1.7% only.

Various studies confirm that serum ferritin is one of the most sensitive method for assessment of iron stores and for the detection of mild iron depletion (26). Its levels are directly related to bone marrow iron in all disease groups except those involving chronic inflammatory stage, malignancy and increased red cell turnover (27).

The overall prevalence of iron deficiency anaemia (Low haemoglobin, blood smear suggestive of iron deficiency and low serum ferritin) was 53.3% in our study. Whereas in another study by Basu et al[10] in Chandigarh none of the boys had confirmed Iron deficiency anemia i.e., hemoglobin level below the cut off for the age and serum ferritin level less than 15 ng/mL, but the total number of boys tested for serum ferritin was small.

Conclusion

This study highlights that prevalence of anaemia is low in adolescent boys (16.4%; IDA -53.3%) and so iron-deficiency anaemia is not a public health problem in this section of society unlike adolescent girls. Government is giving equal dosage of iron tablets to all adolescents including the boys and to those who're not anemic. The chances are there that children, who're not anemic, will react adversely to the overdose and fall ill.

Recommendation

Therefore, we suggest that there is a need for well planned, systematic and large-scale studies by using standardized methodologies to estimate the prevalence of anaemia as well as the causes of anaemia at the community level among adolescent boys in all the age groups, with the representation of the different regions of India. Also, screening for anaemia must be done first before giving Iron supplements to all blindly.

Limitation of the study *(If any)*

To study the iron status of this population some other tests in addition to serum ferritin, like serum transferrin and serum iron could have provided better estimate than the serum ferritin alone. Also, serum ferritin estimation was not performed for all the boys but only for those who were suffering from anaemia due to logistic reason.

Relevance of the study

There are very less community based studies on the nutritional status and specially iron status of adolescent boys. Exact magnitude of anaemia in adolescent boys is also not well known. This study is trying to throw some light on this relatively untouched area.

Authors Contribution

Author 1 – Planning the study, Data collection, Analysis, Writing the paper, Author 2 - Planning the study, supervising the study, Final review of the paper, Author 3 - Planning the study, Reporting of the slides, supervising the study, Final review of the paper.

Acknowledgement

We would like to thank the study participants for their co-operation.

References

1. Worldwide prevalence of anemia 1993 – 2005. Eds. Bruno de Benoist et al. WHO, Geneva, 2008.
2. Demayer EM. Preventing and Controlling Iron Deficiency Anemia Through Primary Health Care - A Guide for Health Administrators and Programme Managers. Geneva, World Health Organization, 1989; p 26
3. Halterman JS. Iron deficiency and cognitive achievement among school-aged children and adolescents in the US. Pediatrics. 2001; 107(6): 1381-6.
4. Dugdale M. Anemia. Obstet Gynecol Clin North Am. 2001; 28 (2): 363-81
5. WHO. Assessing the iron status of populations.WHO, Geneva, 2005
6. Neda Jahanshada, Omid Kohannima, Derrek P. Hibara. Brain structure in healthy adults is related to serum transferrin and the H63D polymorphism in the HFE gene PNAS Proceedings of

the National Academy of Sciences, USA April 3, 2012 vol. 109 no. 14E851-E859.
7. Press Bureau of India, GOI (2013). Ministry of Health and & Family Welfare (24th April, 2012). Weekly Iron and Folic Acid Supplementation Programme for adolescents [Press release]. New Delhi,
8. Government of India. A strategic approach to Reproductive, maternal, new-born, child and adolescent health (RMNCHA+A) in India. Ministry of Health and Family Welfare. New Delhi: Government of India; February 2013.
9. WHO. Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity. Vitamin and Mineral Nutrition Information System. Geneva, World Health Organization, 2011 (WHO/NMH/NHD/MNM/11.1). Available at (http://www.who.int/vmnis/indicators/haemoglobin.pdf, accessed [11/12/2013]).
10. IIPS/NFHS. National Family Health Survey Phase-III. International Institute for Population Sciences; 2005-06. Deonar, Mumbai-78, India. http://www.nfhsindia.org
11. Basu S, Basu S, Hazarika R, Parmar V. Prevalence of anemia among school going adolescents of Chandigarh.Indian Paediatrics. 2005;42:593-597.
12. Muthayya S, Thankachan P, Zimmermann MB, Andersson M, Eilander A, Misquith D, Hurrell RF, Kurpad AV. Low anemia prevalence in school-aged children in Bangalore, South India: possible effect of school health initiatives.
13. Goel S, Gupta B P. Low anaemia prevalence among adolescents of an urban hilly community. Indian J Community Med 2007;32:67-8.
14. Balcı, Karabulut, Gürses, Çövü. Prevalence and Risk Factors of Anaemia among Adolescents in Denizli, Turkey. Iranian Journal of Pediatrics 2012. 22(1):77-81.
15. Ahmed F, Rahman A, Noor AN, Akhtaruzzaman M, Hughes R. Anaemia and vitamin A status among adolescent schoolboys in Dhaka City Public Health Nutr Bangladesh. 2006 May;9(3):345-50.
16. Agha F, Sadaruddin A, Khan RA, Ghafoor A. Iron Defi ciency in Adolescents. J Pak Med Assoc., 1992; 42(1): 3-5.
17. Sudhagandhi B, Sundaresan S, William W E, Prema A. Prevalence of anaemia in the school children of Kattankulathur, Tamil Nadu, India. Int J Nutr Pharmacol Neurol Dis 2011;1:184-8.
18. Jain T, Chopra H, Mohan Y, Rao S.Prevalence of anemia and its relation to socio-demographic factors: crosssectional study among adolescent boys in urban Meerut, India. Biology and Medicine. 2011;3(5):01-05.
19. Hyder SMZ, Chowdhury SA, Chowdhury AMR. Prevalence of anaemia and intestinal parasites in a rural community of Bangladesh. Bangladesh: Research and Evaluation Division, BRAC;1998.
20. Hettiarachchi M, Liyanage C,Wickremasinghe R, Hilmers DC, Abrahams SA. Prevalence and severity of micronutrient deficiency: a cross-sectional study among adolescents in Sri Lanka. Asia Pac J Clin Nutr. 2006;15(1):56-63
21. Shahabuddin AKM, Hassan MQ, Seal A, Hannan MA, Tomkins, Bangladesh. 14-15 February, 1998. Costello A. Adolescent nutrition in a rural community in Bangladesh. Paper presented at the 7th Annual Scientific Conference (ASCON-VII) of the International Centre for A Diarrhoeal Disease Research
22. K Anand, Kant S, Kapoor S K. Nutritional Status of Adolescent School Children in Rural North India. Nutritional Status of Adolescent School Children in Rural North India 1998.
23. Pravin N Yerpude, Keerti S Jogdand. A cross sectional study of socio-demographic determinants of anaemia in adolesecent boys of urban slum area in south India. International Journal of Medical Research and Health Sciences. 2013;2(3):463- 468. Available at: <http://ijmrhs.com/a-cross-sectional-study-of-socio-demographic-determinants-of-anaemia-in-adolesecent-boys-of-urban-slum-area-in-south-india/>. Date accessed: 14 Dec. 2013.
24. Gupta D, Pant B, Kumari R, Gupta M. Screen Out Anaemia among Adolescent Boys as Well!. Natl J Community Med 2013; 4(1): 20-5.
25. Verma M, Chhatwal J, Kaur G. Prevalence of anemia among urban school children of Punjab. Indian Pediatr. 1998 Dec;35(12):1181-6. PubMed PMID: 10216692.Eur J Clin Nutr. 2007 Jul;61(7):865-9. Epub 2007 Jan 24. Blood 1980; 56: 786-791.
26. Richard LG. Iron deficiency and iron deficiency anemia. Richard LG, Foerster J, Lukem J, Paraskevas F, Green JP, Rodgus GM, editors. Wintrobe's Clinical Haematology. 10th ed. Baltimore: Interprint; 1999; p 979-1010.
27. Jacob RA, Sandotead HM, Klevay LM. Utility of serum iron as a measure of iron deficiency in normal males undergoing repetitive phlebotomy.Blood 1980; 56: 786-791.

Figures

FIGURE 1 BOX PLOT SHOWING MEDIAN VALUES AND INTERQUARTILE RANGE OF HAEMOGLOBIM IN DIFFERENT AGE GROUPS

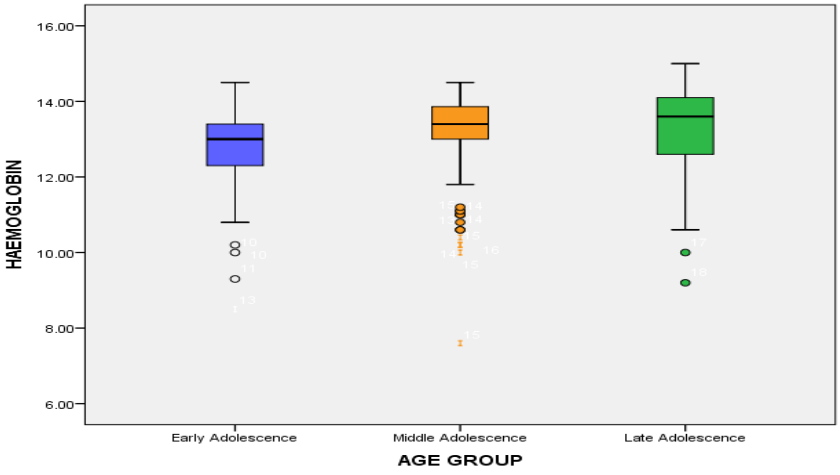

FIGURE 2 PREVALENCE OF ANEMIA AND ITS CLINIC-PATHOLOGICAL TYPES IN ADOLESCENT BOYS

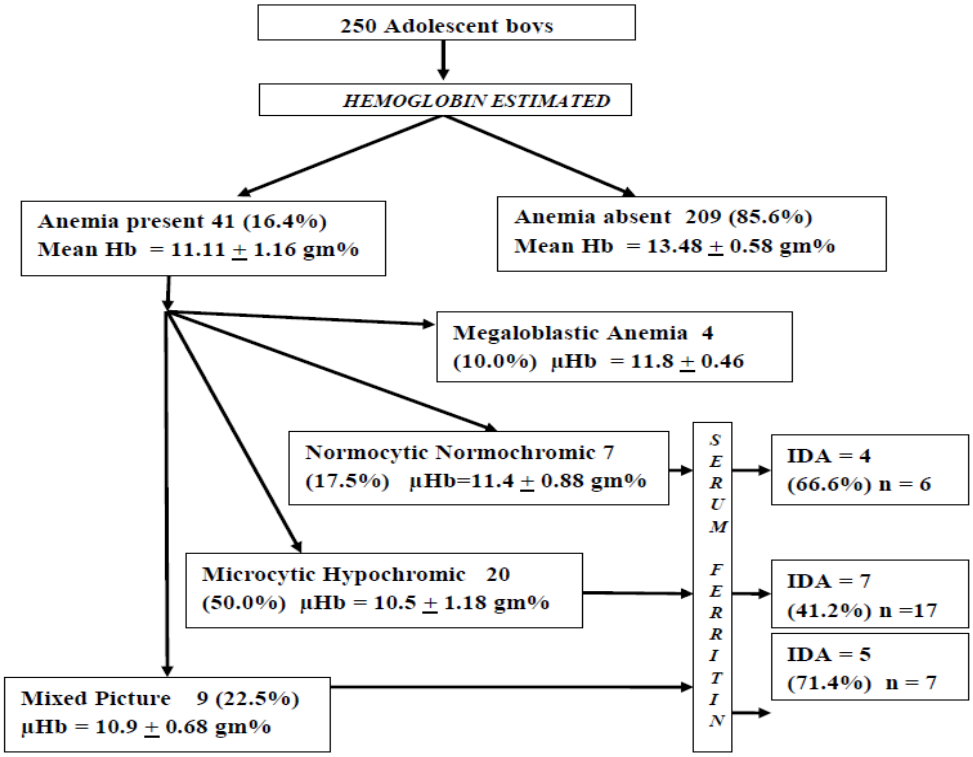

FIGURE 3 BAR CHART SHOWING SEVERITY OF ANEMIA IN THE THREE STAGES OF ADOLESCENCE