Original Article

Screening Anemia in Adolescents: A Study Conducted at a Tertiary Care Rural Hospital

Tanvi Ramakant Sambhus, Mangala Nagare, Pratik Kamlik, Gauri Metkar, Harsha Jaykar, Smita P. Bhide

Department of Pathology, Maharashtra Institute of Medical Education and Research, Pune, Maharashtra, India

ABSTRACT

Background: Anemia is a global public health concern. Adolescence is defined by the World Health Organization as ages between 10 and 19. In this phase of life, anemia can hamper neurodevelopment, puberty, and work capacity, and it can increase susceptibility to infectious diseases. A complete blood count (CBC) along with red cell indices is a helpful tool for the routine investigation of anemia. **Aims:** This study aims to screen for anemia in adolescents at a tertiary care rural hospital. **Settings and Design:** This was a retrospective study conducted in the Department of Pathology. **Materials and Methods:** CBC reports of the study participants were analyzed. Results were tabulated using MS Excel software version 2301. **Statistical Analysis Used**: Frequency analysis was performed to describe descriptive statistics frequency analysis; percentage analysis was used for categorical variables and the mean and standard deviation were derived for continuous variables. **Results:** Out of 188 adolescent patients, the mean age was 14.9 years; males predominated (n = 106; 58%), and anemia was most severe in the 11-year-old age group (n = 19; Hb–11.3 g/dL). Ninety-six patients were anemic; 49 had microcytic anemia (mean corpuscular volume [MCV]–67.3 femtoliters [fL]). Four patients had macrocytic anemia (mean MCV–104.6 fL); 43 patients had normocytic anemia (mean MCV–85.4 fL). **Conclusion:** This study was an assessment of anemia in adolescents in the Maval region of Maharashtra, India. Nutrition and underlying infection have a role to play in the etiology of anemia. In resource-limited conditions, a simple CBC is a powerful tool to identify and classify anemia.

Key words: Adolescent, anemia, hemoglobin

INTRODUCTION

Anemia is a global public health concern. In this condition, the oxygen-carrying capacity is so reduced that the physiological needs of the body are unmet. The physiological needs depend on the age, sex, level of elevation, smoking habits, and pregnancy.[1] Adolescence is defined by the World Health Organization (WHO) as ages between 10 and 19.[2] In this phase of life, anemia can hamper neurodevelopment, puberty, and work capacity, and it can increase susceptibility to infectious diseases.[3] While it remains a global concern, anemia is more prone to affect those residing in low-to-middle-income countries (LMIC) due to poverty, malnutrition, and limited access to health care.[4] Adolescent boys require increased amounts of iron to make up for increased muscle mass whereas girls are at a greater disadvantage due to blood loss from menstruation including menorrhagia and in the case of early pregnancy potential perinatal complications.

Access this article online	
Website: themmj.in	Quick Response Code
DOI: 10.15713/ins.mmj.86	

Address for correspondence:
Dr. Mangala Nagare, Department of Pathology, Maharashtra Institute of Medical Education and Research, Pune, Maharashtra, India. Mobile: +91-9881099589. E-mail: stencildiagnostics@gmail.com

India is home to 253 million adolescents, comprising one-quarter of the population.[5] Anemia affects 18% of boys and 40% of girls.[6] The etiology of anemia can be broadly divided into those related to impaired production of red blood cells (RBCs) or increased destruction. Chronic illness and infections are contributory factors. Nutritional anemias comprise the greater proportion of the former and include deficiencies of iron and Vitamin B. According to the WHO, iron deficiency is the leading cause of nutritional anemia.[7]

A complete blood count (CBC) is a routine tool to evaluate the health of an individual. It includes RBC indices, total leukocyte count (TLC), and platelet count which can offer a clue to the status of anemia among individuals. The parameters included in the RBC indices are hemoglobin (Hb) level, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and MCH concentration (MCHC). These parameters were introduced by Wintrobe in 1929 to describe the size and Hb content of RBCs. Normal MCV values are 87 ± 7 femtoliters (fL). Normal MCH values are 29 ± 2 picograms (pg) per cell. Normal MCHC values are 34 ± 2 (g/dL).[8] Red cell indices are invaluable in the morphologic diagnosis of anemia. An experienced clinician can pinpoint the cause of anemia with a humble CBC and a peripheral smear.

There are some data available in this country about the severity of anemia in adolescent girls whereas information on anemia in the male counterpart is lacking.

Aims and Objectives

This study aims to assess anemia in adolescents at a tertiary care rural hospital.

MATERIALS AND METHODS

This was a retrospective, cross-sectional study conducted over 6 months at a tertiary rural health care center in the Maval region of the Pune district of Maharashtra, India. Adolescents between 10 and 19 years of age were included. Details regarding age, sex, and CBC of the study participants from January to March 2023 were retrieved from the laboratory information system. Confidentiality was maintained. The universal sampling method was used. 2 ml of venous blood of each study participant was collected in an ethylenediaminetetraacetic acid vial, and the sample was analyzed by the MINDRAY 6000 hematology analyzer. Hb was estimated using the modified cyanmethemoglobin method. The Hb concentration cut-offs taken were as follows: <11.5 g/dL for 10–11 years old; <12 g/dL for individuals between 12 and 14 years of age and females between 15 and 19 years; and <13 g/dL for males between 15 and 19 years.[9] Normal MCV was taken to be 80–100 fL. Values <80 fL were considered microcytic anemia and those above 100 fL were considered macrocytic. Normal MCH was taken as 27–34 pg. Values <27 pg were considered hypochromic. Normal MCHC was taken to be 32–36 g/dL. Normal TLC was considered between 4000 and 11,000 cells/mL. Values above the upper limit were taken to be indicative of infection. The results were tabulated using MS Excel software version 2310. Frequency analysis was used to describe descriptive statistics and frequency analysis and percentage analysis were used to describe categorical variables and mean, and standard deviation was used to describe continuous variables.

RESULTS

There were a total of 210 study participants in this study. Males predominated (58%). The mean age was 14.9 years. Most of the study participants were 18-year-old males [33%; Figure 1]. The mean Hb was 12.3 g/dL. Overall, females were seen to be anemic in comparison to males (n = 89; mean Hb–11.4 g/dL). The mean Hb distribution over age groups and sex was calculated. Study participants in the 10–11-year age group were the most anemic [11.4 g/dL; Figure 2].

Severe anemia was seen most in females in the 15–19-year age group (5/24). Moderate anemia was also seen most in females in the 15–19-year age group (14/24). Mild anemia was seen most in males in the 15–19-year age group [9/13; Table 1].

The mean MCV, MCH, and MCHC were 81.4 fL, 40.2 pg, and 33 g/dL. Microcytic hypochromic anemia was seen most in females in the 15–19-year age group [n = 24/72; Figure 3]. Figure 4 shows the distribution of the three morphologic categories of anemia based on MCV.

DISCUSSION

Anemia is a globally prevalent disease and India, being one of the LMIC countries, is severely affected. India is home to 240 million (20%) adolescents of which 115 million (48%) are girls.[10] According to Scott *et al*.,[5] in India, anemia is prevalent in 28.5% of adolescents; more

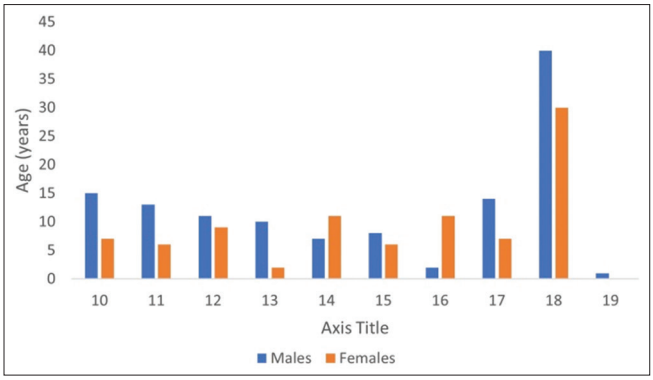

Figure 1: Age wise sex distribution.

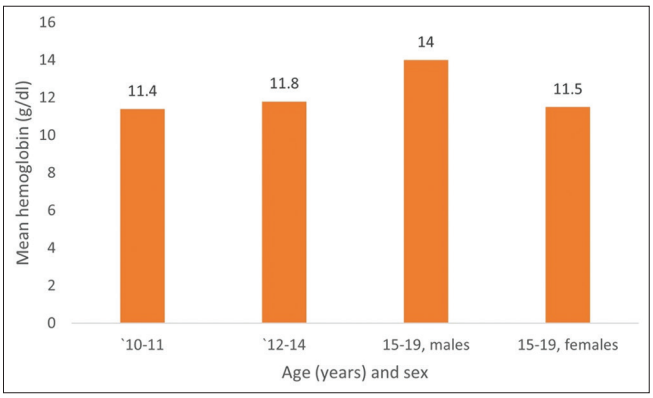

Figure 2: Mean hemoglobin levels according to age and sex.

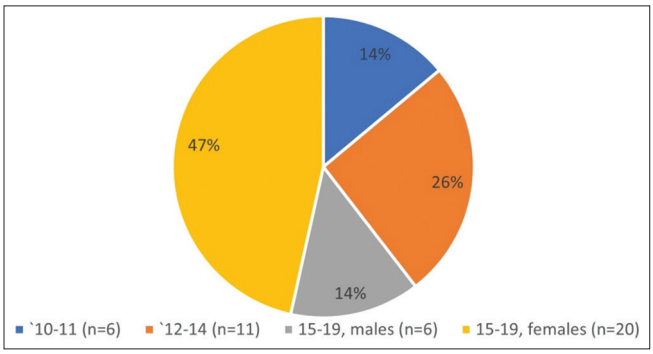

Figure 3: Distribution of microcytic hypochromic anemia according to age and sex.

than 72 million adolescents. They reported anemia to be present more in girls (48.7 million; 39.6%) than in boys (23.7 million; 17.6%). In the present study, the female population was more anemic (n = 89; 11.4 g/dl) as compared to the male population (n = 121; 13.0 g/dl), a finding concordant with the study. Similar findings were reported by Soman *et al*.[11] where anemia was seen in 62% of females compared to 46.1% of males. It is conceivable that these results may be related to the

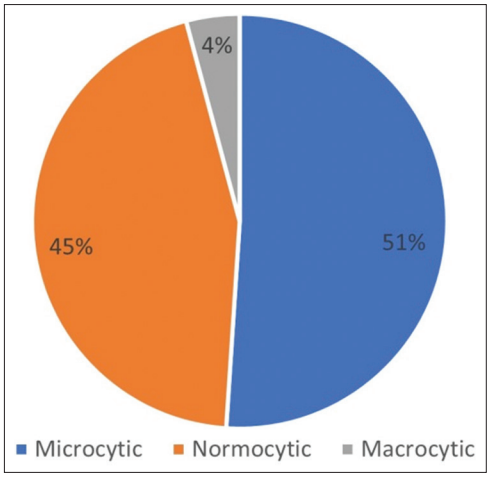

Figure 4: Classification of anemia based on MCV and hemoglobin. MCV - mean corpuscular volume.

Table 1: Severity of anemia according to age and sex

Age (years) and sex	Mean hemoglobin	Mild anemia	Moderate anemia	Severe anemia
10–11 (n=16)	11.4	4	9	3
12–14 (n=19)	11.8	6	9	4
15–19, males (n=13)	14	9	3	1
15–19, females (n=24)	11.5	5	14	5

onset of menstruation in adolescent girls which leads to blood loss and a potential deficiency of iron and decreased Hb levels.[12]

According to the study conducted by Scott *et al*.,[5] girls in the 15–19-year-age group (47.5%) were the most affected whereas 10–14-year-old (17.1%) adolescent boys were the least anemic. However, in the present study, anemia was most severe in the 10–11-year age group (n = 16; 11.4 g/dL) whereas males in the 15–19-year age group (n = 13; 14 g/dL) were the least anemic.

MCV is a measure of the volume of an RBC. An RBC with a normal MCV (80–100 fL) is called a normocyte. An RBC that is smaller than this, i.e., has an MCV <80 fL is called a microcyte. Conversely, one that has an MCV >100 fL is called a macrocyte. When the MCV is paired with Hb levels, anemia can be classified as microcytic, macrocytic, or normocytic based on this parameter. The most common etiology of microcytic anemia is iron deficiency anemia. Thalassemia, sideroblastic anemia, and lead poisoning are additional causes. Macrocytic anemia is commonly caused by megaloblastic anemia, chronic alcoholism, and hypothyroidism. In our study, most of the participants had microcytic anemia. Keen attention should be paid to determine the role played by deficiencies in nutrition of individuals in the adolescent age bracket.

MCH is a measure of the hemoglobinization of RBCs which is reflected by the central pallor of the RBCs. RBCs with low MHC (<27 pg) are said to be hypochromic, and the central pallor increases. Individuals with a low MCV and a low MCH are said to have microcytic hypochromic anemia; the RBCs are smaller than the size of the nucleus of a small lymphocyte with a greater central pallor. The most common cause of this kind of anemia is yet again iron deficiency anemia. In the present study, females in the 15–19-year age group predominantly suffered from microcytic hypochromic anemia.

CONCLUSION

This is the first study of its kind conducted in the Maval region of Maharashtra, India. This study was an assessment of anemia in adolescents referring to the outpatient department of a tertiary care rural health-care center. Female adolescents were seen to be most affected by anemia. Nutrition and underlying infection have a role to play in the etiology of anemia. When further investigation is unaffordable, a simple CBC is a powerful tool to identify and classify anemia in resource-limited conditions.

Limitations

The limitations of this study included the lack of clinical and examination details. This study took place in a rural setting; most of the participants were unable to afford special tests such as iron studies, B12, and folate levels.

REFERENCES

1. World Health Organization. Haemoglobin Concentrations for the Diagnosis of Anaemia and Assessment of Severity. Geneva: World Health Organization; 2011.
2. Ocak S, Kilicaslan O, Yildiz Yildirmak Z, Urganci N. Adolescents and anemia. SiSli Etfal Hastan Tip Bul/Med Bull Sisli Hosp 2017;4:309-17.
3. Balarajan Y, Ramakrishnan U, Özaltin E, Shankar AH, Subramanian SV. Anaemia in low-income and middle-income countries. Lancet 2011;378:2123-35.
4. Kaur S, Deshmukh PR, Garg BS. Epidemiological correlates of nutritional anemia in adolescent girls of Rural Wardha. Indian J Community Med 2006;31:45-54.
5. Scott S, Lahiri A, Sethi V, de Wagt A, Menon P, Yadav K, *et al.* Anaemia in Indians aged 10-19 years: Prevalence, burden and associated factors at national and regional levels. Matern Child Nutr 2022;18:e13391.
6. Golden NH, Cotter EM. Adolescent nutrition. Encyclopedia of Child and Adolescent Health. 1st ed., Vol. 1. Netherlands: Elsevier; 2023. p. 780-9.
7. Kumari R, Bharti RK, Singh K, Sinha A, Kumar S, Saran A, *et al.* Prevalence of iron deficiency and iron deficiency anaemia in adolescent girls in a tertiary care hospital. J Clin Diagn Res 2017;11:BC04-6.
8. Green PT. Red cell indices. Manit Med Rev 1950;30:371-2.
9. Sachdev HS, Porwal A, Acharya R, Ashraf S, Ramesh S, Khan N, *et al*. Haemoglobin thresholds to define anaemia in a national sample of healthy children and adolescents aged 1-19 years in India: A population-based study. Lancet Glob Health 2021;9:e822-31.
10. Aguayo VM, Paintal K, Singh G. The adolescent girls' anaemia control programme: A decade of programming experience to break the inter-generational cycle of malnutrition in India. Public Health Nutr 2013;16:1667-76.
11. Soman SK, Areekal B, Murali AJ, Varghese RG. Adolescent anaemia its prevalence and determinants: A cross-sectional study from south Kerala, India. Int J Community Med Public Health 2017;4:2750.
12. Kocaoz S, Cirpan R, Degirmencioglu AZ. The prevalence and impacts heavy menstrual bleeding on anemia, fatigue and quality of life in women of reproductive age. Pak J Med Sci 2019;35:365-70.

How to cite: Sambhus TR, Nagare M, Kamlik P, Metkar G, Jaykar H, Bhide SP. Screening Anemia in Adolescents: A Study Conducted at a Tertiary Care Rural Hospital. MIMER Med J 2023;7(1):5-8.

Source of Support: Nil. **Conflicts of Interest:** None declared.