



# Significance of Mentzer Index and Erythrocyte Indices to Evaluate Erythrocyte Morphology and Spectrum of Anemia in Adult Population in a Tertiary Care Hospital in Rural Haryana

Abhimanyu Sharma, Aasif Hamid Lone, Mehak Sharma, Manish Chaudhry

## Abstract

Anemia, reduced red cell mass below normal range, results in reduction of oxygen carrying capacity of blood that results in tissue hypoxia. MCV, MCH, MCHC and RDW represent a sensitive indicator to study erythrocyte morphology. Mentzer Index recommended  $MI < 13$  to be suggestive of  $\beta$ -TT and  $MI > 13$  for Iron deficiency anemia. 100 cases were analyzed prospectively over a span of 1 year at MMIMSR, Mullana. The study revealed 34% of patients to be in age group of 21-30 years with (59%) female predominance out of which majority of cases were of moderate anemia (73%). Erythrocyte indices revealed pattern with majority of samples having MCV, MCH and MCHC to be in normal range while RDW showed increased values. Mentzer index came out to be  $> 14$  in 96% of samples. To conclude evaluation of erythrocyte indices and Mentzer index aids in quantitative assessment of anemia and also to distinguish between iron deficiency anemia and thalassemia trait.

## Key Words

Mentzer index, Thalassemia, Iron deficiency anemia, RDW

## Introduction

Anemia is defined as reduced red cell mass below normal range along with reduction in the oxygen carrying capacity of blood that results in tissue hypoxia (1). In developing countries iron deficiency anemia is the most common nutritional disorder seen usually in young children & women of reproductive age group. Studies show with advancing age the prevalence of anemia increases (2). Anemia is more common in females under 75 years of age and it is common in males above 75 years of age. 30% of the world's population has iron deficiency anemia whereas its prevalence is 20% in industrialized nations and 30% in non-industrialized nations (3). In India a high prevalence of anemia is primarily because of low intake of Iron ( $< 20 \mu\text{g/day}$ ) and folic acid ( $< 70 \mu\text{g/day}$ ). Other causes include chronic blood loss due to worm infestation and also high phytate and fibre rich Indian diet causing poor bioavailability of Iron (3-4%) (4). In order to

characterize the type of anemia and make a differential diagnosis, the workup should include physical examination and laboratory tests such as evaluation of hematocrit, hemoglobin and erythrocyte indices which include MCV, MCH, MCHC and RDW (5).

RDW as calculated by automated analyzers measures RBC size heterogeneity and gives RBC size range in the sample. RDW represents a sensitive indicator and index representing the anisocytosis seen in peripheral blood. Iron deficiency anemia shows high RDW with normal to low MCV whereas uncomplicated  $\beta$ -TT shows normal RDW with low MCV (6-8). Mentzer index was introduced to distinguish between the two as, Mentzer Index recommended  $MI < 13$  is suggestive of  $\beta$ -TT and  $MI > 13$  suggestive of Iron deficiency anemia (9).

This study was an attempt to evaluate various patterns of anemia in adult population and significance of

From the Department of Pathology, Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana, Haryana- India  
Correspondence to: Abhimanyu Sharma, Assistant Professor, Department of Pathology, Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana, Haryana.

morphological evaluation of RBC on peripheral smear examination as well as erythrocyte parameters along with significance of Mentzer index in anemia.

### Material and Methods

A prospective study, comprising of 100 cases, was conducted at MMIMSR over a period of 1 year; 2018-19. All adult patients suspected of having anemia were analyzed by cell counter. Peripheral smear examination of anemic blood samples was done under light microscopy for morphological evaluation of anemia.

#### Inclusion criteria:

- Adult population from 19 to 84 years of age
- Both male and female of adult population were included in this study.

#### Exclusion criteria:

- Not willing for test

Samples were analyzed using cell counter with colorimetric method as well as manual staining using Leishman stain, for determining RBC morphology. All adult patients were then classified as anemic males with Hb < 13gm/dl & females with Hb < 12gm/dl & the patients with severe anemia below 7gm/dl. EDTA (K2) anticoagulated blood samples were used to estimate complete hemogram and erythrocyte parameters with Sysmex XP 100 hematology analyzer.

Mentzer originally described the ratio of MCV and RBC count as Mentzer index and it is calculated by using formula as MCV/RBC count (millions/ $\mu$ L). A Mentzer index more than 13 is an indicative of Iron deficiency anemia whereas index less than 13 is suggestive of Thalassemia (10). It was used to distinguish cases of iron deficiency from thalassemia.

### Results

100 samples were analyzed over a period of 1 year and out of which majority of patients were females; 59 within the age group of 21-30 years; 34% while minimum cases; 2% were in age group 71-80 years with mean hemoglobin levels between 8.1-9.0 g%.

Out of 100 cases it was observed that 8 had mild anemia, 74 had moderate anemia, 18 had severe anemia (Table 1). Peripheral Smear Findings are shown in Table 2.

In the study, microcytic hypochromic anemia predominated with 46 cases, normocytic normochromic

**Table 1: Distribution of Patients According to Degree of Severity of Anemia**

Anemia (g%)	No of Patients
Mild (10.0-10.9)	8
Moderate (7.1-10.0)	74
Severe (<7.0)	18
Total	100

**Table 2: Peripheral Smear Findings in Anemia**

PBF Findings	No. of Patients
Macrocytes	9
Tear Drop Cells	5
Target Cells	8
Pencil Cells	9
Basophilic Stipplings	1
Hypersegmented Neutrophils	5
Elliptocytes	1
Toxic Granules	3
Shift to left	5
Nucleated RBC's	1
Polychromasia	2
Fregmented RBC's	1

**Table 3: Morphological Types of Anemia**

Type of Anemia	No. of Patients
Microcytic & Hypochromic	46
Normocytic & Normochromic	25
Dimorphic	20
Macrocytic	9
Total	100

**Table 4: Distribution According to Mentzer Index**

Mentzer Index	Male (%)	Female (%)
<12	00	00
12.0-14.0	02	02
>14	39	57
Total	41	59

anemia followed with 25 cases, dimorphic and macrocytic anemia were the last to follow with 20 and 9 cases respectively (Table 3).

In the study, we found 96 patients revealed Mentzer Index >14 (Table 4).

Graphical representation of MCH and MCHC distribution is depicted in Fig. 1 & 2.

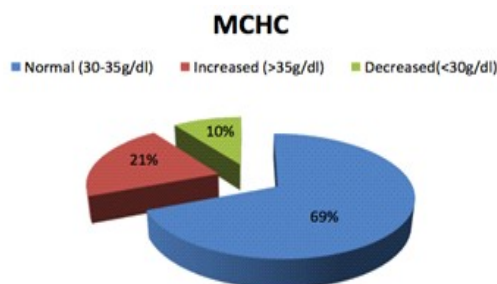


Figure 1: MCV Distribution

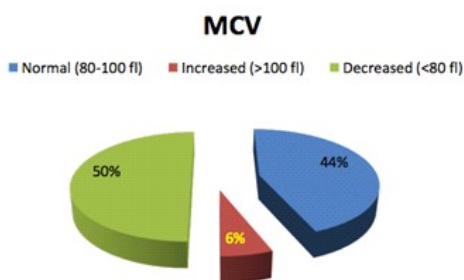


Figure 2: MCHC Distribution

## Discussion

In this study maximum number of patients 34% were in age group 21-30 years, while minimum cases 2% were in age group 71-80 years, which was in concordance to study, done by Babu *et al.* and Kouli *et al.* (11,12). The study revealed female preponderance of anemia in adult age groups especially in the reproductive age. The high prevalence of iron deficiency anemia among women in childbearing age has important public health implication (13). Iron requirements are greater in pregnancy & iron deficiency is associated with nutritional death, preterm delivery and low birth (14,15).

59.0% anemic patients in the study came out to be females and 41.0% were males. Similar to Babu *et al.*, which showed female preponderance with female 61.2 % and male 38.8% (11). Some authors have argued that estrogen act as inhibitor of erythropoiesis and makes women more vulnerable to development of anemia that might be a possible explanation (16).

In the study 73 patients had moderate anemia, 18 had severe anemia and 8 patients had mild anemia. Study done by Mourougessine *et al.* also revealed similar findings where in 64.5% had moderate degree of anemia and further supported by study done by Kouli *et al.*

(12,17).

In the study most common morphological type of anemia observed was microcytic hypochromic constituting 46% of cases. Study done by Singh *et al.* on 361 patients also revealed microcytic hypochromic anemia to be the most common type of morphological pattern in 246; 68.1% patients (18). Other types of anemia observed in our study were normocytic normochromic 25%, dimorphic 20%, and macrocytic 9% which were in concordance with Mourougessine *et al.* (17). While studies done by Bhasin *et al.* and Elsayid *et al.* revealed normocytic normochromic anemia as the most common morphological type (19,20).

In clinical practice the morphological classifications of anemia are based on red cell indices MCV, MCH, MCHC and RDW (21). In microcytic hypochromic anemia MCV, MCH, MCHC are decreased and RDW is increased. Some patients of microcytic hypochromic anemia in the study had MCHC within normal range.

Study conducted by Barve *et al.* showed MCHC within normal range too (22). Hematinic therapy and regular follow up might fit in the reason for that. RDW was increased in majority of the patients indicating severe anisocytosis in RBCs, pointing towards iron deficiency as a cause of microcytic hypochromic anemia as seen in study conducted by Banushree (23). Macrocytic blood picture revealed increased MCV and MCH but MCHC was within normal range. Whereas the study conducted by Barve *et al.* showed increased MCV, MCH & MCHC (22).

In dimorphic anemia RDW was increased similar to the study conducted by Raghavan *et al.* (24), but in contrast to study carried out by Babu *et al.*, which showed normal RDW in dimorphic anemia (11). In normocytic normochromic MCV was within normal range.

In the present study 96 patients had increased Mentzer index. Most of the patients in our study had MI more than 13. Distinguishing  $\hat{a}$  thalassemia trait from iron deficiency has important clinical implication because each disease has an entirely different cause, prognosis and treatment (25).

Hence to conclude, anemia is not a condition but a manifestation of variety of pathologies, which needs adequate medical attention. The study of RBC parameters along with peripheral blood smear examination is an effective way for quantative assessment. Red cell indices also provide diagnostic aid in classification and monitoring of anemia.



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