

# MORPHOLOGICAL PATTERN OF ANEMIA IN PATIENTS ATTENDING A PRIVATE DIAGNOSTIC LABORATORY

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## ABSTRACT

**Introduction:** Anemia is a hematological disorder and one of the most prevalent in the world, especially in developing nations, to which it poses a great public health threat. The current task is about the morphological pattern of anemia of patients visiting a private diagnostic laboratory. Laboratory investigation is highlighted as being a key factor in the diagnosis of different morphological types of anemia and gaining insight into the distribution of different types among the different age groups.

**Aim:** The purpose of the study is to find the most prevalent morphological type of anemia and to study the distribution of different types of anemia by age and sex group in patients visiting a private diagnostic laboratory.

**Materials and Methods:** The study's design was descriptive cross-sectional design with a private diagnostic laboratory as the research setting. Counting investigations and peripheral blood smears were used to analyse 100 patient samples with anaemia. The classification of anemia was done using the red blood cell indices and microscopic examination.

**Results:** The results of the study showed that in the patients microcytic hypochromic anemia was the most prevalent morphological pattern present. Anemia was the most common diagnosis in females and those aged 20–40 years. In peripheral blood smear, heavy abnormalities in the morphology were observed such as microcytic anemia, hypochromia, anisocytosis, and poikilocytosis.

**Conclusion:** It is concluded that microcytic hypochromic anemia is still the most frequent morphological picture in the diagnostic laboratories that are set up within the private sector. Early detection and effective management of anemia depend on appropriate laboratory diagnosis, complete blood picture and peripheral blood smear.

**Keywords:** Anemia, Microcytic hypochromic anemia, Peripheral blood smear, Morphological pattern, Diagnostic laboratory.

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## 1. Introduction

### 1.1 Background of Anemia

Anemia is your illness where you have fewer red blood cells or less than the normal level of hemoglobin (also known as carrying oxygen hemoglobin) in your red blood cells. Low hemoglobin (Hb) decreases the amount of O<sub>2</sub> in the bloodstream that is available to transport to tissues, as hemoglobin transports O<sub>2</sub> from the lungs to the tissues. Anemia is a condition of blood in which the number of haemoglobin molecules in any person's blood is less than normal, according to the World

Health Organization (WHO). The World Health Organisation (WHO) definition of Anemia is when an individual's bloodstream contains less than 13 g / dL haemoglobin in males and less than 12 g / dL in females. Anemia is experienced by everybody and it's an area of concern around the world.

In the world, almost two billion people—the majority of them women, children and elderly people—walk around with anemia. This is compounded by the lack of feeding and infection, lack of access to health care

and social issues in developing countries. Iron deficiency anemia (IDA) is the most prevalent anemia all over the world. Anemia and other hematological disorders have profound effects on the quality of life, affecting all its facets in such a way as to cause a drop in immunity, fatigue and weakness, making people dizzy and increasing their work productivity. Health effects can also occur to the cardiovascular system, such as death and/or heart impairment.

## **1.2 Morphological Classification of Anemia**

Different forms of anemia are distinguished by the nature of the anemia shown in the microscope by the size, shape and hemoglobin-containing properties of the red blood corpuscles. These classifications aid the health care worker in diagnosing the cause of the anemia and the appropriate treatment (1).

A kind of anemia known as microcytic hypochromic anemia is the condition in which the red blood cells (RBCs) are smaller and hemoglobin less dense. Iron deficiency and thalassemia's relate to each other. Normocytic normochromic anemia is defined as having a normal sized red blood cell (RBC) level, a normal hemoglobin level (which measures the amount of hemoglobin in the red blood cell), but an abnormally low red blood cell count (number of cells). This type is most frequently observed in chronic diseases and suffering from scant blood. Macrocytes are very large red blood cells as a result of the macrocytic anemia, often found in vitamin B12 or folate deficiency. Wherever in dimorphic anemia there are two kinds of red cells and this anemia is usually due to several nutrient deficiencies.

## **1.3 Importance of Diagnostic Laboratories**

In this context, private diagnostic laboratories are crucial in the diagnosis and management of anemia. Laboratory tests give

valuable and dependable data on blood parameters which can help the doctor determine the nature and amount of anaemia. One of the most common test used to assess the concentration of haemoglobin, red blood cell indices, and haematocrit value is called Complete blood count (CBC).

Peripheral blood smear (2) is another related lab determination of morphology of the red blood cell. The morphology analysis reveals abnormalities such as microcytosis, macrocytosis, anisocytosis and poikilocytosis. Correct diagnosis in the laboratory is crucial as the treatment strategies depend on the morphology and cause of anemia.

## **1.4 Problem Statement**

Incidences of anaemia have increased markedly in the recent few years, mainly among women and children in poorer countries. Few patients are diagnosed; because of inadequate healthcare capacity, or lack of awareness. If improperly classified, the treatment may be inadequate, and recovery delayed. In addition, there are several weaknesses in diagnostic laboratories, including low resources, human error and lack of accuracy in patient records. Therefore, accurate morphological evaluation of anemia is necessary to improve the diagnosis, and treatment of the patients, in anaemic individuals.

## **1.5 Research Aim**

This study aimed to investigate the pattern of the anemia of the visitors to a private diagnostic laboratory in terms of morphological features.

## **1.6 Research Objectives**

- To recognize some of the morphological subtypes of anemia.
- To study the age and gender distribution of anemic patients.
- To assess laboratory methods of detecting anemia.
- To assess the prevalence of different morphological patterns of anemia..

### 1.7 Research Questions

- What are the (morphological) patterns that are common in all anemias?
- Which ages/sexes are most affected by anemia?
- In which ways do laboratory investigations aid in diagnosis of anemia?
- Which type of anemia (morphological) is most common in the attendance of private diagnostic lab patients?

## 2. Literature Review

### 2.1 Overview of Anemia

Anemia occurs as a result of different physiological and pathological conditions which lead to decrease in hemoglobin blood levels. The most frequent causes include iron, folate and vitamin B12 deficiency. Other causes that may contribute to causing anemia include chronic infections, kidney disease, inflammation and cancer. Other genetic disorders, such as disorders of hemoglobin production (e.g., sickle cell and thalassemia) are also inherited causes of anemia.

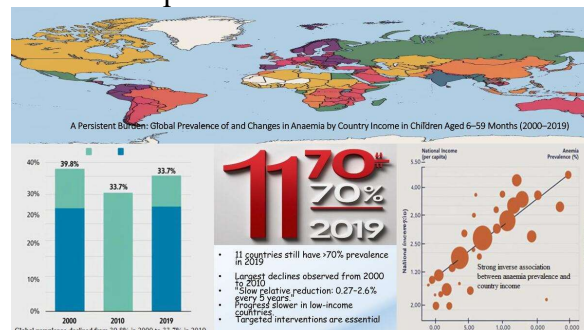
Because iron is needed for the synthesis of hemoglobin, iron-deficiency is the most common cause of anemia in the world. Iron deficiency anemia can be caused by poor nutrition, long-term blood loss and pregnancy. Deficiency of folate and Vitamin B12 may impair DNA synthesis which can results in abnormalities in mature red blood cell maturation and cause macrocytic anemia.

### 2.2 Morphological Patterns of Anemia

The most common morphological type in developing countries is microcytic hypochromia. It is associated with decreased MCV and MCHC. The most common cause is iron deficiency, but chronic blood loss also can be a factor, as can thalassemia (3,4).

Normochromic refers to an absence of color and normocytic to an absence of a large size; hence, the term normocytic normochromic anemia indicates that the blood cell color and

shape are normal. It is known to be associated with chronic inflammatory disease, disorders of the renal system, acute bleeding and secondary disorders of the bone marrow system. This morphological pattern is very common in patients with chronic diseases.



**Figure 1: Global prevalence of and changes in anaemia by country**

(Source:

<https://www.archivesofmedicalscience.com>) Macrocytic anemias are caused by the presence of large red cells for which the average cell size has increased. Lack of B12 and folate are the most common. Other factors, such as alcoholism, liver disease, and some drugs, can also cause macrocytic changes (4).

Dimorphic anemia is the simultaneous presence of two types of red blood cell population. It is commonly due to the combination of iron deficiency and deficiency of vitamin B12, or blood transfusion therapy.

### 2.3 Laboratory Diagnosis of Anemia

The importance of laboratory investigations for the correct diagnosis and classification of anemia can't be overemphasized. By far the most important test for the severity of anemia is the measurement of hemoglobin. Complete Blood Count (CBC) gives comprehensive and detailed information about the red blood cell indices like mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) as well as mean corpuscular hemoglobin chrononimic (MCHC).

The peripheral blood smear is still an important diagnostic tool for this reason that

direct visualization of red blood cell morphology can be done(5). Morphological abnormalities like target cells, macro-ovalocytes, hypochromia and anisopoikilocytosis provide clues for underlying disease conditions. A reticulocyte count also is helpful in the assessment of bone marrow response and erythropoietic activity.

Modern laboratories are equipped with automated hematology analyzers which have enhanced the diagnostic accuracy and efficiency in laboratories. A microscopic examination, however, is still required for determining abnormalities in morphology.

#### **2.4 Previous Studies on Morphological Patterns**

Accurate documentation, that the microcytic and hypochromic form is the common form in anemic patients has been reported in a few Indian and other studies. It was revealed that women of childbearing age (15-49 years) suffer from iron deficiency anemia prevalence due to the poor intake of foods and menstrual blood loss.

The same studies have been conducted among tertiary care hospitals revealing also that the normocytic anemia is very common in the elderly of chronically ill patients, with normochromic anemia. Alcoholism was strongly correlated with macrocytic anemia, which was found to be less prevalent (6).

Studies worldwide show the difference in the prevalence of anemia based on soci economic factors, diet and access to health care. This can be geographer but in the world it is the greatest cause.

#### **2.5 Factors Affecting Anemia**

Gender significantly contributes to the prevalence of anemia since menstruating women, pregnant women and women who have heightened nutritional needs are more vulnerable. Another crucial point is age, as children, adolescents and elderly are at higher risks (6,7).

A low and inadequate diet plays a crucial role in anemia among the poor. As well, socioeconomic status is a factor of diet, access to health care, and nutrition-related health beliefs. Diseases such as infectious diseases or chronic diseases add to the chances of anemia.

### **3. Research Methodology**

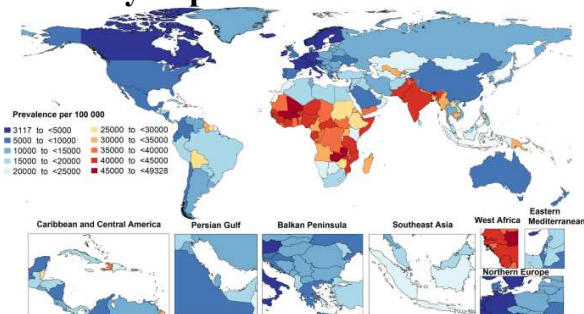
#### **3.1 Research Design**

The present study was descriptive cross sectional research with an aim of studying the morphology pattern in anaemic patients visiting a private diagnostic laboratory. This design was selected because the researcher was interested in studying the patterns of anemia prevalence and distribution of a well-defined population during a defined time. The use of cross sectional studies to estimate disease prevalence, provide demographic distribution and laboratory data in hematological investigations without the need of long-term follow-up makes it a commonly used study type. This study aimed at studying the morphology of red blood cells and the laboratory abnormalities of anemic patients by standard hematological methods.

#### **3.2 Study Setting**

The study has been carried out in a private diagnostic laboratory, equipped with automated hematology Analyzer and microscopy facilities for routine investigations of blood. The laboratory does complete blood count, peripheral blood smear exam and hemagglutination to the patients referred from the hospital and clinic regularly basis. All samples were taken, treated and analyzed as per standard lab procedure to obtain accurate and reliable results (8).

### 3.3 Study Population



**Figure 2: Burden of anemia and its underlying causes in 204 countries and territories, 1990–2019**

(Source: <https://media.springernature.com>)

Study population comprised patients with low hemoglobin levels and laboratory findings and diagnosed with anemia. The study group included both sexes of patients from all ages.

### 3.4 Inclusion and Exclusion Criteria

Individuals whose hemoglobin values were below the World Health Organization reference values were added to the study. Laboratory reports which were incomplete, and blood that was clotted or not adequate were not analysed.

### 3.5 Sample Size

For detailed morphological analysis, there were 100 patient samples with anemia that were included in the study

### 3.6 Data Collection Methods

Full blood count reports, peripheral blood smear examination and laboratory records were used to collect data. The microscopic examination and indices of red blood cells such as MCV, MCH and MCHC were involved in the process of morphological classification of anemia (9).

### 3.7 Data Analysis Techniques

The data collected was analysed using percentage distribution, frequency tables and graphical representation technique. The different morphological types were grouped based on red blood cell morphology.

### 3.8 Ethical Considerations

All the confidentiality principles for protecting the identity of patients were

adhered to during the study. No personal identification was disclosed and all laboratory information used exclusively in an academic purpose.

## 4. Results and Analysis

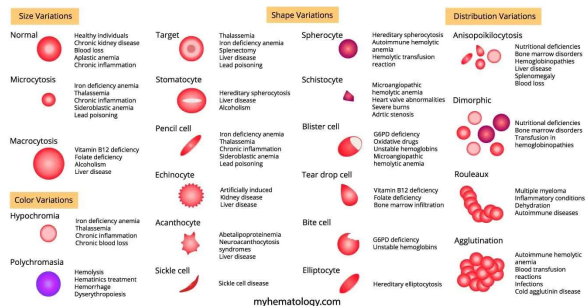
### 4.1 Gender-wise Distribution of Patients

The results of the study showed prevalence of anaemia higher in women than in men. The breakdown of 100 anaemic cases studied was around 65% female and 35% male. Females may be at higher risk related to menstrual blood loss, pregnancy and lactation and greater nutritional needs. Iron deficiency is also caused by insufficient dietary intake to a large extent resulting in anemia in women of reproductive age (10).

Male; there were fewer cases of anemia being identified in the patient but a few did have moderate to severe anemia related to chronic diseases, nutritional deficiency, and lifestyle related diseases. The results suggest that gender plays an important role in anemia prevalence and distribution. These are similar results to past hematological studies that have found females to be more likely to be anemic than males. Their results shed light on the vital role nutrition awareness and periodic screening programs play for women to lower the proportion of anemic individuals.

### 4.2 Age-wise Distribution

Age distribution analysis showed anemia at a relatively high frequency among people aged 20-40. The study showed that this age group had the most number of people with anemia. This high prevalence rates found among young adults is possibly associated with increased physiological demand, occupational stress, dietary diet and health issues related to reproductive health (11). In particular, female patients in this age group were troubled by pregnancy and menstruation blood loss. In this population, menstruation and pregnancy was a particular problem for female patients.



**Figure 3: Abnormal Red Blood Cell Morphology**

(Source: <https://myhematology.com>)

Anemia also was highly prevalent among elderly patients with a significant association mainly with chronic morbidities, nutritional deficiencies and physiological changes with age. Normocytic normochromic anemia related to chronic inflammatory ailments and renal diseases was the usual pattern seen in people older than 60 years. Within the present study group, children/teenagers had comparatively lower levels of its prevalence, however, nutritional anemia is still common among younger children in developing countries (12).

### 4.3 Morphological Pattern Distribution

The study could recognize various morphologies of anemia for each patient sample studied. In the morphological types, microcytic hypochromic anemia was the most common anemia associated, about 55% of all the anemia cases. This is often seen with iron deficiency anemia, and is evidence of a lack of hemoglobin synthesis. Affected patients had a small-sized hypochromic red blood cells with increased central pallor in peripheral blood smear (13).

Around 25% of cases were diagnosed as normocytic normochromic anemia and this type of anemia was primarily seen in and above 30 years group of patients and with chronic diseases. These RBCs were normal in size and colour but in a decreased count. Macrocytic anemia accounted for almost 12% of all cases and beta vitamin B12 and folate deficiency were present. RBCs were

enlarged and macro ovalocytic in affected individuals on peripheral smear.

### 4.4 Hemoglobin Level Analysis

The severity of anemia among the study population was seen from the hemoglobin result analysis. Patients were classified as mild, moderate and severe anemia according to the World Health Organization hemoglobin criteria. Moderate anemia was observed as the most prevalent category among patients and a great percentage of the total cases. Patients with moderate anemia would typically come with complaints of tiredness, weakness, fainting and decreased physical activity (14).

A small number of patients were seen with slightly lower levels of hemoglobin but with no clinical consequences. More severe anemia was less frequent, but did occur in patients who had more severe nutritional deficiencies and those who had chronic blood loss or underlying disease conditions. In severe anemia cases, the hemoglobin level was significantly reduced with severe clinical symptoms that needed immediate care.

### 4.5 Peripheral Smear Findings

Peripheral blood smear examination showed that there is significant morphologic abnormalities in the anemic patients that were included in the study. These were the common findings seen on mic Elena and they were as follows: Microcytic hypochromic cells, anisocytosis, poikilocytosis, target cells and macro-ovalocytes (15). These changes in the morphology aided in the diagnosis of the underlying cause and type of anemia.

Microcytic hypochromic red blood cells predominated in all the patients having IDA. In macrocytic anemia due to either vitamin B12 or folate deficiency, the common changes observed were macro-ovalocytes and hypersegmented neutrophils (16). The presence of target cells and anisopoikilocytosis was further noticed in some patients indicating that chronic

hematological and nutritional abnormalities are present.

## 5. Discussion and Critical Analysis

### 5.1 Interpretation of Findings

From the present study it was concluded that microcytic hypochromic is the most prevalent morphologic pattern with reference to the patients attending the study field – Private diagnostic laboratory. This discovery is a strong indication of the presence of iron-deficiency as a significant public health problem. There was a higher prevalence in female patients possibly caused by an increased need of iron in women (17).

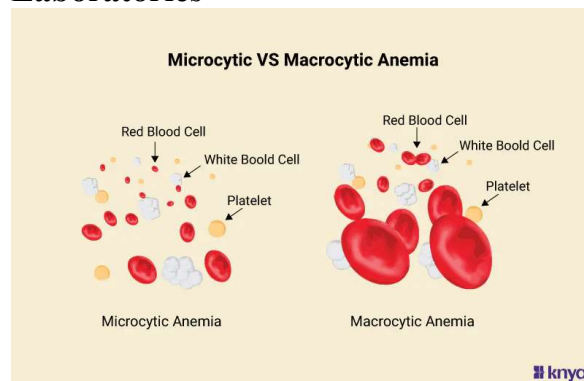
### 5.2 Comparison with Previous Studies

The observations revealed in this study are in line with the earlier study in India and other developing countries where iron deficiency anemia was found to be the most common morphological type. Higher anemia rates were similarly observed for females and reproductive-age in other studies. A slight variation in prevalence could be explained by differences in food consumption, socioeconomic status and access to health care.

### 5.3 Importance of Morphological Diagnosis

Morphology-based classification has significance as it helps lead a clinician to an accurate diagnosis and treatment (18). Microcytic, normocytic and macrocytic forms help to identify the cause of anemia, whether it is nutritional deficiency or chronic disease or a genetic disease. A morphological assessment at earlier stages increases the treatment efficacy and decreases treatment complications.

## 5.4 Challenges in Diagnostic Laboratories



**Figure 4: Difference Between Microcytic and Macrocytic Anemias**

(Source: <https://knyamed.com>)

Laboratorians have several diagnostic problems to consider when assessing anemia. Laboratories and equipment issues and insufficient skilled personnel can affect the accuracy of the diagnosis. The accuracy of results may also be affected as a result of human error in smear preparation and microscopic analysis (20). The diagnosis/interpretation is further complicated because of incomplete patient history.

### 5.5 Clinical Implications

Earlier detection of anemia is vital to prevent the resulting issues such as weakened immune response, cardiovascular issues and cognitive impairment. The requirement is periodic screening and sensitisation campaign on public health awareness by the community for early detection of anaemia. Laboratory diagnosis is crucial in providing a successful patient care and treatment (18).

## 6. Recommendations

There is a need to promote nutritional awareness programme to prevent anemia among the children in the Nutritional Improvement Forum through healthcare organisations. It is recommended to foster iron rich diets, vitamin supplementation and provide balanced nutrition, particularly for women and children. Regular screening of students to identify them early (as young as

19) afflicted with anemia should be carried out at school, healthy care or college (19).

The advances made by private laboratories, diagnostic laboratories in particular, must make better use of diagnostic efficiency by providing better training of staff and maintain quality control. The reliability of the results may be improved through automated hematology analyzers, and through standardisation of the process that is carried out in the laboratory. There should be greater public health education outreach in response to increased efforts to prevent and treat anemia. Good diagnosis and intervention at an early stage in cases of anemia are very important in mitigating the morbidity and enhancing the quality of life of the patient.

## 7. Conclusion

Anemia remains a world-wide serious health issue in all age groups and all socio-economic status groups. In the present work the morphological type of anemia of the patients got-to the private diagnostics lab has been examined with the result of the observations the microcytic type of hypochromia anemia was the most prevalent type. The majority of patients were females, and young adults.

Morphological classification plays a very important role in identifying haematological changes for cause of anemia thus treatment and approach should be undertaken. The peripheral smear and complete blood count examination are important lab tests that can aid in understanding the type and severity of anemia. It also reaffirms the need to pay attention to early diagnosis and optimal nutrition care and improvement of lab services to help reduce the prevalence of anaemia and its effects.

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