



# University Of Fallujah College Of Medicine Medical Biochemistry



## **Lecture 6: Estimation of Blood Iron and TIBC**

**Stage: 2<sup>nd</sup> Year**

**Lecturer: Yousif Saleh**

**Department: Medical Biochemistry**

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# Learning Objectives

1

**Explain the physiological role and daily requirements of iron in the human body.**

2

**Differentiate between functional iron and storage iron and describe their distribution.**

3

**Describe the factors that enhance or inhibit iron absorption.**

4

**Identify normal serum iron reference ranges for males and females.**

5

**Recognize clinical causes and symptoms of iron deficiency and iron overload.**

6

**Outline correct sample collection and handling procedures for accurate serum iron estimation.**



Iron is the most essential trace element in the human body.

It has a major role in the transfer of O<sub>2</sub> from the lungs to all parts of the body by hemoglobin.

An adult human body contains 3-5 g Iron.

The normal limit for iron consumption is 20 mg/day for adults, 20-30 mg/day for children, and 40 mg/day for pregnant women.

In the human body, iron exists in two forms:

Essential iron or functional iron: about 85% of the total body iron is essential or functional iron which exists as a constituent of Hb.

Storage iron: about 15% of the total body iron is stored in the body as a constituent of iron storage ferritin.

# Iron Absorption

- **Iron is normally absorbed from the stomach and upper duodenum.**
- **Most of the dietary iron exists in a ferric state ( $\text{Fe}^{+++}$ ).**
- **Iron is absorbed from the gut in a ferrous state ( $\text{Fe}^{++}$ ).**
- **Vitamin C promotes the intestinal absorption of iron by reducing  $\text{Fe}^{+3}$  to  $\text{Fe}^{+2}$ .**
- **Acidic pH and acidic foods promote the intestinal absorption of iron**
- **Tea and coffee decrease the intestinal absorption of iron.**





## Iron deficiency:

Iron deficiency occurs when your body doesn't have enough iron. This leads to a condition called **iron-deficiency anemia**.

Malabsorption

Pregnancy.

Blood loss: **GI bleeding, menstruation, donation**



## Symptoms of iron deficiency:

Fatigue

Pale skin

Shortness of breath

Headaches

Heart palpitations

Dry and damaged hair and skin

Brittle nails

## High iron levels

### This occurs due to:

- Taking large amounts of iron
- Iron poisoning
- Repeat blood transfusion

### Symptoms of high blood iron:

- Enlarged liver or painful liver
- Fatigue
- Joint pain
- Unexplained weight loss
- Mood changes
- Hemochromatosis.

## Normal values

**Men:** (60 – 175)  $\mu\text{g/dL}$  or  
(10.7 - 31.3  $\mu\text{mol/L}$ ).

**Women:** (50 – 170)  $\mu\text{g/dL}$   
or (9.0 - 30.4  $\mu\text{mol/L}$ ).



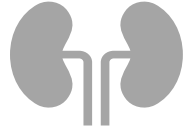
## Sample collection

- Serum
- Heparinized plasma (using a Heparin tube)
- Hemolyzed samples are rejected (Ruptured red cells falsely elevate the serum results).
- EDTA, Citrate plasma must not be used

# Home Message



**Iron is an essential trace element vital for oxygen transport and cellular function.**



**Both deficiency and excess have serious systemic consequences.**



**Accurate laboratory estimation depends on proper sample type and handling (avoid hemolysis, EDTA, citrate).**



**Understanding iron metabolism bridges basic biochemistry with clinical diagnosis and patient management.**



**Always interpret laboratory iron results in conjunction with ferritin, TIBC, and clinical findings.**

# Total Iron-Binding Capacity (TIBC)

- Total Iron-Binding Capacity (TIBC) measures the maximum amount of iron that can be bound by transferrin in the blood.
- It reflects the availability of transferrin to bind and transport iron and is an indirect indicator of transferrin concentration.



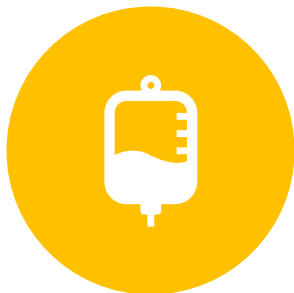
# Physiological Concept



Transferrin is the main plasma protein that carries iron in circulation.



Each transferrin molecule can bind two  $\text{Fe}^{3+}$  ions.



TIBC indicates the blood's capacity to transport iron.



It changes inversely with iron stores.

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Normal  
Range

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Adults: 250 – 400  $\mu\text{g}/\text{dL}$   
(45 – 72  $\mu\text{mol}/\text{L}$ )

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High TIBC  $\rightarrow$  Iron  
deficiency

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Low TIBC  $\rightarrow$  Iron overload  
or chronic inflammation

# Clinical Interpretation

<u>Condition</u>	<u>Serum Iron</u>	<u>TIBC</u>	<u>Transferrin Saturation</u>	<u>Interpretation</u>
<b>Iron Deficiency Anemia</b>	↓	↑	↓	<b>Low iron, body produces more transferrin to capture available iron</b>
<b>Anemia of Chronic Disease</b>	↓	↓ or N	↓	<b>Iron trapped in macrophages, transferrin production suppressed</b>
<b>Hemochromatosis / Iron Overload</b>	↑	↓	↑	<b>Excess iron saturates transferrin</b>
<b>Pregnancy / Oral Contraceptives</b>	N or ↓	↑	↓	<b>Estrogen increases transferrin synthesis</b>

# Formula



**Transferrin Saturation (%) = (Serum Iron ( $\mu\text{g}/\text{dL}$ )  $\times$  100) / TIBC ( $\mu\text{g}/\text{dL}$ )**



**Normal transferrin saturation:  
20–45%**

1

High TIBC → suggests iron deficiency (more transferrin synthesized)

2

Low TIBC → suggests iron overload or inflammation (less transferrin)

3

Always interpret TIBC with serum iron and ferritin for accuracy.

# Home Message

- Iron is a **vital trace element** required for hemoglobin synthesis and oxygen transport.
- **Both iron deficiency and iron overload** have serious systemic consequences.

Accurate diagnosis depends on the **combined interpretation** of:

- Serum iron
  - Ferritin
  - Total Iron-Binding Capacity (TIBC)
  - Transferrin saturation
- **TIBC** increases in iron deficiency and decreases in iron overload.
  - Proper **sample handling** is crucial — use **serum or heparinized plasma**, and **reject hemolyzed samples** to avoid false results.
  - Always interpret biochemical results **alongside clinical findings** for accurate patient evaluation.

# Thank you

