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THE COEXISTENCE OF HEMOGLOBIN AND SERUM IRON LEVELS: ARE THEY ALWAYS SYNCHRONIZED

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ABSTRACT

Objective: This study aimed to show the correlation between hemoglobin levels (Hb) and serum iron levels (Fe) and whether low serum iron levels are always associated with low hemoglobin levels and vice versa. **Materials and Methods:** This study was a retrospective study of 859 women between 18-45 years old. Hemoglobin levels and Serum iron levels of these women were obtained. This study was performed on 859 women who reviewed Alhomsi Clinical Laboratories between August 2018 to September 2019. Statistical analysis was done using SPSS 25.0 **Results:** 210 patients (24%) had Hb level of 6.5-10 g/dl with Fe level of 8-25 µg/dL (Moderate Iron Deficiency Anemia), 228 (26%) had Hb level of 10-12 g/dl with Fe level of 25-40 µg/dL (Mild Iron Deficiency Anemia). 430 (50%) had Hb level of 12-15.5g/dl with 236 of them having Fe level of 40-125 µg/dL (Normal Cases- Normal Hb levels with normal Fe levels). However, the remaining 194 cases (of the 430 whom Hb was normal:12-15.5 g/dl) had Fe level of 28.2-42 µg/dL, which is defined as iron deficiency. This is quite an abnormal finding that in our opinion could be attributed to many reasons especially, the increased ration of smoking in women by either cigarettes or waterpipe (hookah). **Conclusion:** Iron deficiency anemia is a very common issue worldwide and is not the main point of this article, however, normal hemoglobin levels with low serum iron levels raises many questions about concomitant factors that could lead to this surprising finding.

KEYWORDS: Anemia, Iron Deficiency, Hemoglobin, Syrian women, Reproductive age.

INTRODUCTION

Anemia is defined by a decrease in the total amount of hemoglobin or the number of red blood cells. Iron deficiency anemia is a form of anemia due to the lack of sufficient iron to form normal red blood cells. Iron deficiency anemia is typically caused by inadequate intake of iron, chronic blood loss (menstrual cycle), or a combination of both. Iron deficiency anemia is the most common cause of anemia in the world. Approximately 5% and 2% of women and men, respectively, have iron deficiency anemia.[1] Iron deficiency is the single most prevalent nutritional deficiency worldwide. It accounts for anemia in 5% of women and 2% of men.[2]

Anemia adversely affect cognitive and motor development and cause fatigue and low productivity.[3,4,5] Low hemoglobin concentrations during pregnancy can be associated with an increased risk of maternal and perinatal mortality and low size or weight at birth.[3,5,6,7] Maternal and neonatal deaths are a major cause of mortality in developing countries, and together cause between 2·5 million and 3·4 million deaths worldwide.[8,9,10] Although some adverse effects are associated with high hemoglobin concentrations,[11] most take place along a majority of low concentrations.[3,5]

MATERIALS AND METHODS

This study was a retrospective study of 859 women between 18-45 years old. Hemoglobin levels and Serum iron levels of these women were obtained. Normal Range of Hemoglobin for women in our lab is 12-16 g/dl and serum iron levels are 37-140 µg/dl. This study was performed on 859 women who reviewed Alhomsi Clinical Laboratories between August 2018 to September 2019. Hemoglobin and Serum iron have been referred to and Hb and Fe in this article for simplicity. To ensure the privacy, only the authors collected all the data and all the names and personal information were blinded. Informed consent was taken from all the patients to be included in this study. Statistical analysis was done using SPSS 25.0.

RESULTS

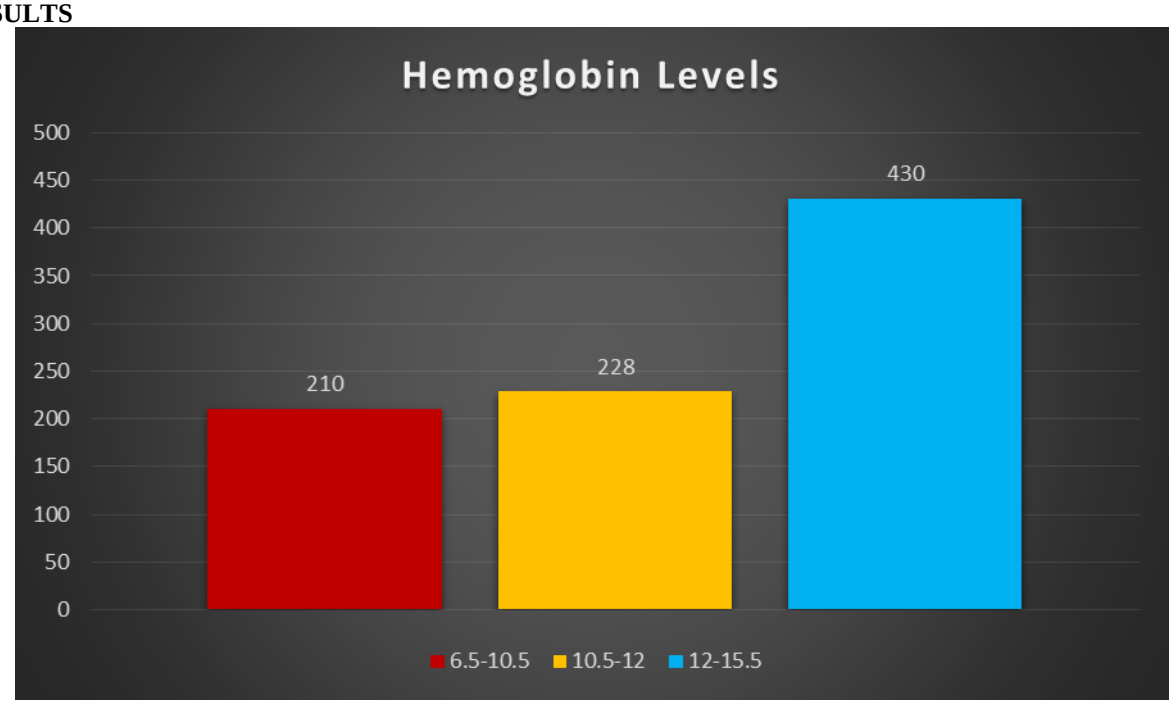

Figure 1: Hemoglobin Levels in participants of our study.

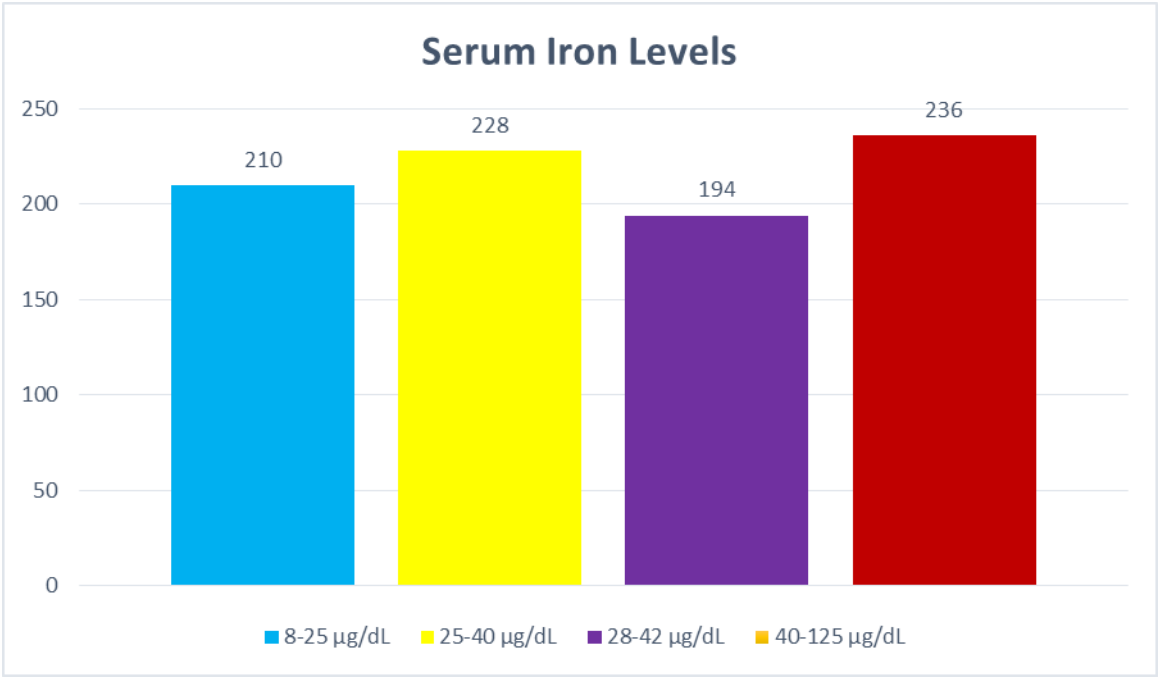

Figure 2: Fe levels in participants of our study.

Table A: Comparison between Hemoglobin Levels and Serum Iron Levels in participants of our study:

Fe Levels / Hb Levels	8-25	25-40	28.2-42	40-125
6.5-10	210			
10-12		228		
12-15.5			**194**	
12-15.5				236

In our study, 210 patients (24%) had Hb level of 6.5-10 g/dl, 228 (26%) had Hb level of 10-12 g/dl and 430 (50%) had Hb level of 12-15.5g/dl. (Figure 1)

Regarding Fe levels, 210 patients (24%) had Fe level of 8-25 µg/dL, 228 (26%) had Fe level of 25-40 µg/dL, 194 (22.6%) had Fe level of 28.2-42 µg/dL and 236 (27.4%) had Fe level of 40-125 µg/dL. (Figure 2)

The main point of this study is to show the relation between Hb levels and Fe levels in women of reproductive age, who are more likely to having lower Fe levels due to blood loss (menstrual cycle). 210 patients (24%) had Hb level of 6.5-10 g/dl with Fe level of 8-25 µg/dL (Moderate Iron Deficiency Anemia), 228 (26%) had Hb level of 10-12 g/dl with Fe level of 25-40 µg/dL (Mild Iron Deficiency Anemia). 430 (50%) had Hb level of 12-15.5g/dl with 236 of them having Fe level of 40-125 µg/dL (Normal Cases- Normal Hb levels with normal Fe levels). (Table A)

However, the remaining 194 cases (of the 430 whom Hb was normal:12-15.5 g/dl) had Fe level of 28.2-42 µg/dL, which is defined as iron deficiency. This is quite an abnormal finding that in our opinion could be attributed to many reasons especially, the increased ration of smoking in women by either cigarettes or waterpipe. A larger study with the inclusion of many other cofactors is needed to determine the exact cause of this finding and its sequels. (Table A)

DISCUSSION

The World Health Organization (WHO) defines anemia as blood hemoglobin values of less than 7.7 mmol/l (13 g/dl) in men and 7.4 mmol/l (12 g/dl) in women. Typically, the evaluation of the cause of anemia includes a complete blood cell count, peripheral smear, reticulocyte count, and serum iron indices. The severity of anemia is based on the patient's hemoglobin/hematocrit level. Iron deficiency anemia is characterized by microcytic, hypochromic erythrocytes and low iron stores. The mean corpuscular volume is the measure of the average red blood cell volume and mean corpuscular hemoglobin concentration is the measure of the concentration of hemoglobin in a given volume of packed red blood cells. The normal reference ranges for mean corpuscular volume is 80–100 fl and mean corpuscular hemoglobin concentration is 320–360 g/l. The patient's cells are said to be microcytic and hypochromic, respectively, when these values are less than the normal reference range. Of note, up to 40% of patients with true iron deficiency anemia will have normocytic erythrocytes (i.e. a normal mean corpuscular volume does not rule out iron deficiency anemia).[12] The red cell distribution width is a measure of the variation of red blood cell width and is used in combination with the mean corpuscular volume to distinguish an anemia of mixed cause from that of a single cause. The normal reference range is 11–14%; an elevated red cell distribution width value signifies a variation in red cell size, which is known as anisocytosis. The red cell distribution width may be elevated in the early stages of iron deficiency anemia or when a patient has both iron deficiency anemia and folate with or without vitamin B12 deficiencies, which both produce macrocytic anemia. It is not uncommon for the platelet count to be greater than 450,000/µl in the presence of iron deficiency anemia. Upon examination of a patient's peripheral smear with chronic iron deficiency anemia one will typically see hypochromic, microcytic erythrocytes; thrombocytosis may also be apparent. It is important to note that microcytosis visible on the peripheral smear may be seen prior to abnormalities on the complete blood cell count. If the patient has coexistent folate or vitamin B12 deficiency, the peripheral smear will be a mixture of macrocytic and microcytic hypochromic erythrocytes, along with normalization of the mean corpuscular volume.

Iron studies diagnostic for iron deficiency anemia consist of a low hemoglobin (<7.7 mmol/l in men and 7.4 mmol/l in women), a low serum iron (<7.1 µg/l), a low serum ferritin (storage form of iron) (<30 ng/l), a low transferrin saturation (<15%), and a high total iron-binding capacity (>13.1 µmol/l) (1,12). The ferritin level may be misleading in the presence of acute or chronic inflammation as ferritin is also an acute phase reactant and thus one cannot exclude iron deficiency as the cause of anemia when the serum ferritin is normal or even elevated in the presence of an inflammatory process.[12,13] In the presence of an underlying infection or inflammation other iron markers may be useful including the reticulocyte hemoglobin content which, because reticulocytes are only 1–2 days old, is reflective of the iron available in the bone marrow for erythropoiesis.

Compliance with Ethical Standards

Funding: This study was not funded by any institution.

Ethical approval: The names and personal details of the participants were blinded to ensure privacy.

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