Int J Biol Med Res. 2013; 4(1): 2717-2719

BioMedSciDirect Publications

Contents lists available at BioMedSciDirect Publications

International Journal of Biological & Medical Research

Journal homepage: www.biomedscidirect.com

Original Article

Association of serum iron and total iron binding capacity in rural children

A. N. R. Lakshmi , Pitta Paramjyothi

MD in Physiology, Superintendent MGM Hospital, Professor & HOD of Physiology, Kakatiya Medical college, Warangal, Andhra Pradesh - India.
MD in Physiology, Assistant Professor of Physiology, Kakatiya Medical College, Warangal, AndhraPradesh - India.

ARTICLE INFO

Keywords:
Serum iron
TIBC- Total Iron Binding Capacity
Rural children

ABSTRACT

Background & objectives: To assess the nutritional iron status and anemia prevalence in rural children of Warangal district, A.P. INDIA. Methods: We have studied serum iron, total iron-binding capacity (TIBC) relation ship in 50 rural children in the age group of 8-12 years. Results: As expected there was a highly significant increased levels of serum iron and a lower TIBC. The Mean ± SD serum iron concentration was 270.8840 ± 88.0737 and TIBC was 24.2790 ±10.9848. There was highly significant inverse relationship between serum iron and TIBC with a p value of 0.0001. Interpretation & conclusion:Iron deficiency and anemia appear to be an important public health problem among children and the effective actions aimed at the prevention and control of this deficiency are strongly recommended.

1. Introduction

Iron homeostasis is one of the most critical functions in living systems. Too little iron can lead to anemia and tissue-specific disorders, such as splenomegaly. Excessive systemic iron is characteristic of hemochromatosis and is implicated in the brain in Parkinson's disease.

Historically, several different parameters have been used to assess the iron status of individuals, including their dietary intake, hematological and biochemical parameters that are predictive of the body's iron reserves, transferrinemia and erythropoiesis.5 The available laboratory parameters reflect different stages of deprivation, encompassing a wide spectrum that goes from subclinical deficiency to the onset of anemia.

The objective of this article is to assess nutritional iron status and anemia prevalence among children under 15 years of age in terms of abnormally low body iron reserves, low transferrinemia, deficient erythropoiesis and anemia.

Biologically, iron is essential for a number of cellular, molecular, and physiological activities and acts in oxygen transport and as cofactor in metabolic pathways. Reservoirs of iron include both essential iron (hemoglobin, myoglobin, iron-sulfur enzymes, cytochromes, etc.), as well as nonessential pools (ferritin and hemosiderin). Nearly two-thirds of the iron in the body is found in the red cell mass. The other portion of the essential iron pool comprises 5–10% of body iron. The storage pool of iron in ferritin and hemosiderin is available to provide iron to the plasma iron transport system when iron absorption fails to meet the needs of daily iron requirements. The consequences of iron deficiency over a period of time results in tissue iron deficiency despite the action of homeostatic mechanisms in gastrointestinal cells to increase iron absorption (2). Iron overload can also be problematic and is linked to diseases, such as hemochromatosis and Parkinson's disease. Thus it is evident that iron requires tight regulation. Accordingly, because there are many proteins involved in iron absorption, elimination, and change in oxidative states, iron homeostasis is quite complex and influenced by multiple genes. Iron deficiency affects around 2.1 billion people worldwide, one third of who exhibit clinical evidence of the problem.

2. Materials and methods:

The work was carried out at Mahatma Gandhi Memorial Hospital, warangal, AndhraPradesh, India. The study was approved by the Kakatiya Medical College ethical committee.

We have selected 50 rural children in the age group of 8-12 years. Children were excluded if they had consumed vitamin or mineral supplements during the 30 days prior to data collection. The diet provided comprised five meals which, in principle, met dietary recommendations.

* Corresponding Author : **Dr. A. N. R. LAKSHMI**
Superintendent Mgm Hospital
Kakatiya Medical College, Warangal
Fax: 0870 2446869
Phone Number: 9849228625
E-mail Id: Lakshmianr@gmail.com

Serum samples were collected by veni-puncture to measure total serum iron and TIBC levels. Hemoglobin concentrations (Hb) were determined using the Sahli's Acid-Hematin method and children considered anemic when Hb < 11 g/dL.6 Levels of SI < 50µg/dL and TIBC > 400 µg/dL were adopted as indicative of deficiency.6

The procedures followed were in accordance with the ethical standards of the committee on human experimentation of the institution in which the experiments were done or in accordance with the Helsinki Declaration of 1975.

Method of collecting serum sample:

Serum samples of approximately 10 ml of blood were taken between 8.30am to 9.30 am. All plastic, sterile, disposable syringes with stainless needles were used for collecting blood. After standing for three hours at room temperature, the specimen was centrifuged and the serum separated immediately. The tubes used for collecting samples were washed with 1% nitric acid and then with tap water followed by glass- distilled water.

Serum iron and total iron binding capacity

These were measured by the method for the automatic determination of serum iron as described by Young and Hicks. This method eliminates the need to render the apparatus or reagents iron free. It's precision as we found, was comparable with other accepted methods for the determination of serum iron.

By using the standard components of Auto Analyzer system of Technicon Instruments Co, Ltd. both serum iron and TIBC were determined colorimetrically.

Principle:

Iron is simultaneously released from protein and reduced by hydrochloric acid and ascorbic acid. The reduced iron is separated form the protein by dialysis and allowed to react with tripyridyl-triazene. The complex is measured colorimetrically at a controlled PH.

The normal value of serum iron: 60 – 160 µg/dl

Total Iron Binding Capacity

The procedure of Ramsay was used to determine the iron binding capacity. 2 ml of a solution containing approximately 50 micro gram ferric iron per 100ml was added to 1 ml of serum in a centrifuged tube and the solutions were mixed. After5minutes 200mg 'light' magnesium carbonate was added. The tube was shaken at intervals for the next 30 to 60 minutes. The tube was then centrifuged at 300 rpm for 5 minutes and a portion of supernatant fluid was decanted into an Auto Analyzer cup and estimated as for serum iron. The TIBC was three times the value calculated form the Auto Analyzer recorder chart.

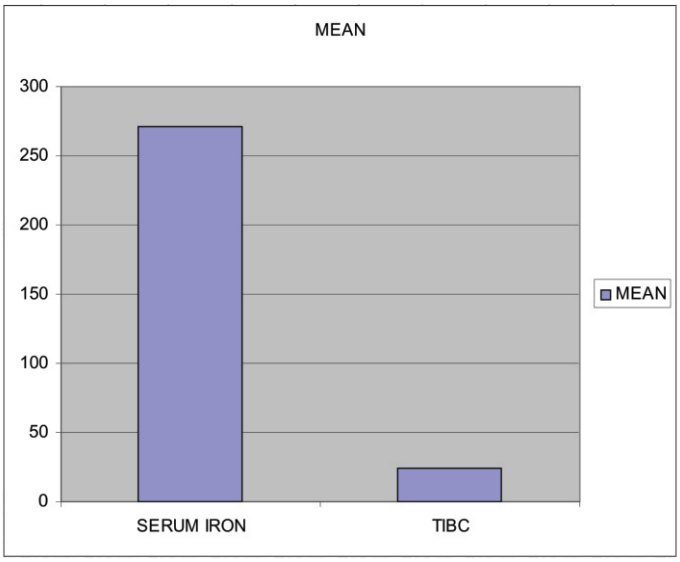
The normal value of TIBC: 250 – 400 µg/dl

3. Results:

Serum iron and tibc in rural children:

Parameters	Mean	SD
Serum iron	270.8840	88.0737
TIBC	24.2790	10.9848

The serum iron and TIBC were inversely related with highly significant p value of < 0.0001. It was found that when the serum iron levels are increased TIBC levels were decreased proportionately.



4. Discussion:

The method used for the measurement of serum iron and TIBC is rapid and easy to perform. In nutritional studies to assess the prevalence of iron deficiency, it has been common practice to define 3 stages of increasing severity: iron storage depletion as defined by low serum iron, high TIBC, low serum ferritin, mild iron deficiency without anemia based on laboratory evidence of iron deficient erythropoiesis (IDE), and overt iron deficiency anemia (IDA). While this approach provides a broad perspective of impaired iron status, the main liabilities of iron lack are associated only with the more advanced stage of IDA. Consequently, the hemoglobin determination can be used to screen for nutritionally significant iron deficiency. Having identified anemia, more specific laboratory studies are needed to establish iron lack as the cause. The traditional measurements of iron deficient erythropoiesis (IDE) such as a low transferrin saturation, elevated erythrocyte protoporphyrin, or decreased mean corpuscular volume are commonly used. The major drawback in using these parameters is that they are affected similarly in individuals with the anemia of chronic disease (ACD), a common form of anemia in low socioeconomic populations. Because iron stores are invariably absent in individuals with uncomplicated IDA, a low serum ferritin concentration below 20 micrograms/L, low serum iron and increased TIBC confirms the diagnosis of IDA when anemia is present.

The low body iron reserves of the children demonstrate that this deficiency is an important specific nutritional deprivation. Iron deficiency and anemia appear to be an important public health problem among children at public daycare centers. Therefore, effective actions aimed at the prevention and control of the deficiency are strongly recommended in this ecological context.

Therefore, timely and effective measures for the prevention and control of iron deprivation are to be recommended for this high-risk population.

References:

[1] BRENDSTRUP P. Serum copper, serum iron and total iron-binding capacity of serum during treatment with coli vaccine. Acta Med Scand. 1953;146(2):114–122. [PubMed]

[2] CARD RT, BROWN GM, VALBERG LS. SERUM IRON AND IRON-BINDING CAPACITY IN NORMAL SUBJECTS. Can Med Assoc J. 1964 Mar 7;90:618–622. [PMC free article] [PubMed]

[3] FOWLER WM, BARER AP. Plasma iron; normal values; response following medication. Am J Med Sci. 1952 Jun;223(6):633–641. [PubMed]

[4] KINGSLEY GR, GETCHELL G. Serum iron determination. Clin Chem. 1956 Jun;2(3):175–183. [PubMed]

[5] MOORE CV, M INNICH V, WELCH J. Studies in iron transportation and metabolism. The normal fluctuations of serum and "Easily split – off" blood iron in individual subjects.. J Clin Invest. 1939 Sep;18(5):543–552. [PMC free article] [PubMed]

[6] J Pediatr (Rio J). 2007;83(4):370-376: Anemia, iron deficiency, hemoglobin, serum iron, serum ferritin, TIBC, transferring saturation, free erythrocyte protoporphysin in pre-school children. 2007;83(4):370-376.

[7] PETERS T, GIOVANNIELLO TJ, APT L, ROSS JF. A simple improved method for the determination of serum iron. II. J Lab Clin Med. 1956 Aug;48(2):280–288. [PubMed]

[8] RAMSAY WN. The determination of iron in blood plasma or serum. Clin Chim Acta. 1957 Jun;2(3):214–220. [PubMed]

[9] SANKARANARAYANAN S, UNTORO J, ERHARDT J, GROSS R, ROSALES FJ. Daily iron alone but not in combination with multimicronutrients increases plasma ferritin concentrations in indonesian infants with inflammation. J Nutr. 2004;134;1916-22. [pubmed/open access]

[10] SERDAR MA, SARICI SU, KURT I, ALPAY F, OKUTAN V, KURNAZ L, et al. The role of erythrocyte protoporphyrin in the diagnosis of iron deficiency anemia of children. J Trop Pediatr. 2000;46:323-6.[crossref] [pubmed/open access]

[11] STENGLE JM, SCHADE AL. Diurnalnocturnal variations of certain blood constituents in normal human subjects: plasma iron, siderophilin, bilirubin, copper, total serum protein and albumin, haemoglobin and haematocrit. Br J Haematol. 1957 Apr;3(2):117–124. [PubMed]

[12] YOUNG DS, HICKS JM. METHOD FOR THE AUTOMATIC DETERMINATION OF SERUM IRON. J Clin Pathol. 1965 Jan;18:98–102. [PMC free article] [PubMed]