

# Total Iron Binding Capacity (TIBC) and Transferrin Saturation as Indicators of Iron Status in Breastfed and Bottle Fed Infants

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## ABSTRACT

**Objective:** To evaluate iron status in breastfed and bottle fed infants using TIBC and transferrin saturation and also to compare iron status in breastfed and bottle fed infants.

**Subjects and methods:** This was cross-sectional randomized study. Ninety infants of 6-8 months of age were enrolled which declared healthy by preventive Pediatrics Department of Jinnah Hospital, Ganga Ram Hospital and Mayo Hospital and some MCH Centres of Allama Iqbal Town and Wahdat Colony, Lahore. They are further divided into 3 groups, group I breastfed (human milk), group IIA formula milk fed and group IIB animal milk fed. Healthy infants declared healthy by concerned preventive pediatrics department were included in the study. While sick infants, those on iron supplements were not included. It was based on proforma based information and laboratory investigations. Iron, TIBC and transferrin saturation was calculated by standard laboratory procedures to protocol.

**Results:** Serum TIBC in breastfed group I was in range of 280-302 µg/dl. Mean value was 293.67±4.73. In group IIA (formula milk fed) TIBC was in range of 280-300 µg/dl with mean was 289.3±6.06. Serum TIBC in group IIB (animal milk fed) was in range of 339-400 µg/dl with mean value of 386.60±10.3. Transferrin saturations in group I was 29-35% with mean 32.1±1.26, group IIA was 32.6-39.2% with mean 35.98±1.66 and Group IIB 8.52-11.84% while mean 9.87±0.73 respectively.

**Conclusion:** Serum TIBC of breastfed infants and formula milk fed infants was in same range similarity transferrin saturation showed same pattern in normal range for these two groups. In animal milk fed, the TIBC was in lower range along with transferrin saturation. So it can be concluded that iron status in breast milk fed infants iron is same as that formula milk fed infants. The infants fed on animal milk are deficient in their iron levels. Breast milk feeding must be encouraged to avoid iron deficiency in infants.

**Keywords:** Serum total inhibition binding capacity, Formula milk, Iron status

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## INTRODUCTION

There is mounting evidence that iron deficiency in infants can cause permanent neurocognitive deficits even before it has progressed to stage where it can cause anemia<sup>1,2</sup>. The exact relationship between iron deficiency anemia and developmental effects is not clearly understood, but these manifestation only occur when severe iron deficiency is there for longer period of time. The maternal iron stores are sufficient upto 4 months of infants age of mother is not anemic. So provision and supplementation of iron in infants is being stressed infants at weaning are given iron fortified diets. WHO has recommended that all formula milks must be iron fortified<sup>3,4</sup>. Serum iron deficiency is considered as most common entity in third world countries because of poor socioeconomic conditions. Lower levels of public awareness and substandard/not fortified diets<sup>5</sup>. Moreover various physiological and dietary factors play important role in absorption of iron like vitamin C intact healthy duodenal epithelial tissue etc. Human milk's iron content is not so high but it's bioavailability in much higher than other sources. So it fulfills iron needs

during the period of age when it's requirement is high (i.e. 6 months to 2 years of age) as new stores of iron have to be built during this time and maternal stores being used up at 4-6 months of infantile life<sup>6,7</sup>. Formula (fortified) milks also contain sufficient amount of iron but their absorption is not as good as that of human milk<sup>8</sup>.

Iron content in animal milk is very low (0.15 ng/L) and its bioavailability is also very poor. The recommended daily allowance (RDA) of iron for 6-12 months of age is 11 mg/day and this requirement is fulfilled to much extent by human milk or formula milk (fortified), because principal source of iron in infants (on weaning) is human milk or formula milk (iron fortified). Absorption and tolerance of human milk is much better than animal milk and formula milk. Among animal milks, cow's milk has very low source of iron and Vitamin C.<sup>9</sup> Moreover formula milks containing iron can irritate bowel and can cause diarrhea while human milk being species specific milk contains vital nutrients and minerals (Ca, PO<sub>4</sub> etc) and iron and is more friendly to infants regarding absorption and tolerance. As risk of developments of iron deficiency anemia is higher in infants fed on whole cow's milk and animals milk during infancy<sup>10,11</sup>. Research studies regarding determination of iron status in apparently healthy infants fed on various milk and breast milk are not in a large number may

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be seen (iron deficiency anemia) is considered as a problem of under developed countries. So it is need of hours to do studies to evaluate iron status in infants based on parameter other than simply estimating hemoglobin. Serum iron along with TIBC and transferring saturation are important indicators of serum iron status as it differentiates other causes of iron deficiency.<sup>12</sup> The purpose of this study was to determine iron status of infants using TIBC and transferring saturation with a view to know their important as iron level indicators and to compare iron status in various infants fed on different milk.

**SUBJECTS AND METHODS**

A total ninety subjects were included in this study. They were divided into three groups. Group I (breastfed) 30infants on breast feeding predominatly and weaning. Group II (bottle fed infants), it comprised of 60 subjects. It was further divided into two subgroups. Subgroup IIA (formula milk fed infants) and subgroup IIB (animal milk fed infants). Healthy infants declared by concerned preventive pediatrics departments were included. Sick infants with any acute or chronic illness, infants who stopped breast feeding after 7 months and those taking iron supplements (hematonics) were excluded from study.

With consent of parents venous samples of infants were drawn with aseptic precautions, in BD vaccutainers. Serum iron was separated from samples and serum iron and TIBC were performed using Randox Kits on spectrophotometer. Transferrin saturation was measured as ratio of serum iron to TIBC and expressed as percentage. Results are presented using statistical terms like means and standard deviations (SD).

**RESULTS**

In group I (breast fed) serum iron, TIBC and transferrin saturation were 94.43 µg/dl 3.1 with a range of 87- 102 µg/dl, TIBC 293.63±3.5 and the range was 280-102 µg/dl, transferring saturation came out to be 32.16% (range 29.19-35.17%). In group IIA (formula milk fed), serum iron was 104.0±3.0 (range 98-110 µg/dl), TIBC was 289.3±3.6 (range 280-300 µg/dl) and transferring saturation was measured as 35.98% (range 32.6-39.2%). In group IIB (animal milk fed), serum iron was 38.13±2.3 with range was 34-45 µg/dl. Serum TIBC was 386.6 with range of 339-100 µg/dl and transferring saturation was 9-87% with range 8.5-11.84%) (Table 1).

Table 1: Mean±standard deviations of all parameters of total groups

Parameter	Group I	Group IIA	Group IIB
Serum iron	94.43±3.68 (87-102 µg/dl)	94.43±3.0 (98-110µg/dl)	38.13±2.37(34.45µg/dl)
Serum TIBC	293.63±4.73 (280-302 µg)	293.63±3.6 (280-302µg)	396.60±3.6 (280-300µg)
Trasferrin saturation	32.16 (29.1-35.17%)	35.98 (32.6-39.6%)	9.87 (8.5-11.94%)

**DISCUSSION**

The present study clearly proves that serum iron level indicated by TIBC and transferring saturation is higher in breast fed infants (group I) as compared to group IIB (animal milk fed infants) which in conformity with finding of Breymann et al<sup>13</sup>. In formula milk fed infants, serum iron was equivalent or higher than breast fed infants which was also proved by Solomons<sup>14</sup>, Bhutta and Salam<sup>15</sup>. This is because less intake of iron in weaning food is associated with iron deficiency, iron fortified foods/diet following exclusive breast feeding is recommended to reduce iron deficiency<sup>19</sup>. It is proved that TIBC is good indicator of serum iron status as it differentiates iron deficiency due to other causes like chronic infections. It's value is higher in iron deficiency but is normal in chronic disorders<sup>16</sup>. As observed in this study, TIBC was much higher in animal milk fed (group IIB) and accordingly serum iron was low. This is also consistent with the findings of Domeloff et al<sup>17</sup>. Although serum ferritin is good parameter for iron stores of body but it is acute phase reactant being affected by acute and chronic inflammatory

conditions of body<sup>18</sup>. In the countries, where animal milk is still fed to the infants like Ghana, parts of India-Pakistan, iron deficiency is more prevalent than other countries where animal milk is not used as predominant feed/ diet for infants<sup>19</sup>. Moreover formula milk fortification rules and policies being implemented by Ministries of health in most of the counties of world have significantly improved the iron status of infants.<sup>20</sup> As a result of these measures iron deficiency anemia are decreasing in these countries. As for as breast (human milk) fed infants are concerned their iron status has improved as shown by lesser number of infants having iron deficiency anemia seen in these infants. This is because of general awareness created by media in general and health departments in particular regarding importance of breast feeding. The screening programs for iron status evaluation have not been developed at mass scale level in developing counties as for as prevalence of iron deficiency anemia is concerned. The indicators for determination of iron deficiency anemia include hemoglobin, red cell indices, blood smear examination, red cell distribution width, serum

iron, TIBC, serum ferritin, transferrin saturation. Among these serum ferritin although indicates stores of body iron, but is acute phase reactant, serum ferritin value may increase because of other factors not related to iron like malnutrition and inflammation<sup>21</sup>. Serum TIBC and transferrin saturation are not affected by acute phases and inflammatory conditions of body (even non overt), so these investigations along with serum iron are easy and readily performed indicators to assess iron status.

## CONCLUSION

Serum iron status of breast fed infants (group I) is higher than animal milk fed (group IIB) infants. Moreover serum iron is equal to formula milk fed infants (group IIA). Serum TIBC and transferrin saturation are significantly better parameters to determine iron status. Keeping in view the prevalent iron deficiency in childbearing age women and their infants at large and dietary deficiencies due to overall socioeconomic conditions of our country research on this part of population is need of hour.

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