

# The effects of serum ferritin levels of mother on developing of iron deficiency anemia in their newborns

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*This study was performed on 52 uncomplicated primiparous mothers and their term infants. Of these infants 22, fed with cow's milk, were followed for 2-4 months. Hemoglobin (Hb), mean corpuscular volume (MCV), serum ferritin, serum transferrin, transferrin saturation, serum iron and iron binding capacity were measured in venous blood of mothers and in cord blood. We detected inadequate iron stores in 34(44.2%) of 52 mothers and evident iron deficiency anemia in 11 (21.1%) of these 34 mothers. Mothers and babies were categorized into two groups according to their serum ferritin levels >12 ng/ml and <12 ng/ml. In 15 infants of mothers with ferritin <12 ng/ml parameters were reevaluated on 2nd month and in 7 infants of mothers with ferritin >12 ng/ml on 2nd and 4th months. All 22 babies fed with cow's milk developed occult or evident iron deficiency anemia during follow-up. Infants of mothers with ferritin levels less than 12 ng/ml developed evident iron deficiency in 2nd month, whereas. Infants of mothers with serum ferritin levels higher than 12 ng/ml developed occult iron deficiency in 2nd month and evident iron deficiency in 4th month. Mean serum ferritin levels of infants of mothers with ferritin value <12 ng/ml were significantly lower than those of newborns of mothers with ferritin value >12 ng/ml (p<0.01). And it was concluded that infants, fed by cow's milk alone, must take iron supplementation on their second months. [Turk J Med Res 1995; 13(1): 38-41]*

**Key Words:** Ferritin, Newborns, Breast feeding, Bottle feeding

Intelligent planning of public health programs, as well as proper management of individual patients with iron deficiency, depends on a familiarity with iron metabolism and with the changes in iron status during development (1). Iron stores present as ferritin and hemosiderin in the body (1-5). Ferritin exists as an intracellular compound and it dissolves in water. Serum ferritin level reflects iron storage status (1,6). Determination of serum ferritin level is a sensitive indicator in early iron deficiency anemia (7,8). Studies showing an inverse relationship between cord serum ferritin and hemoglobin (Hb) concentration suggest that the amount of iron in fetal stores is influenced by the amount required for Hb production. In mothers who have mild iron deficiency anemia, there is little or no effect on the concentration of Hb in the fetus and newborn. However, when the mother has severe iron deficiency anemia during her pregnancy, the Hb con-

centration in the newborn can be substantially decreased, though to a lesser degree than in the mother (1).

Up to date various studies revealed that there is a positive correlation between ferritin values of cord blood and mother's venous blood (8,9). We evaluated infants fed by cow's milk of mothers with adequate and inadequate iron stores for the development of iron deficiency anemia in second and fourth months.

## MATERIALS AND METHODS

The study was performed on 52 uncomplicated primiparous mothers and their term newborn infants. Of these infants 22, fed with cow's milk, were followed for 2-4 months. Mother's and their infants' liver and renal functions were normal and mothers did not have infection during the last month. Hemoglobin (Hb), mean corpuscular volume (MCV), serum ferritin, serum transferrin, transferrin saturation, serum iron and iron binding capacity were measured in venous blood taken from mothers one hour before delivery and in cord blood. Both mothers and infants whose serum ferritin levels were >12 ng/ml evaluated in two groups (1,6,9).

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**Table 1.** Serum ferritin levels of mothers

Mothers n=52	Serum ferritin levels (ng/ml)
34(65.4%)	<12
16(30.8%)	12-30
1 (1.9%)	46
1 (1.9%)	72

Group I, IA, II, 11A represent mothers' serum ferritin levels <12 ng/ml, infants of mothers with serum ferritin levels <12 ng/ml, mothers with serum ferritin levels >12 ng/ml, infants of mothers with serum ferritin levels >12 ng/ml, respectively. Of the infants whose iron parameters were repeated in second month, the infants of mothers with low serum ferritin were considered as Group IB and the infants of mothers with serum ferritin levels >12 ng/ml as Group MB (1,6,9). In 15 infants of mothers with ferritin >12 these parameters were reevaluated on 2nd and in 7 infants of mothers with ferritin >12 on 2nd and 4th months. Since iron therapy was given to Group IB for evident iron deficiency in second month, parameters were not repeated in the fourth month.

Statistical evaluation was performed by using standard deviation and student't test (10).

## RESULTS

Mean age of 52 primiparous mothers was 26.3±5.3 years, ages ranged between 18-39. Mean birth weight of infants was 3136 (2500-4400) g and gestational ages were between 38-40 weeks. Twenty seven (52%) of these infants were female and, 25 (48%) were male and female to male ratio was 1.1. We detected inadequate iron stores in 34 (44.2%) of 52 mothers and evident iron deficiency anemia in 11 (21.1%) of these 34 mothers. Serum ferritin levels are showed on Table 1. There was no difference in the mean weight between Group IA and Group IIA (p>0.05). There was no difference in the weight gain between these two groups in the fourth month too. Parameters of mothers with adequate (>12 ng/ml) and inadequate (<12 ng/ml) serum ferritin level and their newborn infants are shown in Table 2. Mean serum ferritin value of Group 11A was significantly higher than those of Group IA (p<0.01), statistical differences between the other parameters were not significant (p>0.05). Iron parameters of Group IB in the second month and parameters of Group IIB in the second and fourth months were shown in Table 3.

The positive correlation between Group I and IA and; Group II and Group 11A are shown in Figures 1 and 2.

**Table 2.** Serum ferritin levels of mothers with ferritin value <12 ng/ml (Group I), infants of mothers with ferritin value >12 ng/ml (Group IA), mothers with ferritin value >12 (Group II), infants of mothers with ferritin value >12 ng/ml (Group MA).

Parameters	Group I (n=34) x±SD	Group II (n=18) x±SD	Group I- Group II p	Group IA (n=34) x±SD	Group IIA (n=18) x±SD	Group IA- Group IIA p
Hb (g/dl)	11.6±1.4	13.1 ±0.7	<0.001	15.9±1.6	16.1±1.3	>0.05
Serum ferritin (ng/ml)	9.1±1.7	20.2±12.1	<0.05	76.5±27.7	153.2±56.8	<0.001
Serum transferrin (ng/ml)	281±30.2	279.0±33.6	>0.05	203.2±41.2	208.8±30.4	>0.05
Transferrin saturation (%)	11.3±2.0	14.4±1.1	>0.05	45.0±11.7	44.8±8.1	>0.05
Serum iron (mg/dl)	39.2±5.1	49.2±5.2	>0.05	110.0±10.4	111.2±11.3	>0.05
Total iron binding capacity (mg/dl)	348.1±58.3	348.3±33.4	>0.05	257.7±60.6	265.3±38.4	>0.05

**Table 3.** Iron parameters of infants of mothers with ferritin value <12 ng/ml (Group IB) in 2nd month and parameters of infants of mothers with ferritin value >12 ng/ml (Group IIB) in 2nd and 4th months.

Parameters	Group IB (2nd mo) (n=15)	Group IIB (2nd mo) (n=7)	Group IIB (4th mo) (n=7)	Group IB- Group IIB (2nd mo) P	Group IIB (2nd and 4th mo) P
Hb (g/dl)	11.43±0.84	12.27±0.80	11.88±0.40	<0.05	>0.05
MCV (fl)	80.05±5.43	82.50±4.98	81.14±1.39	>0.05	>0.05
Serum ferritin (ng/ml)	75.86±7.85	104.4±22.35	81.28±6.36	0.001	<0.05
Serum transferrin (mg/dl)	282.5±11.0	270.56±6.18	277.64±4.83	<0.01	<0.05
Serum iron (mg/dl)	41.75±7.73	59.50±4.07	49.37±1.88	0.001	<0.001
Total iron binding capacity (mg/dl)	355.1±16.7	335.37±3.78	353.6±11.7	<0.001	<0.01
Transferrin saturation (%)	11.79±2.52	17.70±1.33	13.94±0.89	<0.001	<0.001

Hb: Hemoglobin

MCV: Mean corpuscular volume

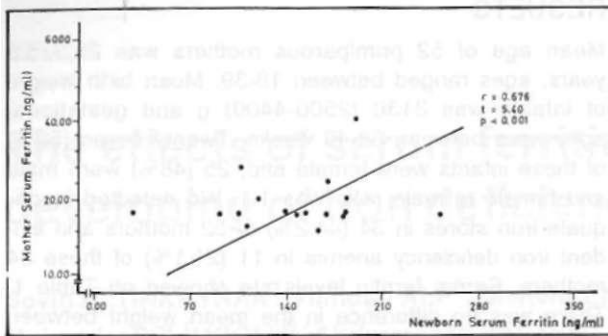


Figure 1. The positive correlation between mothers with serum ferritin level >12 ng/ml and their infants' serum ferritin levels

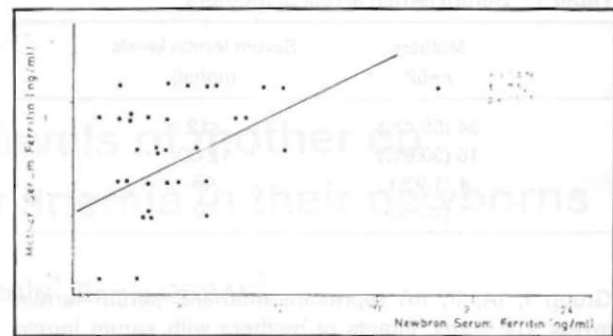


Figure 2. The positive correlation between mothers with serum ferritin level <12 ng/ml and their newborn infants' serum ferritin levels

The statistical differences of all the parameters (erythrocyte and iron) between the infants whose mothers' serum ferritin levels were <12 ng/ml and >12 ng/ml was important (except MCV). Therapy was given to the infants who developed iron deficiency anemia of mothers with depleted iron stores. In the infants of mothers with serum ferritin level >12 ng/ml there were important differences between all the parameters (except Hb and MCV) in the second and fourth months. These all infants developed occult iron deficiency anemia in the second and evident iron deficiency anemia in the fourth months.

## DISCUSSION

Iron deficiency anemia is widespread throughout the world. It affects people of all ages and economic groups although it is more common among the very young, among those on poor diet and among woman. Iron deficient mothers are likely to have babies with low iron reserves (1,2,9,11,12).

Serum ferritin determination is widely used as a test to diagnose iron deficiency anemia (1,6,8).

Iron stores decrease before serum iron levels, erythrocytes and hemoglobin level decrease in the course of iron deficiency anemia. Serum ferritin level is the best indicator for the mothers' iron storage status and it is more sensitive and reliable than the other parameters (8,13).

The only source of fetal iron during pregnancy is the iron transported through placenta. Fetus can provide sufficient iron for erythropoiesis even if mothers' iron stores have decreased. For this reason it is demonstrated that Hb values of newborn infant had not been affected by occult iron deficiency of mothers (1,8).

Only 11 (21.1%) of 52 mothers had evident iron deficiency anemia. Macphail et al (15), Hussain et al (16), Milman et al (8) reported that mothers had evident iron deficiency as 17.5%, 7.9%, 2.4%, respectively. We attributed this high ratio of anemia to inadequate

iron supplementation, irregular obstetric examinations during pregnancy, due to low socioeconomic and socio-cultural status of our region.

We detected depletion of iron stores in 34 (65.4%) of 52 mothers. Despite depleted iron stores, Hb was in normal ranges in 23 mothers (44.2%) of these 34 mothers. This indicates that serum ferritin level decreases much more before the Hb level decreases and this result demonstrates that serum ferritin is more sensitive and more reliable than Hb in diagnosis of iron deficiency anemia (8,12).

As it is shown in Table 3 only the mean Hb and serum ferritin values were lower in mothers with depleted iron stores than mothers who have normal iron stores ( $p < 0.001$ ). There was no statistical difference between the other parameters ( $p > 0.05$ ); this was similar to the literature (6,12).

In Figures 1 and 2 positive correlation between mothers and their newborn infants was shown and this was also similar to the literature (8,9,12,14,17).

Serum ferritin level lower in newborn of mothers with depleted iron stores than newborns of mothers with normal iron stores and it was statistically important ( $p < 0.01$ ). Whereas the difference between the other parameters were not important ( $p < 0.05$ ) and there was a correlation with literature knowledge (8,9). Results supported that Hb level of newborn infants were not affected by mothers' occult iron deficiency or depleted iron stores and that the serum ferritin concentration is the best indicator of iron reserves. And it is observed that iron stores of newborn infants of mothers with depleted iron stores were less than normal ranges. Infants with depleted iron stores who were fed with cow's milk were followed as regards the time of developing iron deficiency anemia. In contrast, parameters of infants of mothers with normal iron stores was these 22 infants with depleted or normal iron stores who fed with cow's milk were followed up to determine the time of development of evident iron deficiency anemia. Since values of Hb, MCV, serum ferritin and iron parameters of infants of mothers with

depleted iron stores were lower than normal levels in 2nd months, in infants of mothers with normal iron stores, occult iron deficiency was detected in 2nd months and evident iron deficiency in 4th month.

In our region compared to formula, cow's milk is widely used for infant feeding during the first two years of life because of its low cost. Exclusive feeding with cow's milk causes inadequate intake of food rich in iron and also causes occult gastrointestinal bleeding. Since iron stores of infants who are not fed by human milk or formula decrease nearly in three months, diets of these infants must be fortified by iron or they must be treated with iron (1).

With these results it was concluded that infants who are fed by cow's milk alone must take iron supplementation on their second months.

### **Anne serum ferritin düzeyinin bebekte demir eksikliği anemisi gelişimine etkisi**

*Atatürk Üniversitesi Tıp Fakültesi Kadın Hastalıkları ve Doğum Kliniğinde doğumu gerçekleştirilen 52 komplikasyonsuz primipar anne, miadında yenidoğan bebekleri ve bu 52 bebeğin tek başına inek sütü alan 22 tanesi 2., 4. aylarında çalışma kapsamına alındı. Anne ve bebeklerin karaciğer fonksiyonlarının normal ve son bir ayda enfeksiyon geçirmemiş olmasına dikkat edildi. Anneden doğumdan bir saat önce venöz kandan, 52 miadındaki yenidoğandan kordon kanından, 2., 4. ayda juguler venden kan örnekleri alınarak hemoglobin, ortalama eritrosit hacmi, serum ferritini, serum transferini, transferrin saturasyonu, serum demiri, bağlama kapasitesi ölçüldü. 52 annenin 34'ünde (44.2%) yetersiz demir deposu ve bu 34 olgunun da 11'inde (21.1%) demir eksikliği anemisi tesbit edildi. Serum ferritin seviyesi <12 ng/ml ve Ö12 ng/ml olarak anne ve infantları iki gruba ayrıldı. Ferritin seviyesi <12 ng/ml olan annelerin 15 infantı 2. ayda, ferritin seviyesi >12 ng/ml olan annelerin 7 infantı 2. ve 4. ayda tekrar değerlendirildi. Bu değerlendirmelerde tek başına inek sütü ile beslenen 22 bebeğin tümünde gizli veya aşikar demir eksikliği anemisi gelişti. Demir depoları tükenen annelerin bebeklerinde ortalama serum ferritin değerinin demir depoları tükenmeyen annelerin bebeklerine göre önemli derecede düşük olduğu saptandı (p<0.01). Serum ferritini 12 ng/ml'nin altında olan annelerin bebeklerinde 2. ayda aşikar, 12 ng/ml'nin üzerinde olan annelerin bebeklerinde ise 2. ayda gizli, 4. ayda aşikar demir eksikliği anemisi geliştiği gözlemlendi. Tek başına inek sütü ile beslenen infantlara ikinci aydan itibaren demir takviyesi yapılması gerektiği vurgulandı. [Turk J Med Res 1995; 13(1): 38-41]*

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