Ferritin and iron status in Senegalese women¹,²

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ABSTRACT  Ferritin, iron status, and hematological parameters—Hb, hematocrit—were determined in 172 mature women at screening visits in first aid medical care units located in Senegal. Of the subjects 36.6, 39.5, and 34.9% had Hb, hematocrit, and ferritin levels below accepted norms (i.e., Hb < 11 g/dl, hematocrit < 33%, serum ferritin < 10 ng/ml). Serum iron level was normal (> 50 μg/dl) in 94.2% of the subjects, but 48.3% had marginal levels (51 to 100 μg/dl). The distribution curves of Hb level in the population indicates that about 58% of the women had Hb < 12 g/dl. Furthermore, the very low serum ferritin levels (< 20 ng/ml) encountered in 75.6% of subjects, demonstrate the small size of their iron stores. This precarious iron balance indicates that these women are at a high risk of nutritional anemia. Numerous factors such as pregnancy or parasitical infestation can dramatically modify this iron balance and increase the prevalence of anemia in this population.  *Am J Clin Nutr* 1982;36:314–318.

KEY WORDS  Hemoglobin, hematocrit, serum iron, serum ferritin, nutritional anemia

Introduction

For many years, the World Health Organization (WHO) has been concerned with the global problem of nutritional anemia in developing countries. The 1968 and 1972 WHO reports (1, 2) propose the measurement of several hematological and biological parameters for its survey (3). Hb level below 11 g/dl, hematocrit (Hct) below 33%, serum iron level (SI) below 50 μg/dl (4), and serum ferritin level (SF) below 10 ng/ml (5, 6) are considered to be indicative of patent anemia. General medical practice in the field assumes that Hb and Hct levels are equally useful in screening for anemia (7). This assumption is supported by a close correlation between Hb and Hct level variations (8). To characterize further the nutritional origin of anemia, several investigators have studied the serum iron and ferritin levels among African women (9–11). Such studies have proved useful to determine the prevalence and severity of nutritional anemia (12–15). The current study was undertaken to evaluate the prevalence of serum ferritin and iron deficiencies among Senegalese women and the relationship between these biological parameters and Hb and Hct levels.

Methods

One hundred seventy-two mature, nonpregnant women (age range 19 to 45 yr) were included in the study. They were all from low socioeconomic levels. Venous blood samples were drawn during screening visits in First Medical Care Units located on the west coast of Senegal (Dakar, Thies, Louga, St. Louis). Blood samples were tested for Hb, Hct, and SI level by standard techniques (16, 17). An aliquot of serum was frozen and shipped to France for the determination of ferritin level by radioimmunoassay (18). Statistical analysis was carried out by nonpaired Student’s t test.

Results

Figure 1 shows the Hb, Hct, SF, and SI data of the 172 subjects. Among these 36.6% (n = 63), 39.5% (n = 68), 34.9% (n = 60) had

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Hb, Hct, and SF levels below accepted norms. However, 10 women below the Hct cutoff value (33%) had Hb more than 11 g/dl and five women below Hb cutoff value had Hct more than 33%. Serum iron level was normal (> 50 μg/dl) in 94.2% of the subjects.

Table 1 shows the mean values (± SEM) of the hematological data of the 63 anemic (36.6%) and 109 nonanemic women (63.4%); and Hb level below 11 g/dl is considered, according to WHO, to be the real indicator of anemia. The two groups differ significantly for all parameters (p < 0.001). However, the SF and SI values for the anemic women were higher than the cutoff levels specified by the WHO.
The data for SF and SI are also presented in the form of distribution curves to illustrate better the difference between anemic and nonanemic groups.

Figure 2 shows the distribution of SF values in anemic and nonanemic women. Of the population 75.6% (n = 130) had a low ferritin level (< 20 ng/ml) whether anemic or nonanemic. However, a significant difference can be seen between anemic and nonanemic groups for an SF level below 20 ng/ml.

Discussion

The data presented in Figure 1 show that Hb and Hct tests, at commonly assumed “equivalent” cutoffs (Hb < 11 g/dl and Hct < 33%) detect varying population prevalence of anemia: 36.6 and 39.5%, respectively. The false-positive rate—the percentage of women below 33% hematocrit, but who were above 11 g/dl Hb—is 9.2%. The false-negative rate indicates that 7.9% of women above the Hct cutoff value were considered anemic because their Hb was below 11 g/dl. Using only an Hct test to detect possible iron deficiency, there is an overdiagnosis of anemia of 14.7% and a failure to detect 4.8% of the women who might be considered anemic using an Hb test. These results agree with those of Graiter et al. (19).
However, a recent report (3) indicates that it seems desirable to characterize the hematological status of a population by determining the frequency distribution of the hematological parameters. We found that of the studied population, 20.3% (n = 35) had severe anemia (Hb < 10 g/dl), 36.6% (n = 63) were below accepted norms (Hb < 11 g/dl), but 58.1% (n = 100) had Hb < 12 g/dl. So, a large part of the women may be considered at a high risk of anemia.

The mean value and distribution curve of serum iron show that only 5.8% of the population had SI values below the cutoff level proposed by WHO, but 48.3% (n = 83) of subjects were in a low normal range (51 to 100 μg/dl) whether anemic or nonanemic. These values agree with those of Koh et al. (21) who recently reported a mean serum iron level of 69 ± 25 μg/dl in Black women (≤ 59 years). Anemic women have lower iron values than nonanemic women but in most of the subjects these levels are just above normal. It has been demonstrated that when body iron stores are reduced, the amount of iron absorbed increases in proportion to the depletion of the store (22).

The Figures 1 and 2 show that 75.6% (n = 130) of women (anemic and nonanemic) have serum ferritin levels below 20 ng/ml. Of the 60 subjects with SF below accepted norm, 24 were in the nonanemic population. These results are in agreement with previous reports (9, 13) and emphasize that the African woman has an important body iron store depletion (5, 15). A number of factors often present in developing countries are known to increase serum ferritin values particularly liver and inflammatory diseases (23, 24). This suggests that the "real" iron stores may even be lower than ferritin measurements would indicate.

The present report demonstrates that a large body of the female population has a severe nutritional anemia and a precarious iron balance. Numerous factors such as preg-
nancy (25) or hookworm infestation (26, 27) which increase iron requirements or losses, can dramatically destroy this weak iron equilibrium. With no iron stores to draw on, anemia immediately supervenes (28).

In conclusion, because a very high risk of nutritional anemia exists in this population, it is our belief that women with low Hb and low serum ferritin levels should be retested periodically. In addition, further studies including other hematopoietic measurements (folate, vitamins . . . ) are needed to understand the etiopathogenesis of nutritional anemia and determine the best way for its eradication.

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