Assessing the IRON STATUS of populations

Second edition

Including Literature Reviews

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Report of a Joint World Health Organization/
Centers for Disease Control and Prevention

Technical Consultation on the Assessment of Iron Status at the Population Level

GENEVA, SWITZERLAND
6–8 APRIL 2004

1. Consultation

1.1 Rationale for the Consultation

Anaemia is one of the most common and intractable nutritional problems in the world today. The World Health Organization (WHO) estimates that some two billion people are anaemic defined as haemoglobin concentrations that are below recommended thresholds. The main causes of anaemia are: dietary iron deficiency; infectious diseases such as malaria, hookworm infections and schistosomiasis; deficiencies of other key micronutrients including folate, vitamin B_{12} and vitamin A; or inherited conditions that affect red blood cells (RBCs), such as thalassaemia.

Iron deficiency with or without anaemia has important consequences for human health and child development: anaemic women and their infants are at greater risk of dying during the perinatal period; children's mental and physical development is delayed or impaired by iron deficiency; and the physical work capacity and productivity of manual workers may be reduced. There have been many efforts to fight iron deficiency and anaemia over the past two decades but, despite these efforts, the conditions are still common.

One of the reasons for the apparent failure to reduce the prevalence of anaemia is that many programmes and their interventions have been designed with the assumption that the only cause of anaemia is iron deficiency. This has meant that, when trying to control anaemia, the role of other causes has been underestimated, and that iron deficiency without anaemia has not been addressed as a major and common health problem.

In the absence of international agreement on how to assess the iron status of populations, the prevalence of iron deficiency has often been derived from the prevalence of anaemia using measurements of blood haemoglobin concentration. However not all anaemic people are iron deficient and iron deficiency may occur without anaemia. This means that the prevalence of anaemia and iron deficiency varies in different populations and no consistent relationship between the two can be applied throughout the world. When anaemia is considered from the point of view of programmes to improve nutrition and health, an estimate of the prevalence derived from the haemoglobin concentration alone does not allow the contribution of iron deficiency to anaemia to be estimated, and ignores the role of other causes of anaemia.

To plan effective interventions to combat both iron deficiency and anaemia there is an urgent need to have better information on the iron status of populations. This will enable the right interventions to be chosen in the first place and then, once programmes are in place, to have the right indicators to monitor their impact.

These were all reasons for holding the Joint WHO/Centers for Disease Control and Prevention (CDC) Technical Consultation on the Assessment of Iron Status at the Population Level. The Consultation took place in Geneva, Switzerland, from 6 to 8 April 2004.

1.2 Objectives of the Consultation

The objectives of the Consultation were:

- to review the indicators currently available to assess iron status;
- to select the best indicators to assess the iron status of populations;
- to select the best indicators to evaluate the impact of interventions to control iron deficiency in populations;

- to identify priorities for research related to assessing the iron status of populations.

2. Working definitions of key terms

For the sake of clarity and to achieve a consensus, several key terms were defined during the Consultation.

In clinical terms *anaemia* is an insufficient mass of RBCs circulating in the blood; in public health terms *anaemia* is defined as a haemoglobin concentration below the thresholds given by WHO, UNICEF, UNU (*1*). These thresholds are set at the 5th percentile of the haemoglobin concentration of a normal population of the same sex and age group. There is a separate threshold for pregnant women.

Although iron deficiency is probably the most common cause of anaemia, there are other causes as well, including: acute and chronic infections that cause inflammation; other micronutrient deficiencies, especially of folate, vitamin B_{12} and vitamin A; and genetically inherited traits such as thalassaemia.

Iron deficiency is a state in which there is insufficient iron to maintain the normal physiological function of tissues such as the blood, brain, and muscles. Iron deficiency can exist in the absence of anaemia if it has not lasted long enough or if it has not been severe enough to cause the haemoglobin concentration to fall below the threshold for the specific sex and age group (*1*). Evidence from animals fed on iron-deficient diets indicates that iron deficiency becomes detectable at about the same time in the blood, brain, and tissue enzyme systems (*2*).

Storage iron is the pool of iron in the body that is not being used by tissues. Healthy children and adults (apart from infants aged 6–11 months and pregnant women) usually have some iron stores to act as a buffer against iron deficiency during periods when dietary iron may be temporarily insufficient. *Iron depletion* is the state in which storage iron is absent or nearly absent but the tissues that need iron are able to maintain normal physiological functions.

It is possible for a *functional iron deficiency* to develop even when iron stores are present if the normal physiological systems for transporting iron to target tissues are impaired. This occurs most commonly because of cytokines released during inflammation caused by infectious diseases, and appears to be mediated by hepcidin (*3*). Iron supplementation or fortification has no benefit in such circumstances. Deficiencies of other nutrients such as vitamin A may also cause a functional iron deficiency even when iron stores are adequate (*4*).