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GUIDELINES FOR THE CONTROL OF IRON DEFICIENCY IN COUNTRIES OF THE EASTERN MEDITERRANEAN MIDDLE EAST AND NORTH AFRICA

Teheran, Islamic Republic of Iran, 22 - 26 October 1995

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This document is based on the deliberations of the Joint WHO/UNICEF Consultation on Strategies for Control of Iron-deficiency Anaemia, which was held at the Institute for Nutrition and Food Technology, in Teheran, Islamic Republic of Iran, from 22 to 26 October 1995

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Preface

The countries of the Eastern Mediterranean Region are facing a multitude of nutritional problems, all having a cumulative effect on physical and intellectual development, which affects work performance

and socioeconomic development. In the control of iodine deficiency disorders marked successes have been achieved in the Region with assistance of WHO and UNICEF. Most countries in the Region will achieve or have achieved the mid-decade goals.

At the World Summit for Children (1990) and the International Conference on Nutrition (ICN, 1992) governments committed themselves to reduce by one-third 1990 levels of anaemia in women of child-bearing age by the end of the ensuing decade.

At present, two thousand million people worldwide suffer from anaemia. Over half the world's pregnant women are anaemic, and 238 million men and 458 million adult women suffer from iron deficiency. It accounts for 24% of the diseases in these women. Its causes are multiple, originating not only from physiological conditions but based in much deeper social, economic and sometimes gender inequities.

Iron deficiency mainly affects women of childbearing age and young children and leads to increased perinatal and maternal mortality and low birth weight. It affects cognitive behaviour, learning capacity and physical development. This results in reduced productivity, reduced income and reduced ability to care for children. Therefore a conceptual framework that recognizes the relationship between poverty, poor health and the empowerment of women is very important for defining interventions for control.

Childbearing patterns, parasitic infections, consanguinity and dietary factors all play a role in iron-deficiency anaemia. In the Region iron intake is generally below recommended levels, consumption of factors that inhibit iron uptake (tea, unleavened bread) is high and iron uptake enhancers (such as vitamin C–containing foods) are often available only seasonally.

Recommended interventions include supplementation of dietary iron, fortification of food with iron, together with improvement of health-care facilities, control of parasitic infections and a more adequate and varied diet. A combination of measures are required with an overall importance of communication and education.

Unfortunately, very few countries have as yet taken national action to eliminate iron-deficiency anaemia.

The joint WHO/UNICEF Consultation on strategies for the control of iron deficiency was a milestone on the road towards achievement of the social development goals for the year 2000, which include the elimination of iodine deficiency disorders and vitamin A deficiency, and reduction in the prevalence of iron-deficiency anaemia, which is only possible with sustained social and

economic development.

This important Consultation developed effective regional strategies to combat the persistent problem of anaemia, including iron supplementation, dietary diversification, public health measures and food fortification, with different emphasis for each of the three subregions: affluent societies, middle-income countries and poor countries. The present document will, thus, be a useful tool for countries in the Region to establish appropriate programmes for the control of iron deficiency, and achieve the goal of a one-third reduction in the prevalence of iron-deficiency anaemia by the turn of the century.

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1.?Introduction

This document is based on the deliberations of the Joint WHO/UNICEF Consultation on Strategies for Control of Iron-deficiency Anaemia, which was held at the Institute for Nutrition and Food Technology, in Teheran, Islamic Republic of Iran, from 22 to 26 October 1995. The Consultation brought together 28 experts from 12 countries within and outside the Region, as well as WHO and

UNICEF representatives. The objectives of the Consultation were:

- to develop effective strategies for control of iron deficiency and anaemia including monitoring and evaluation and mechanisms for information, education and communication.

- to develop mechanisms for integrating control of iron deficiency and anaemia with other micronutrient deficiency control programmes such as those for iodine and vitamin A.

A list of those who participated in the Consultation can be found in Annex 2.

2.?Iron deficiency and anaemia: an overview

2.1?Anaemia epidemiology

Nutritional anaemia refers to a condition in which the haemoglobin content of the blood is lower than normal as a result of a deficiency of one or more essential nutrients (usually iron, less frequently folate or vitamin B_{12}), regardless of the cause of such deficiency. There are no sharp cut-off points below which anaemia can be stated as present. However, standards below which anaemia is likely to be present at sea level have been set out by WHO and are presented in Table 2.1. Anaemia is diagnosed by haemoglobin concentration. This is however a relatively insensitive index of milder degrees of nutrient depletion. By the time anaemia is diagnosed, the person in question is already suffering from a marked degree of nutrient deficiency. Since there are multiple causes of anaemia, and since iron deficiency can exist without haemoglobin levels being lowered, there are potentially four different situations or populations:

1. those iron anaemic and iron deficient

2. those iron deficient but not (yet) anaemic

3. those anaemic but not due to iron deficiency

4. those iron replete with normal haemoglobin.

Causes of anaemia other than nutrient deficiency include malaria, intestinal parasites and genetically determined haemoglobinopathies such as thalassaemia. It is generally held that at least half of the anaemia worldwide is due to nutritional iron deficiency, and that subclinical iron deficiency, also related to functional disadvantages, is as widespread as iron deficiency with anaemia. Therefore, anaemia prevalence can generally be taken as an indicator of the extent and trends of iron

deficiency.

Subjects affected by anaemia are, in approximate descending order of severity, pregnant women, preschool children, low-birth-weight infants, other women, the elderly, school-age children and men.

Table 2.2 Epidemiological criteria

Category	Prevalence (%) Severe	Moderate	Mild
Mild/moderate anaemia[a] or 25% < haematocrit < 33%	> 40	10–39	1 –9.9
Severe anaemia (Hb < 7 g/dl) or haematocrit < 24.9%	> 10	1– 9.9	0.1–0.9

According to WHO criteria; see Table 2.1

On a population level, anaemia prevalence can be distinguished as mild, moderate or severe. Appropriate epidemiological criteria are presented in Table 2.2.

Table 2.1 **Haemoglobin levels indicative of anaemia in populations living at sea level**

Age/sex group	Haemoglobi level (g/dl)
Children 6 months–5 years	< 11
Children 6–14 years	< 12
Adult males	< 13
Adult females (non-pregnant)	< 12
Adult females (pregnant)	< 11

2.2?Etiology

Body iron can be considered as having two main components, functional iron and storage iron. The functional component is found largely in the circulating haemoglobin (and a smaller quantity in body tissue, myoglobin and enzymes). A deficiency of iron in the functional component does not ordinarily occur until stores are completely exhausted. The storage component, found as ferritin and haemosiderin in liver, spleen and bone marrow, serves as a reserve source for the functional component.

The diminishing of iron stores results from an imbalance between iron absorption and the body's needs. Such an imbalance can generally arise from low dietary iron intake, poor absorption/utilization of ingested iron or increased demand. Demand is increased in case of growth, blood loss related to menstruation, childbirth and chronic parasitic infections such as malaria, hookworm and schistosomiasis. Figure 2.1 gives a schematic overview of causality of iron deficiency and anaemia.

2.3?Dietary iron requirements

A dietary intake of iron is needed to replace iron lost in the stools and urine and through the skin. These basal losses represent approximately 0.9 mg of iron per day for an adult male and 0.8 mg per day for an adult female. For women of reproductive age, the extra iron losses in menstrual blood must be taken into consideration. When basal losses are added, the total iron loss for menstruating women is about 1.25 mg per day.

Although menstruation-related losses are reduced to nil during pregnancy, additional iron is nevertheless required for the fetus, the placenta and the increased maternal blood volume. This amounts to approximately 1000 mg of iron over the entire pregnancy. Requirements per day during pregnancy rise from 0.8 mg per day in the first trimester to a high of 6.3 mg per day in the third trimester.

Infants, children and adolescents require iron for their expanding red cell mass and growing body tissue. Overall, the requirements for infants and children are substantially lower than in adults. But since they have lower total energy requirements than adults, they eat less and are thus at greater risk of developing iron deficiency, especially if their dietary iron is of low bioavailability.

Figure 2.1 **A schematic overview of causality of iron deficiency and anaemia**

2.4?Iron sources, bioavailability, enhancers and inhibitors

Dietary iron may be considered as being composed of two distinct pools, haem iron and non-haem iron. Haem iron is highly available (20% to 30% absorbed) and is found in meat. Non-haem iron is found in cereals, pulses, fruits, vegetables and dairy products and comprises the major source of dietary iron. Absorption of non-haem iron is highly variable, depending on enhancing and inhibiting factors. Figures of 1–20% absorption have been found in various studies of mixed diets, although figures of over 50% have been quoted where the iron was mainly from animal sources.

Factors known to stimulate absorption (bioavailability) of non-haem iron are the presence of meat, poultry, seafood and various organic acids, particularly ascorbic acid (vitamin C). Important iron absorption inhibitors are polyphenols, including tannins, phytate, certain forms of protein and some forms of dietary fibre. Foods that contain these factors and therefore have a strong inhibiting effect on iron absorption include tea, coffee, egg yolk and bran.

In addition to the nutritional interactions, non-haem iron absorption is significantly affected by an individual's iron status. Absorption decreases when iron stores increase and conversely a decrease in body iron stores is associated with an increase in absorption.

2.5?Consequences of iron deficiency and anaemia

Iron deficiency and anaemia have repercussions on working capacity, intellectual performance and pregnancy. Studies have shown the direct relationship between haemoglobin levels and the ability to perform physical exercise. The productivity of iron-deficient individuals is significantly less than that of workers with normal haemoglobin levels. After supplementation with iron, the performance of iron-deficient subjects improved most in those with the lowest initial haemoglobin levels. Studies indicate that even mild anaemia can decrease performance in exercise. Impaired work capacity results in adverse effects on productivity, earnings and the ability to care for children in the home.

Maternal anaemia results in intrauterine growth retardation, low birth weight, increased perinatal mortality and increased maternal morbidity and mortality. In developing countries, severe anaemia is the main causal factor in up to 20% of maternal deaths. Morbidity from infectious diseases is increased in iron deficient populations because the immune system is affected adversely. Iron

supplementation of deficient children and fortification of their milk or cereal reduces morbidity from infectious diseases. In addition, iron-deficient children are particularly vulnerable to lead poisoning, as lead has a high affinity for haemoglobin.

Anaemia is associated with less than optimal behaviour in infants and children. Iron-deficient children scored lower on tests of development, cognition, learning and school achievement. The impairment of performance has been put at 5–10 points deficiency in IQ. Studies of infants have shown conclusively that iron deficiency anaemia delays psychomotor development and impairs cognitive development. This negative impact in children is not likely to be reversed by subsequent iron therapy. The effects of iron-deficiency anaemia in early childhood were observed in Egyptian children; children who suffered anaemia in childhood had lower IQ scores at school-entry than children who were formerly non-anaemic. A study among Canadian children suggests that there is a negative impact on psychomotor development even when comparing non-anaemic iron-deficient children and controls.

Since the technological advancement and economic development of a nation depend heavily on its trained human resources, the behavioural effects of anaemia are highly relevant. Consequently, if anaemia is highly prevalent in a country's children, it can substantially affect its intellectual and economical potential.

3.?The causality of iron-deficiency anaemia: availability and bioavailability of dietary iron

Leif Hallberg

Why is there anaemia while there are numerous natural sources of iron and while we consume 10 times more iron than our bodies absorb? Iron requirement is the same as iron expenditure, which includes loss of iron as basal iron loss, loss in menstruation and sweat (negligible), and the use of iron for growth, pregnancy and lactation.

Relative iron requirements are highest in infancy (six months–two years) and in absolute terms in adolescence (for girls *and* boys). Variation in menstrual blood losses is big between individuals and small within individuals. Blood loss is higher in women using older types of intrauterine contraceptive and lower in those using more recent kinds.

The natural (unfortified) diet of the infant does not contain enough iron to cover its requirements. Breast milk is low in iron, but this iron is well absorbed. Also with breast-feeding the risk of infection and therefore the risk of anaemia is low. The only way adequate iron can be provided once complementary feeding is introduced is through supplements or fortified foods. The iron status of the

pregnant mother is a key determinant for the young infant's iron status.

Dietary variation can have immense impact on iron availability. In the diet, haem iron (from meat and more bioavailable) provides 10–20% of iron intake while non-haem provides 80–90%. Non-haem iron absorption is influenced by the iron status of the subject and the balance between inhibitors and enhancers much more than haem iron. The main enhancers of non-haem iron absorption are meat (haem iron), ascorbic acid, and, less extensively studied, fermented foods. Inhibitors include phytate (nuts, bran products, oat products, flours of high extraction rate, i.e. whole wheat and brown flours), polyphenols (gallolyl groups in tea, coffee, cocoa, some spices and vegetables), calcium (in different foods, especially milk products), and other factors (e.g. soy protein). Haem iron absorption is influenced by the amount consumed, food preparation (time, temperature) and calcium content.

Interesting data were presented of the effect of inhibitors and enhancers on the iron absorption which showed that, for example, a glass of milk with a meal reduced absorption by 50%, as did the addition of oregano to a pizza.

In many cases, the actual inhibiting or enhancing substances and the mechanisms by which they work in a particular inhibitor or enhancer have not been identified (e.g. gallolyl groups in different foods). In order to have effective dietary interventions more knowledge should be obtained.

Ferritin is not considered a good indicator for iron stores as there is too much interference from infection, which increases ferritin levels.

A study was carried out in which four diets of different bioavailability were tested. Results showed that more iron was absorbed with decreasing serum ferritin; and when serum ferritin reached a level of about 50–60 mg/l (the critical iron balance point, CIBP) there was no difference in total iron absorbed between the four diets. The body mechanism protects against iron overload by reducing absorption to almost nothing. This implies that control of iron absorption from the diet is extremely effective.

Discussion

Concerns were raised about the possibility of contradictory dietary recommendations being made for different nutritional deficiencies and related diseases. For example, calcium is recommended for prevention of osteoporosis while it is an inhibitor of iron absorption. Increased consumption of bran is recommended for prevention of coronary heart disease but bran inhibits iron absorption. Public education messages should try to harmonize these different concerns.

Zinc and iron do not interact whatsoever as they have different receptors in the gut; this is not the

case for iron and manganese. Iron from leavened bread is absorbed better than that in unleavened bread as yeast destroys the iron–phytate bond thus making the iron more bioavailable.

There is a gap between theory and knowledge. Very little of the available knowledge is applied in practice. The potential for dietary diversification in order to increase iron availability is immense in theory. However, the difficulties of changing dietary habits (determined by cultural traditions and taboos) and the complexity of influencing factors limit chance for success to a great extent as an intervention measure for iron-deficiency anaemia control. It was stressed however that one should however not look where intervention is not possible but where it *is* possible without structurally changing food habits and dietary patterns.

Much research need to be done on content of inhibitors and enhancers in food and the mechanisms behind them.

4.?The extent and magnitude of iron deficiency and anaemia

4.1?The global picture

Barbara Underwood

At the World Summit for Children (1990) and the International Conference on Nutrition (1992), political commitment was reached to combat iron-deficiency anaemia. The decade target of reduction of iron-deficiency anaemia by one-third of 1990 levels was endorsed by all governments in the Region.

The knowledge about the prevalence of anaemia is based largely on data collected globally from pregnant women. Extrapolation to a larger population led to a global figure of two thousand million people suffering from anaemia, which was presented in 1990 to WHO. There are many reservations about the quality of the data. However, there is no doubt that anaemia affects more people than any other of the micronutrient deficiencies and is not dependent on income or geography. The highest prevalences are found among women of reproductive age, infants and young children, especially those in poor socioeconomic conditions. Those anaemic represent probably about half of the population who are iron-deficient. Based on data from several counties iron deficiency can be estimated from iron-deficiency anaemia. For example, 30–40% iron-deficiency anaemia means that 80–100% of the population is iron-deficient. This primarily counts when prevalences of other causes of anaemia, such as malaria, are low.

Mid-decade recommendations for iron, endorsed by governing bodies of WHO and UNICEF in the Joint Committee on Health Policy (JCHP, 1995) state that in populations where more than 30%

of pregnant/lactating women have iron-deficiency anaemia, universal iron/folate supplementation should be given to:

- pregnant/lactating women, as is already a standard recommendation

- children between the ages of six months and five years, and low-birth-weight infants from three to twelve months of age should also be given supplements at regular intervals.

Pre-adolescent children and all women 10–49 years in that order of priority should also be considered. In addition

- a community based primary health care system should be used

- food fortification with iron should be explored

- advocacy to increase awareness need to be strengthened.

As iron deficiency (even without anaemia) has many functional consequences, there is a need to examine the bigger problem of iron deficiency and not just iron-deficiency anaemia. Iron deficiency and anaemia have negative effects: on maternal and infant mortality, on health and development, on learning capacity and on work and productive capacity. In addition, they increase susceptibility to heavy metal toxicity.

WHO has developed a Micronutrient Deficiency Information System (MDIS) for vitamin A deficiency, iodine deficiency disorders and iron-deficiency anaemia to determine the magnitude of the problem, track global progress towards the mid-decade and decade goals and feed back this information to countries for programme use. For iron-deficiency anaemia there are many limitations in terms of nationally representative data, which have to be used with caution in calculating global estimates of at-risk populations. There are very few national data on iron-deficiency anaemia prevalence. Countries are requested to make their data available to feed into MDIS. Establishment of iron-deficiency anaemia control programmes should, however, not wait until prevalence data are available.

Monitoring of prevalence over time to identify changes is also very important. Prevalence data on anaemia in Egypt show a decrease in iron-deficiency anaemia prevalence, which is thought to be due to an improvement in the diet, improvement of bioavailability (increased meat, vegetable and fruit [ascorbic acid] consumption), and an increase in birth intervals.

4.2?Anaemia in the Region—a call for action

Anna Verster

The situation in the Eastern Mediterranean Region shows that anaemia prevalence is hardly related to income; in all countries of the Region the prevalence of anaemia in women is moderate or severe according to WHO criteria. There is no "mild" anaemia. This is also true for anaemia in preschool children in the Region. Many countries affected by iodine and/or vitamin A deficiency are also affected by iron-deficiency anaemia.

Figures 4.1 and 4.2 illustrate the problem in children and in women of child-bearing age and/or pregnant in the Eastern Mediterranean Region, based on reports presented officially to WHO by its Member States, as well as on published data.

Figure 4.1 **Reported prevalences of anaemia in preschool children in selected countries of the WHO Eastern Mediterranean Region**

The definitions that are used to classify the severity of the problem are based on the WHO classification of anaemia, whereby one speaks of mild anaemia if 1–9% of the population have haemoglobin (Hb) values below the relevant Hb reference value, moderate if 10–39% of the population are below the reference level and severe anaemia if more than 40% have Hb values below the reference level. It must be noted that not all data are from nationally representative samples.

The high prevalence of iron-deficiency anaemia in children makes it essential to address not only women but also children in iron deficiency control strategies, especially as iron-deficiency anaemia has a negative impact on learning capacity and cognitive development with an IQ loss estimated at 10–15 points, comparable to the IQ loss caused by iodine deficiency disorders.

Figure 4.2 **Reported prevalences of anaemia in women of child-bearing age and/or pregnant in selected countries of the WHO Eastern Mediterranean Region**

When reviewing the factors described in the schematic overview of the causality of iron deficiency and anaemia (Figure 2.1), it can be seen how all of these apply to the Region.

1. Low total intakes: in several countries total iron intake is below recommended levels. This was reported to the International Conference of Nutrition by Cyprus, Egypt, Pakistan, Jordan and Tunisia. A food consumption survey in Morocco in 1985 showed that dietary intake covered only 70% of daily iron needs for the lowest income groups compared to 97% for the highest income groups.

2. Low bioavailability: most iron in the Eastern Mediterranean Region is of non-haem origin. In many diets over 80% of iron is of non-haem origin. An exception reportedly is Kuwait but even there 60% of iron is of non-haem origin.

3. High intake of inhibitors of iron absorption: unleavened bread and tea are severe inhibitors of iron absorption and these are highly consumed everywhere. In Jordan, as in many other countries, young children get bread and tea as complementary food.

4. Intake of enhancers of iron absorption such as fruit: the intake is largely seasonal. In many countries (like the Islamic Republic of Iran) much fruit is consumed, but not during meals.

5. High birth rates and short birth intervals are common in most countries of the Region.

6. Parasites are highly prevalent, especially in school-age children.

7. Genetic factors: while their influence and prevalence is not clear, studies among Bedouin in Saudi Arabia suggest that an important fraction of anaemia may be due to thalassaemia.

So far, control strategies in the Eastern Mediterranean Region have focused on supplementation with iron tablets, although fortification of food with iron is gaining interest. From studies carried out in countries in the Region, the following problems hampering the efficacy of existing supplementation programmes can be identified.

1. Low antenatal coverage: not all women attend antenatal clinics or they attend very late in pregnancy.

2. Low coverage with supplements For example, in the Syrian Arab Republic, 43% of women attending antenatal clinics did not get any tablets. Others got only 60 tablets on average per pregnancy (see Table 7.1 for recommended daily and weekly dosages).

3. Lack of tablets: This was reported from Egypt, the Islamic Republic of Iran and Sudan.

4. Lack of conviction in health workers: An evaluation of the anaemia control programme carried

out by UNRWA (West Bank) and an evaluation carried out by the Ministry of Health in Oman both showed health workers did not always give the tablets, and if they did, they did not always provide good reasons for the supplementation or, especially, explain about possible about side-effects. Also, different kinds of tablets were often given without saying why.

5. Low-compliance: The Oman study showed that less than half of the women knew what they were taking. Reasons given for noncompliance were side-effects, forgetfulness and “wrong beliefs”.

It is clear from the above that there is a need for urgent action in the Eastern Mediterranean Region, based on a regionally appropriate mixture of strategies, which should include:

- fortification of suitable foods
- effective supplementation programmes
- effective public education to achieve appropriate dietary modification
- promotion of breast-feeding and adequate complementary feeding
- control of parasitic infections
- family planning for health.

4.3?A multicentre study on anaemia and iron deficiency in selected countries of the Region

Saher Shuqaidef

A multicentre study on anaemia and iron deficiency was planned in five countries of UNICEF’s Middle East and North Africa Region focusing on women of child-bearing age and adolescent girls with optional inclusion of children below five years. The study looked at etiologic factors and aimed for methodological consistency so that results could be compared. At the time of the Consultation, the Islamic Republic of Iran and the Syrian Arab Republic had completed their studies, Jordan had designed one and was ready for field work, and both Algeria and Sudan were preparing their studies. Annex 1 gives an overview of the results of the studies already completed or still ongoing.

Discussion

In the ensuing discussion it was mentioned that the maternal and child health programme is the only working system in the Region through which iron is distributed at the moment. There is need to explore iron supply through routes other than the maternal and child health programme and the

medical system. There is lack of awareness about the dangers of iron-deficiency anaemia among pregnant women and their husbands, as well as among health workers.

In fortification strategies, other micronutrients could be included (such as vitamin A, vitamin B_{12}, vitamin B_1 and zinc) in addition to iron.

When developing strategies, it is important not to forget to cater for bad food habits. Also, in many countries, purchasing power is low, and endemic diseases (such as malaria, tuberculosis and schistosomiasis) have an impact on iron-deficiency anaemia: these facts should be included in the strategy. Also, how to sell the programme is very important. It has to be adopted and promoted by ministries of health.

Strategies have to be country specific: e.g. in Jordan people did not accept the authority of the midwife but only that of the physician. The meeting was informed that Egypt found that its diet has intermediate bioavailability (11–19%); dietary guidelines were developed by Egypt, and iron fortification of bread will cover the entire country within three years.

5.?Iron requirements

Table 5.1 Iron requirements of 97.5% of individuals (mean + 2 standard deviations) in terms of absorbed iron,1 by age group and sex

Age/sex	in ? g/kg/day	in mg/day2
4–12 months	120	0.96
13–24 months	56	0.61
2–5 years	44	0.70
6–11 years	40	1.17
12–16 years (girls)	40	2.02
12–16 years (boys)	34	1.82
Adult males	18	1.14
Pregnant women[3]	24	1.31

Menstruating women	43	2.38
Post-menopausal women	18	0.96

[1]Absorbed iron is the fraction that passes from the gastrointestinal tract into the body for further use

2Calculated on the basis of median weight for age

3Requirements during pregnancy depend on the woman's iron status prior to pregnancy. See text for further explanation

Abstracted from DeMaeyer et al. (1989)

A dietary intake of iron is needed to replace iron lost in the stools and urine and through the skin. These basal losses represent approximately 14 ?g per kg of body weight per day, or approximately 0.9 mg of iron for an adult male and 0.8 mg for an adult female. The iron lost in menstrual blood must be taken into consideration for women of reproductive age (see Table 5.1).

While the volume of menstrual blood lost is relatively constant for a given woman from month to month, it varies greatly between women. Several studies have shown that the median blood loss during menstruation ranges between 25 and 30 ml per month. This represents an iron loss of 12.5–15 mg per month, or 0.4–0.5 mg per day over 28 days. When basal losses are added, the total iron loss for menstruating women is about 1.25 mg per day. This means that the iron requirements of half of all women are in excess of 1.25 mg per day. Taking into account the skew of the frequency distribution of menstrual blood loss, one can calculate that only 2.5% of women have iron requirements in excess of 2.4 mg per day.

Although menstruation-related iron losses are reduced to nil during pregnancy, additional iron is nevertheless required for the fetus, the placenta and the increased maternal blood volume. This amounts to approximately 1000 mg of iron over the entire pregnancy. Requirements during the first trimester are relatively small, 0.8 mg per day, but rise considerably during the second and third trimesters to a high of 6.3 mg per day (see Figure 5.1). Part of this increased requirement can be met from iron stores and by an adaptive increase in the percentage of iron absorbed. However, when iron stores are low or non-existent and dietary iron is poorly absorbed, as is often the case in developing countries, iron supplementation is essential. During lactation the absence of menstrual blood loss is partially offset by the secretion of about 0.3 mg of iron per day in breast milk, in addition to basal losses. A woman's mean requirement during the first six months of lactation is estimated to be about 1.3 mg of iron per day.

Figure 5.1 Daily requirements for absorbed iron in 97.5% of women (mean±2 standard deviations) before, during and after pregnancy

The horizontal axis is not a true scale. Lactation, for example, should continue well into the second year

Source: DeMaeyer et al. (1989)

Infants, children and adolescents require iron for their expanding red cell mass and growing body tissue. A normal infant at birth has about 75 mg of iron per kg of body weight, two-thirds of which is present in red blood cells. During the first two months of life there is a marked decrease in haemoglobin concentration with a consequent increase in iron stores. These stores are subsequently mobilized to supply iron for growth needs and to replace losses; hence, during this period there is a minimal requirement for dietary iron. By four to six months, however, iron stores have decreased significantly, and the infant needs a generous dietary intake of iron. During the first year of life, a child triples its body weight and doubles its iron stores.

6.?Functional consequences of iron-deficiency anaemia

Fernando Viteri

Maternal anaemia results in intrauterine growth retardation, low birth weight, increased perinatal mortality and increased maternal morbidity and mortality. In developing countries, severe anaemia is the main causal factor in up to 20% of maternal deaths. Maternal anaemia precipitates early delivery (by two or three weeks) and affects the birth weight and iron stores of the child. Iron-deficient women die because of haemorrhage and uterine dysfunction. Perinatal infection also occurs: laboratory studies show that the mother's immune system is impaired. In lactation, iron deficiency in the mother does not affect the amount of milk, nor does it diminish the iron content of breast milk.

Newborns of iron-deficient mothers have less iron stored, and may have low birth weights. Breast milk and also complementary foods do not contain enough iron, so infants draw on their iron reserves, which are depleted by about six months of age. Children from iron-deficient mothers have low iron stores and quickly deplete them, resulting in earlier iron deficiency. Iron-deficient children have impaired mental development and psychomotor function, which is to some extent irreversible (measured after five years). Iron supplements to pregnant women have been shown to result in a higher serum ferritin in the mother's blood as well as the infant's cord blood, which was still higher

after two months. Compared with never anaemic children, the previously iron-deficient children consistently perform worse (all lower than the norm). Sleep patterns and affective relationships are also impaired, and attention span is limited. Studies of infants in Chile, Costa Rica, Guatemala and Indonesia, and of preschool children and schoolchildren in Egypt, India, Indonesia, Thailand and the United States of America have shown conclusively that iron-deficiency anaemia delays psychomotor development and impairs cognitive development.

This negative impact is not likely to be reversed by subsequent iron therapy. The effects of iron-deficiency anaemia in early childhood were observed in Egyptian children; children who suffered anaemia in childhood had lower IQ scores at school-entry than children who were never anaemic.

A recent study among Canadian children suggest that there is a negative impact on psychomotor development even when comparing non-anaemic iron-deficient children and controls.

In addition to the negative effects already mentioned, iron deficiency decreases the capacity of the immune system to kill pathogens. Morbidity from infectious diseases is increased in iron-deficient populations because the immune system is affected adversely. Iron-deficient children are particularly vulnerable to lead poisoning, as lead has a high affinity for haemoglobin. Diarrhoea is more severe and longer lasting in iron-deficiency anaemia (as found in Egypt). Prevention of iron deficiency is therefore most important, as several effects seem to be irreversible.

Studies conducted in 1979 on latex collectors in Indonesia and female tea collectors in Sri Lanka provide outstanding evidence of the direct relationship between haemoglobin levels and the ability to perform physical exercise. The productivity of iron-deficient individuals was significantly less than that of workers with normal haemoglobin levels. After supplementation with iron, the performance of iron-deficient subjects improved most in those with the lowest initial haemoglobin levels. Even mild anaemia can decrease performance in exercise. Impaired work capacity results in adverse effects on productivity, earnings and the ability to care for children in the home.

The functional alteration in working capacity as a result of iron deficiency is explained by a lower blood transport to the tissues, which means that the energy utilization at the muscle level is decreased. An individual brought up iron-deficient will not have the same number of muscle fibres as someone with sufficient iron. Also hormonal production, such as thyroid hormones, neurotransmitter function, epinephrine turnover and motor functions are impaired, which results in the inability to maintain temperature when exposed to cold; mental, physical and reproductive functions are also affected.

The focus for iron-deficiency anaemia prevention should be on women not only because they show

higher prevalence of anaemia but also because they have the main share of the workload in many parts of the world. In addition, the iron status of the mother determines the quality of brain development of the unborn child during pregnancy (iron has to reach the brain in the right amount at the right time; all brain iron is installed in early age: 10% by birth, 50% at 10 years, and 100% at 25 years). Iron deficiency is not to be taken too lightly, it is not as harmless as once believed.

Since the technological advancement and economic development of a nation depend heavily on its trained human resources, the behavioural effects of anaemia are highly relevant. Consequently, if anaemia is highly prevalent in a country's children, it can substantially affect its intellectual and economical potential. It is estimated that the cost–benefit ratio of measures to control (prevent and correct) iron deficiency and its anaemia is between US$40 and US$70 benefit for each US$1 invested. Thus there is no excuse to delay measures that will control iron deficiency and its anaemia.

In brief, iron deficiency and anaemia impair personal and societal development, and cause demands on health care beyond those due directly to anaemia.

Discussion

The interaction between iron and other nutrients was discussed. Very few people have just iron deficiency. Very often deficiency of both vitamin A and iron occurs. Studies have revealed that improved vitamin A intake not only improved vitamin A status but also iron status. Zinc seems to have an important role in many of the parameters. Zinc supplements improve growth, and when given to thin pregnant women it increases birth weight. There is a relationship between zinc deficiency and stunting and low birth weight. Interventions for iron deficiency should be integrated with supplementation of other micronutrients (such as zinc). Correction of anaemia/iron deficiency does not need to be a very rapid measure (except in life-threatening situations such as very severe anaemia leading to heart failure). Replenishment can be done gradually.

Iron deficiency is a silent disease: iron-deficient subjects may feel well, as they know no better, but when given iron they realize how lousy they felt before. So there is not so much adaptation as tolerance to increasing iron deficiency.

There are two critical periods when iron deficiency can occur; the first is the last trimester of pregnancy, when iron is taken from the "bank account" (serum ferritin). The second is the period of infancy from six months to two years when there is no backup of a iron reserve. Breast-feeding will delay the onset of anaemia. Prolonged breast-feeding without timely complementary feeding, however, can lead to iron deficiency. All children tend to get anaemic at the end of the first year, but breast-fed children are protected for a longer period. Breast milk is very low in iron, but the available iron is very well absorbed. Either fortified complementary foods or supplementation should

be given to children in the complementary feeding stage.

7. Strategies for the prevention and control of iron deficiency

The four basic approaches to the prevention of iron-deficiency anaemia are: 1) dietary change and diversification to increase iron intake; 2) supplementation with medical iron; 3) fortification of a suitable staple food with iron; and 4) the control of infection through public health activities.

National programmes should consider these approaches within the context of their health policies in an integrated and dynamic fashion. None of these strategies is exclusive of the others, rather they are complementary and may be of greater or lesser value according to present and changing circumstances.

7.1?Dietary diversification

Leif Hallberg

Before asking how the diet can be diversified, we need to know what the present diet is and how bioavailable its iron content is. An implication is that no simple calculation can be made to know how much iron will be absorbed, as all foods in the diet influence each other. Moreover, there is lack of knowledge: food tables lack information on polyphenols, phytate, and ascorbic acid content. Also one needs to know what the food habits are so as to define feasible scenarios. Food preparation methods (cooking, fermentation) have to be examined and their effect on phytate content assessed. Some fermented foods have been shown to enhance the bioavailability of iron present in the diet, thus having a dramatic effect on iron intake.

The main intervention strategies in the realm of dietary change are: a) change meal composition to decrease the intake of inhibitors of iron absorption and to increase vitamin C–rich foods in meals that contain iron-rich foods; b) increase consumption of iron-rich foods, particularly meats and other sources of haem iron; c) limit or avoid the consumption of fresh cow’s milk by infants and toddlers; d) promote food processing that destroys phytate (seed sprouting, fermentation processes, cooking) or that reduces fibre content (low extraction wheat flour).

As is evident, all these changes demand a change in food habits, especially the consumption of haem iron–containing foods, which are among the most expensive and easily contaminated and spoilable food items.

The advantages of this approach are its sustainability and the fact that it is based on “natural foods”. The limitations of this approach are related to food availability and safety and on the need to change

dietary habits of many populations. But also there are limitations on the capacity of diets to satisfy the iron needs of special at-risk groups, in particular infants and young children, the 20–30% of women with high-flow menstruation and women in the last two trimesters of pregnancy. To give an example, if a child consumes 800 calories per day and about 5 mg of iron, in order to satisfy its requirement of 1.2 mg per day, the percentage absorption required is 24%. Such high absorption rates are very difficult to achieve—15% is considered a high absorption rate.

The feasibility of suggested changes must be very carefully considered. It has to be accepted that certain food habits cannot be altered. Therefore it has to be known what these are. As a first step the diets in regions or countries could be described so as to find foods containing considerable amounts of inhibitors or enhancers and to identify alternative foods with better properties. The content of these factors has to be known. It would be desirable to build a database that can be used worldwide as this knowledge is insufficient today. Small-scale absorption experiments coordinated regionally may sometimes be desirable. Lastly, different food preparation techniques (cooking, fermentation) may have a great effect on bioavailability, and studies on their effect are desirable.

Foods inhibiting iron absorption in the diet should be replaced when feasible with similar foods not having a deleterious effect on iron bioavailability. Foods that stimulate iron absorption should be added to the diet. Consumption of folic acid, vitamin C and fermented foods should be increased and phenols and phytates decreased. Tea-drinking, which is widespread throughout the Region, should be promoted *after* meals, not with meals; an interval of at least half an hour between meal-consumption and tea-drinking will be enough to reduce the inhibitory effect sufficiently.

Discussion

The concept of food-to-food "fortification" was brought up. The definition of fortification can be expanded to fortify foods, for example complementary foods, with natural micronutrient-rich foods in concentrated form, such as sun-dried food.

The aspect of timing of food consumption is important, to reduce the intake of inhibitors during meals and promote consumption of enhancers with the iron source-foods. Interventions in this field could have high impact on bioavailability. In this respect other micronutrients should be examined at the same time so as to come up with integrated recommendations.

7.2?Iron supplementation

Fernando Viteri

Iron supplementation has been carried out for several decades in antenatal clinics to control iron

deficiency and anaemia in pregnancy. In spite of these efforts, the problem persists essentially unabated, particularly in the developing world. Many reasons have been given for this relative failure, including late start of antenatal supplementation, inefficient administration of such programmes by the health system and, in the prenatal clinics in particular, insufficient daily doses, poor adherence to the required daily dosage because of inadequate motivation or forgetfulness, misconceptions on the effect of iron supplementation and the development of side-effects.

Action to remedy the situation has included trying to improve the supply and regularity of dispensation of supplements in antenatal clinics and health centres and trying to create a greater awareness of the need for iron supplementation. In addition, doses of daily iron supplements as high as 120 mg have been recommended (see Table 7.1). It was thought that with these elevated doses supplementation would be more efficient, even if it starts late in pregnancy and/or if compliance with daily intake is less than optimal. The first assumption has been proven wrong, and the inconvenience of having to take two to four iron tablets plus the fact that gastrointestinal side-effects increase with daily iron dosage led to the abandonment of such programmes, thus defeating possible benefits from higher daily iron doses.

These difficulties have led to the search for preparations that improve iron absorption and that produce fewer side-effects, such as the gastric delivery system. Unfortunately such formulations are several times more costly than simple ferrous sulfate and folic acid tablets.

A new approach for the control of iron deficiency in pregnancy could be the weekly administration of iron and folic acid supplements beginning as early as possible and ideally for several months before conception in order to improve pre-pregnancy iron reserves. This approach is based on experimental studies in animals that show that the intake of a large dose of iron blocks the absorption of subsequent doses. This had led Dr Viteri to explore the absorption of supplemental iron when it was administered only at intervals coinciding with the turnover of the intestinal mucosa (three days in the laboratory rat and five–six days in the human). It was found that the efficiency of iron absorption was more than doubled in rats given iron every three days. Theory suggests that in the human the ideal timing would be to give iron on a weekly basis in order to find a “new mucosal lining” every time iron supplements were administered. The effectiveness of weekly iron supplementation in preventing iron deficiency, increasing iron reserves, and correcting mild to moderate iron-deficiency anaemia has been shown in studies in preschool children in China, in adolescent girls in Malaysia, in menstruating women in the USA and in pregnant women in China and Guatemala. The added advantages of the weekly dosing schedule are the lack of side-effects.

Table 7.1 **Supplementary doses of iron recommended for preventive supplementation**, **either on a daily or weekly basis**

	Daily dose	**Weekly dose**
Infants and preschool children	2 mg of iron as $FeSO_4$ per kg body weight from six months	3 mg of iron as $FeSO_4$ per kg body weight from six months
Older children and adolescents	30 mg of iron as $FeSO_4$ for three months	60 mg of iron as $FeSO_4$
Women of child-bearing age	60 mg of iron as $FeSO_4$ for three months	60 mg of iron as $FeSO_4$
Pregnant women	60–120 mg of iron as $FeSO_4$ starting as soon as possible	120 to 180 mg of iron as $FeSO_4$ (the larger doses may be recommended in the case of teenage pregnancies)
Lactating women		60 mg of iron as $FeSO_4$

When anaemia is already present, daily treatment doses should be given

Folic acid tablets should be added in appropriate doses

In the studies on pregnant women conducted in China and in Guatemala, the effects were less clear in the Guatemala study than in the China study. In China all subjects were older than 20 years, all parities were single, calcium intake was higher; while in Guatemala many of the subjects were teenagers, and one-third of the women were nulliparous, one-third had had one or two pregnancies and one-third had been pregnant three or more times. This suggests very strongly that the amount of iron to be given as weekly doses needs to be studied in each particular country. Compliance with

daily and weekly doses needs to be closely monitored in an efficacy study.

It is becoming more evident that pre-pregnancy iron stores are the most important determinant of iron status at term, even where antenatal iron supplementation programmes are in place. Iron reserves should be built prior to pregnancy. As iron requirements during pregnancy are so high it is the inappropriate time to correct iron deficiency. This fact may further explain the documented little efficacy of antenatal iron supplementation in most developing countries.

As part of a global effort to prevent and correct, that is, to control the problem of iron deficiency and anaemia in women, the World Health Organization has recommended antenatal daily iron supplementation of up to 120 mg of iron plus 250 µg of folic acid as a universal measure in countries where iron deficiency and anaemia are prevalent. It has also recommended that if food-based strategies (including effective food fortification) are not foreseeable in the near future, daily iron supplementation for two to four months per year be implemented for "population groups in greatest need of iron or at greatest risk of becoming iron-deficient", including "women likely to become pregnant". Supplementation with weekly doses has shown to be a realistic alternative to daily iron supplementation in all age-sex-physiological states in which it has been tested and is essentially free of side-effects. Folic acid in antenatal supplementation is generally provided with iron to improve folate nutrition and to ensure that folic acid deficiency does not limit the response to iron. The UNICEF tablets that are distributed worldwide at very low cost contain both nutrients. However the folic acid content of these tablets is not enough if given only on a weekly basis. Adequate folic acid nutrition in women likely to become pregnant is also highly desirable to reduce the risk of neural tube defects in their offspring.

A study on menstruating women comparing the effect of administering weekly iron doses for seven months with the WHO recommended regime of administering daily iron for three months, followed by four months without iron supplementation, showed that both regimes were equally efficient in bringing haemoglobin levels above 120 or 125 g/l in three months, thus correcting mild to moderate iron-deficiency anaemia. However, the proportion of women whose haemoglobin remained above 125 g/l four months later, differed by group. The proportion of women with haemoglobin values below 125 g/l returned to presupplementation levels after not receiving further iron supplements for four months. In contrast, there were no women with haemoglobin levels below that level among women who continued weekly iron supplementation during those extra four months. The weekly iron group would thus consume less iron over the same period of seven months than the daily iron group, while the benefits would be similar or greater.

The changes observed in plasma ferritin were even more dramatic. The women receiving daily iron for three months almost doubled their plasma ferritin values, but only temporarily, because these values fell to pre-supplementation levels in the following four months. The women receiving weekly

iron for seven months exhibited a progressive and sustained rise in plasma ferritin levels. This more physiological improvement in iron status strongly suggests a progressive enhancement of iron reserves, which is consistent with the fact that all these women retained haemoglobin levels above 125 g/l.

The significant elevation of plasma ferritin at the end of three months of daily supplementation followed by a fall of similar magnitude four months after having discontinued the supplementation suggest either of the following possibilities:

- The observed elevation does not reflect "true iron stores", but rather another metabolic condition induced by the daily supplementation with iron for three months. This could be explained by an increase in apoferritin (a protein that binds with iron to form ferritin) as a consequence of daily iron intake, not necessarily associated with increased iron reserves, but for example, as a consequence of induced nonspecific inflammation in the gut or other organs as a consequence of being exposed to a high iron environment (free radical damage?).

- Another possibility could be that the rapid increase in iron stores is accompanied by a subsequent increase in iron losses, as has been observed in short intervention studies. The concomitant change in haemoglobin levels is more supportive of greater iron losses induced by daily iron supplementation. This phenomenon was also observed among rats supplemented with iron daily in contrast to rats supplemented every three days.

The new approach of preventive supplementation based on weekly iron plus folic acid supplementation is effective in controlling mild to moderate iron deficiency and in progressively improving iron reserves in women of reproductive age. It is safe, very well tolerated, extremely inexpensive (5.2 US cents per person per year) and can be implemented by community groups or individual women with medical guidance. Preventive supplementation appears to be an effective way of ensuring adequate pre-pregnancy iron reserves and thus, together with appropriate antenatal care, can be a significant intervention in preventing gestation iron deficiency or facilitating its control, especially in the developing world, where diets are unfavourable for iron bioavailability and where food fortification is very difficult to implement. It is also effective in all other age-sex groups.

In developing countries 35% of the people (47% in rural areas) have access to basic health services. The strategy has to be preventive rather than therapeutic alone. Weekly supplementation is considered only in the area of preventive supplementation. If the person needs treatment, treatment has to be given. A weekly preventive distribution of iron could be a community-based activity (schools, teachers, women's groups, religious groups, etc.). Pre-pregnant women should start taking supplements and increase the dose when they become pregnant. The important thing in pregnancy is that the women reach term non-anaemic. Haemoglobin is important, not serum ferritin. Pregnancy is

not the time to treat iron deficiency.

Discussion

It was stated that if a supplement is taken in between the meals the absorption is 40% higher but the risk of forgetting is also higher and there is more chance of gastric upset. It was therefore thought better to take the tablet with meals. The composition of the meal as such has no effect as the absorption of iron from tablets is quite different than that from meals. Men do not require more iron than dietary iron: if men are anaemic there must be a cause other than low intake, such as worms, bleeding, etc. There is serious concern that daily supplements will not work because of the side-effects and noncompliance. Therefore a weekly preventive dose for all women of child-bearing age and school-age children is a more sensible option. Women bound to become pregnant should be a major target group with the second main target infants and young children. If many pregnancies take place at a young age, supplementation of school-age children should take place as well. The adequate and tolerable dose was suggested to be 3 mg/kg body weight/week. In the discussion various speakers stressed that weekly supplementation can only be introduced after study in particular countries.

When discussing other activities, reference was made to the experience in Guatemala, where there is a multinutrient approach: a nutritious biscuit high in fat and protein with multivitamins and minerals.

An important issue raised was the capacity at community level to take responsibility for preventive measures for iron deficiency, which has so far been underestimated. If the accent is shifted to larger target groups and the emphasis is not only on the medical/prescriptive mode but shifts to community-based activities, existing distribution systems like retail shops could be used to encourage self-purchase of iron supplements

7.3?Food fortification

Leif Hallberg, David Alnwick, Mahshid Lotfi, Fernando Viteri

Fortification has been successful in developed countries and is the most direct approach to eliminating micronutrient deficiencies. Developing countries can learn from the developed countries in this respect. In the USA, two-thirds of the recommended daily allowance for iron comes from fortified foods. Universal fortification avoids the compliance problem and makes the programme sustainable.

Iron fortification is primarily a preventive programme, not intended to treat severe anaemia in large sections of the population. In the latter case it should be combined with supplementation. The vehicle

should preferably be centrally processed and distributed to the target groups. There should be ways of monitoring the iron content of the fortified food and it should have biophysical properties that make the fortification effective. The bioavailability of the iron compound chosen has to be known and constant, and there should be no interaction of whatever sort (discoloration, rancidity, sensitivity to temperature or humidity) with the food being fortified. The fraction of the added iron absorbed is determined by the properties of the diet—the effect of the fortificant is lower/higher when added to a diet with low/high bioavailability. The amount absorbed depends on the amount of fortification iron added, the fraction of the fortification iron that is soluble in the gastrointestinal tract, the bioavailability of the non-haem iron in the meal containing the fortificant iron and the iron status of the subject. The causative factors responsible for the iron deficiency determine the expected effect from the fortificant iron. For example, if the main problem is due to malaria, hookworm or poor bioavailability of the diet, the effect will be low; if the main problem is low intake of dietary iron, the effect will be greater.

More evaluation is required on the different iron compounds used for fortification. Iron fortificants for wheat flour should be insoluble in water as the water content of wheat flour is quite high (10%). If the fortificant is added to a highly bioavailable diet the absorption of all iron in that diet is higher. If the bioavailability is low then high levels of fortificants have to be added, which creates technical problems.

While it is clear that it is difficult to find the right iron compound for fortification, it must be noted that, there are already various examples of iron fortification programmes of staple foods (wheat flour, maize flour, rice, sugar and salt). Wheat flour fortification is technically feasible. Double fortification of salt with iron and iodine may be possible but there seems to be interaction between iron and iodine. The effective level of fortification requires high levels of iron input relative to iodine. While only around 20–40 ppm of iodine need to be added, 1000 ppm of iron are needed. Also, dry mixing of iodine rather than wet mixing has to be done when double fortification is applied which is a problem because almost all current salt iodization in the Region uses wet spraying with a potassium iodate solution. Fortification with a multimicronutrient premix has been applied to maize flour, wheat flour, complementary food and emergency food.

Other countries' experiences of fortification should be obtained, especially programmes of long duration and without side-effects. The programme should be commercially attractive to make it successful. The confidence of politicians must be obtained by demonstrating successful workable approaches and to make the right connection with industry. The industry should not be composed of more than four or five producers. There is scope for fortifying many foods and using creativity: one should however consider the risk of overdose. Another important issue is how to create a demand for the fortified product.

The choice of the vehicle and fortificant is to a large extent country-specific.

Fortification is a very efficient way to increase the iron intake of populations and, if targeted, that of special at-risk groups (e.g. complementary foods). Rice and wheat flour fortification and that of other staples and condiments (such as salt, sugar, curry powders and monosodium glutamate) have been tried. There are special technological and legislative requirements, and monitoring of all aspects in the fortification process from production to consumption is essential.

The advantages of fortification are the widespread or targeted increases in iron ingestion at, generally, very low cost.

The limitations are that if the fortificant is a non-haem source of iron it is subject to the same iron absorption limitations as the rest of the non-haem iron pool. Thus in cereal-based and legume-based diets, fortification iron is also poorly absorbed. One of the ways to overcome this is by the use of different iron chelates such as NaFeEDTA. The US Food and Drug Administration and the Codex Alimentarius have approved its use as a fortificant as long as it is of "food quality". The problem, however, is that "food quality" NaFeEDTA is very expensive at present.

In many instances properly iron fortified complementary foods are not within the reach of those who most need them because of their limited access to centrally processed foods.

Discussion

Fortification programmes need always an accompanying education programme to inform people about the benefits.

Fortification programmes must have a certain degree of flexibility. Monitoring and evaluation should guide the process, which can be stopped, changed or modified as needed. Targeted fortification should be considered for specific geographic areas or age groups, such as milk or complementary foods for children. Electronically reduced iron is usually used to fortify baby food.

The point was raised that iodine deficiency is not income dependent, and the question asked to what extent is iron deficiency income dependent. There are mixed signals: in the USA iron-deficiency anaemia exclusively a problem of the poor. In the Region there seems to be little relation between iron-deficiency anaemia and income.

Speaking of fortificants, it was stated that NaFeEDTA seems to be a promising, highly available, stable and nonreactive fortificant. It has been approved, but widescale experience is not available yet. So far no country in the Region has agreed to use it. One of the problems is the higher cost.

More studies on NaFeEDTA are needed.

Marketed fortified products should be closely watched in terms of adequacy and scientific evaluation.

Double fortification of sea salt was discouraged as the water content would be too high, and as it may interfere with the present successful salt iodization programmes.

7.4?Public health measures

Barbara Underwood

Public health measures are an essential component of iron deficiency control programmes. They have an impact on iron deficiency, and while they alone will not control iron deficiency, they give incremental benefits in combination with the other intervention measures.

An important measure for iron-deficiency anaemia control is promotion of breast-feeding. Although breast milk does not contain much iron, this iron is highly bioavailable and it protects the child from infection.

A second important intervention are deworming programmes. Hookworm infestation causes blood loss, but also affects the absorptive capacity of the intestinal mucosa. Deworming should be combined with supplementation or fortification. Recent studies carried out by WHO in Zanzibar, the United Republic of Tanzania, showed that of deworming had a significant impact on haemoglobin levels, with extensive reduction of blood loss when performed two or three times per year using a low-cost antiparasitic agent. This reeds follow-up in other countries with different epidemiologies of parasitic infestation.

The third important intervention is family planning programmes, including child spacing and improvement of the nutritional status of women. Other public health measures that decrease the frequency of infections, e.g. sanitation, immunization, control of diarrhoeal diseases, are also important.

Discussion

The question of the effect of deworming was discussed. Caution was proposed as the reinfection rate is so high. The Zanzibar studies however showed the advantageous effect of regular deworming even with reinfection, as an interim measure while water and sanitation are improved and other preventive measures to reduce hookworm infestation are taken. There are also merits in deworming

for its own sake as appetite is improved and the individual is given a chance to recover and build iron reserves. Also, positive effects of deworming on child growth have been documented. Some additional public health measures were proposed whereby the emphasis should be on the entire process of development of the child, and its mental capacity, control programmes for endemic diseases (malaria, schistosomiasis) and HIV, and strengthening of nutrition education. A strong system of monitoring needs to be established. Anaemia is one of the consequences of iron deficiency; the other consequences of iron deficiency are however also important and should be addressed in control programmes. Each subregion has to see which public health measures apply to its situation.

8.?The need for advocacy and information, education and communication

Reza Husseini

Advocacy towards policy-makers and donors is an important aspect of iron deficiency control programme, which needs more attention. Anaemia is not as apparent as goitre for example and is often not recognized as a health problem.

Communication is a discipline, and the potential role of social marketing and its shortcomings when compared to product marketing need to be highlighted. The current practice of focusing on maternal health as the main target of iron deficiency control programmes, disguises the fact that iron deficiency is not only a health sector's problem. There is a need for advocacy and involvement of the education, labour and agriculture sectors.

Advocacy at the political level will secure commitment, resources and policy development. Meanwhile, communication targeted at families and communities aims at awareness, empowerment and tapping local resources towards bringing change in lifestyle.

There are at present many shortcomings in a supplementation strategy that is limited to pregnant women. The impact of supplementation programmes is rarely measured. Furthermore, the low use of iron supplements by pregnant women, as shown in the multicentre study in the Islamic Republic of Iran, reflects the lack of awareness of the population and the poor information, education and communication (IEC) on the provider's side. There is need for an approach that gives due attention to all aspects of a control programme, including IEC.

An example on the role of media in advocacy and communication is the programme to control iodine deficiency disorders by providing iodized salt in the Islamic Republic of Iran, where the broadcast media were the major source of public information: radio 34%, friends 33%, television 21%, while none reported that their information came from a health centre. No appropriate messages have yet

been devised to advocate and communicate iron deficiency as a major public health problem, and iron deficiency has not yet been dramatized, as done in the case of iodine deficiency disorders, vitamin A malnutrition and protein–energy malnutrition advocacy tools. Furthermore, the role of the media can enhance intersectoral involvement and collaboration in addressing the problem, such as iodine deficiency disorders and universal salt iodization.

The following reasons can be identified for the failure of advocacy and IEC, in decreasing order: lack of political commitment, lack of consensus and data, lack of or unclear IEC, iron deficiency being handled as a health sector issue only, consequences of iron deficiency not felt, lack of community involvement, lack of money affecting human resources and their motivation. Target groups for iodine deficiency disorders advocacy and communication are, in decreasing order of importance, politicians and decision-makers, communities (including women, especially mothers), health providers, the media, the educational system and nongovernmental organizations.

Figure 8.1 **A framework showing the relationship between advocacy and communication (1)**

Messages that are appropriate in raising awareness of and concern for iron deficiency are, in decreasing order: the effects of iron deficiency on physical and mental function, the effect on a country's development, the effect on educational achievement, the importance of iron supplementation, the effect on health and the role of good nutrition. Figures 8.1 and 8.2 show two frameworks concerning the relationship between advocacy and IEC with respect to the different programme activities and the role of evaluation and monitoring in support of advocacy and communication.

Figure 8.2 **A framework showing the relationship between advocacy and communication (2)**

The above IEC issues were illustrated by examples from countries in the Region. In Oman, it was found that all the necessary components of the supplementation programme were present—political commitment, accessibility to health services and availability of media outlets. The problem was multifaceted. Many of the health-care providers were expatriates without the language skills to communicate to and raise the awareness of people on the importance of iron deficiency, its

consequences and its control strategies, especially in addressing the local belief that “women lose blood anyway” and that therefore there is little point in doing anything about it. The media are not used to inform and educate people. There is lack of follow-up and measurement of the impact of control programmes.

In Egypt it was persistent pressure from professionals on politicians, stressing multisectoral involvement and building on the International Conference on Nutrition, that resulted in the decision to start fortification of wheat flour. The supportive role played by the media both in advocacy with politicians and IEC at different levels was emphasized.

In Pakistan, a national nongovernmental organization used social marketing of iodized salt as a strategy to control iodine deficiency disorders. The approach was to reach households through schools. Messages and iodized salt were given to households through schoolteachers and students. That was concomitant to the media campaign that included a logo for the iodized salt, booklets, and competitions with nominal prizes as incentives. The industry was expected to carry on the promotion of their iodized product.

In Bahrain education is seen as a vital component of the iron deficiency control programme. IEC material has been developed, building on the lessons learned from the mistakes made in the iron supplementation programme.

The Micronutrient Initiative, an international nongovernmental organization, working throughout the world, carries out several activities in advocacy and IEC towards the control of micronutrient deficiency in general and iron deficiency in particular. International events are being used as outlets for their messages, Multiple tools are being used, such as postcards, television spots and posters. Multimedia technologies are being used to enhance widespread advocacy and IEC and software is being developed to look at costs and benefits; also the Internet is being used.

The discussion that followed elaborated on the multidisciplinary involvement of behaviouralists, sociologists and health professionals in addition to communication specialists. The multimedia approach of using television spots, newspapers, soap operas, etc., was stressed.

9.?Integrated control of multiple micronutrient deficiencies and integration with other programmes

Barbara Underwood

Table 9.1 Adverse effects of the three major micronutrient deficiencies

Iodine deficiency	Iron deficiency	Vitamin A deficiency
Psychomotor development and risk of cretinism	Cognitive development i.e. IQ loss	Blindness
Cognitive development i.e. IQ loss	Work capacity productivity falls	Night blindness

Table 9.2 Media for assessing deficiencies of the three major micronutrients

	Iodine deficiency	Iron deficiency	Vitamin A deficiency
Diet	+	+ + meal pattern	+++
Urine	+++	–	–
Blood	++	+++	+++
Breast milk	++	–	+++

Number of + indicates level of importance as an assessment indicator

The three main micronutrient deficiencies, iron deficiency, Vitamin A deficiency and iodine deficiency, all have deleterious effects on the functioning and integrity of the human organism. Table 9.1 reviews the adverse consequences of these three micronutrient deficiencies.

When carrying out surveys to assess the prevalence of these micronutrient deficiencies, it is important to be aware of the major biological substances which are used for the identification of each of them (see Table 9.2).

A new methodology is the use of breast milk for monitoring iodine and vitamin A in populations. This method is not applicable to iron-deficiency anaemia.

Food-based solutions to fix these deficiencies should be sought first:

- breast-feeding by vitamin A–sufficient mothers
- appropriate complementary feeding and post-complementary diets
- dietary diversification/modification—nutrition education, social marketing, horticultural activities
- fortification where appropriate.

Table 9.4 **Public health measures for micronutrient malnutrition control**

	Iodine	**Iron**	**Vitamin A**
Immunization	–	++	+++ (measles)
Deworming	–	++	++
Hookworm/schistosomiasis control		++	+
Diarrhoeal disease control	–	++	++
Respiratory disease control	–	–	+

Number of + indicates level of importance as a public health measure in relation to each micronutrient

There are various animal and non-animal sources which should be assessed to suggest what dietary diversification locally would enable maximum absorption of micronutrients. Table 9.3 shows the most suitable vehicles for fortification for each micronutrient.

Table 9.3 Fortification vehicles for micronutrient enrichment

	Iodine	**Iron**	**Vitamin A**
Salt	++++	++	–
Margarine/oils	–	–	++++
Cereals	??	++++	++
Sugar	++	+++	+++
Condiments[1]	+	++	++
Milk/milk products	+	+++	+++
Flour (bread)	++	+++	+
Fish sauce	+	+++	–

[1] e.g. monosodium glutamate, curry powder

Number of + indicates level of importance as a possible vehicle for fortification

The public health measures that can be used in the control of the three main micronutrient malnutrition problems are to a large extent the same. Iodine deficiency, being mainly geographically determined, does not respond very well to public health interventions. Table 9.4 summarizes the different public health interventions that are appropriate.

Discussion

The role of supplementation should not be minimized. It is something we can do, it is cheap and we know it works. Other micronutrients could be included in an integrated measure: vitamin D, folic acid, vitamin B_{12}, vitamin K and zinc. Deficiency of micronutrients affects appetite which affects absorption of micronutrients: protein–energy malnutrition and micronutrient deficiencies are not separable.Multiple micronutrient supplements should also be explored. It is a complex art to combine the factors: present status, causality, time-frame and cost in a strategy and action plan

Table 10.1 Haemoglobin and haematocrit criteria below which anaemia is considered present for population studies

Age/sex	Hb below (g/l)	Hb below (mmol/l)*	Hct below (l/l)*
6 months–5 years	110	6.83	0.33
5–11 years	115	7.13	0.34
12–14 years	120	7.45	0.36
Non-pregnant women	120	7.45	0.36
Pregnant women	110	6.83	0.33
Men	130	8.07	0.39

* conventional conversion factors: 100 g Hb = 6.2 mmol Hb = 0.30 l/l Hct

Source: World Health Organization/UNICEF/UNU, Indicators and strategies for iron deficiency programmes, (in press)

Table 10.2 Serum ferritin levels

	5 years and older (µg/l)	under 5 years (µg/l)
Risk of severe depletion	< 15	< 12
Risk of excess iron	> 300	> 300

10.?Monitoring and evaluation needs

Barbara Underwood

Monitoring is important to assess the progress of the programme. The WHO criteria for haemoglobin and haematocrit determination in population studies and for serum ferritin levels are summarized in Tables 10.1 and 10.2.

Discussion

In the discussion, it was again stressed that infection leads to higher serum ferritin levels, which leads to reporting of higher anaemia rates. For example, one month after a common cold, anaemia prevalence dropped in one study from 25% to 8%. To correct for this would be useful but it is not feasible. During surveys a question on infection could be included to check for potential bias. However, haemoglobin level is solid and robust and remains the primary indicator while serum ferritin is a research indicator. For field work haemoglobin level should be measured and, possibly in a subsample, serum ferritin. “Haemocues”, small battery-operated machines for haemoglobin determination using disposable pipettes, are ideal for field surveys, the analysis is easier and cheaper than urinary iodine or serum retinol. Distribution curves rather than cut-off points are preferred. Monitoring should be incorporated in other monitoring/surveillance activities. There is lack of sufficient data, capacity building (laboratory facilities and human resources) and nutritional surveillance is needed, but it should go together with action.

11.?Guidelines for developing national iron deficiency control programmes in countries of the Eastern Mediterranean Region

The Consultation agreed that the regional goal for the year 2000 was to reduce the prevalence of iron-deficiency anaemia by 33% of 1990 levels. The strategies for control were reviewed, and their importance was assessed in addressing the three main issues—increasing iron intake, increasing bioavailability of the ingested iron and reducing iron losses (Table 11.1).

Special attention should be given to improvement of the iron nutrition of infants older than six months and young children.

The strategies shown above could be applied to all countries in the Region. It must however be stressed that the order of introduction and the emphasis of each strategy will need to be adapted to the specific situation in each country, including the socioeconomic status.

There are essentially three subregions which are characterized by differences in socioeconomic status. Yet iron deficiency and anaemia are a problem in each of the subregions. It must therefore be stressed that the main control strategies are important for all subregions. The difference will lie in the rate of implementation of the steps of the following implementation plan, the depth of detail in the initial situation analysis and the priority setting. Eventually it is assumed that all countries will have a control programme in which all the four main strategies are used in an appropriate mixture.

Steps in establishing iron deficiency control programmes in countries of the Eastern Mediterranean Region are given below in Table 11.2. The order of the steps is according to priority, noting that Steps 8a, 8b, 8c and 8d are complementary.

The timing of the implementation of Step 8d (fortification), its practicality and feasibility will depend on the socioeconomic status and capability of the country concerned.

It is important to note the following:

- In several countries of the Region, malaria is a major cause of anaemia. The anaemia caused by malaria is not an iron-deficiency anaemia, and measures for its control are related to the prevention and early, appropriate treatment of malaria. Iron should not be given in the acute phase of malaria. Iron deficiency and its anaemia are however also prevalent in the same populations. Prevention and control of iron deficiency and anaemia therefore are a priority also in these countries.

- Preventive measures are needed, such as fortification, dietary diversification or supplementation to ensure that the iron status of women is satisfactory *before* they become pregnant

to avoid brain damage in early pregnancy, when a woman has not yet visited an antenatal clinic or does not even realize that she is pregnant.

- The special needs of infants and young children have been overlooked in many instances. Breast-fed infants will need additional iron from the age of six months. They need to be given iron-fortified complementary foods, or iron supplements. Children who are not breast-fed in the first six months of life should be given fortified infant formula. This has implications for several steps in the action plan.

Table 11.2 **Steps in establishing iron deficiency control programmes in countries of the Region (continued)**

Step	Activities to be undertaken
1. *To assess the situation*	1. Carry out a situation analysis based on existing and, if necessary newly collected information on: • prevalence, including groups/areas most affected • dietary patterns, including consumption of fortifiable foods, food taboos • knowledge, attitudes, practices and beliefs • purchasing power of the target groups 2.Identify main underlying causes of iron deficiency • low iron intake • low bioavailability of ingested iron • high iron losses 3. Identify and evaluate already ongoing control activities, including programmes for control of other micronutrient malnutrition deficiencies 4. Identify resources • human • financial • other 5. Focus-group studies in the community to develop suitable messages and suitable strategies together with the community

Table 11.2 **Steps in establishing iron deficiency control programmes in countries of the Region (continued)**

Step	Activities to be undertaken
2. *To identify opportunities for intervention*	1. For supplementation, for dietary diversification and for public health measures: • ongoing maternal and child health programme • school health programme • community health workers • Other possible channels • IEC channels 2. For fortification: • central processing of foods • availability of foods suitable for fortification • special foods eaten regularly by the target groups, such as complementary foods or bread
3. *To raise the awareness of policy makers about iron-deficiency anaemia and iron deficiency*	1. Conduct a national seminar under the patronage of the minister of health for policy makers, key figures, media, etc. 2. Develop a well written and concise plan of action for presentation to the national seminar 3. Form a national iron deficiency control committee or expand the national micronutrient deficiency control committee as applicable
4. To sensitize all health professionals dealing with mothers and children about iron deficiency and iron-deficiency anaemia	1. Conduct seminars at governorate, state and district levels as applicable 2. Prepare brochures 3. Distribute brochures to all health facilities

Table 11.2 **Steps in establishing iron deficiency control programmes in countries of the Region (continued)**

Step	Activities to be undertaken
5. To train all relevant health workers on the detection and management of iron-deficiency anaemia	1. Conduct a training of trainers workshop at central level 2. Conduct training workshops at peripheral levels, including on-the-job training
6. To ensure that all health centres are capable of testing for haemoglobin and haematocrit	1. Survey of existing facilities for needs assessment 2. Based on Step 1, provide necessary supplies
7. To increase community awareness of the problem and the consequences of iron deficiency and of ways of fighting it via appropriate nutritional behaviour and dietary diversification	1. Preparation of IEC campaign that includes • size of the problem • consequences • what can be done 2. Testing and airing of messages 3. See also Step 1, Activity 5, and carry out if not yet done
8a. To ensure that those groups needing iron supplementation receive adequate and timely supplies	1. Assess existing programme 2. Identify constraints 3. Identify appropriate measures for improvement 4. Examine innovative methods for sustainable supplementation, which can involve weekly supplementation and alternative distribution systems, including self-purchase and the private sector 5. IEC and community involvement to improve compliance 6. Implement changes

Table 11.2 **Steps in establishing iron deficiency control programmes in countries of the Region (continued)**

Step	Activities to be undertaken
8b. Promotion of dietary diversification	1. Review information on dietary pattern collected in Step 1 2. Identify behaviour promoting intake of enhancers or inhibitors 3. Identify effective changes and assess their feasibility 4. Develop suitable messages and other means of promotion
8c. To ensure coverage of target population by relevant public health measures	1. Strengthen existing primary health care programmes • control of diarrhoeal diseases • acute respiratory infections • expanded programme on immunization • family planning 2. Initiate regular deworming of schoolchildren as appropriate 3. Promote breast-feeding and appropriate complementary feeding, with fortified and/or micronutrient rich foods 4. Improve water and sanitation 5. Promote environmental hygiene

Table 11.2 **Steps in establishing iron deficiency control programmes in countries of the Region (continued)**

Step	Activities to be undertaken
8d. To have a functional fortification programme	1. Carry out a study to identify • suitable vehicle and fortificant • safety • logistics • cost 2. Identify those to be involved, such as industry, consumer organizations and the public sector, and involve them from the start 3. Start in pilot area 4. Expand to national scale
9. To establish and/or strengthen a system of monitoring and evaluation using simple, but meaningful indicators of process and impact	1. Choose appropriate indicators 2. Monitoring of routinely collected data 3. Sporadic surveys

12.?Recommendations for action

1 Action to control iron deficiency should start immediately and not wait for the results of prevalence studies.

2 Innovative strategies that involve linkage with sectors outside the health sector should be stressed for strengthening supplementation. Included should be dosage schedules, ways of delivering iron to the target groups, etc.

3 Scientific information on effective strategies that have proven to work elsewhere should be

disseminated to countries. WHO will continue to collate, analyse and disseminate updated scientific knowledge.

4 Community involvement is needed in all facets of implementation and monitoring of the programme, including understanding the importance of iron deficiency and identifying ways of combating it.

5 Iron deficiency anaemia control must be integrated with existing primary health care activities. Horizontal rather than vertical programmes are preferred. National nutrition committees, already established as a follow-up to the International Conference on Nutrition should coordinate integrated action; preventive supplementation should not exclusively be done through the health services (see recommendation 1).

6 Effective information, education and communication is necessary, to be evaluated by consumer surveys to verify its impact and make necessary adjustments where needed. There is a need for a policy paper for policy-makers on the costs of iron deficiency, the effects on work and scholastic performance and productivity, etc.

7 It is important to involve the private health sector, the private commercial sector (shopkeepers, industry, etc.) and the media in iron deficiency control programmes, especially in information, education and communication activities.

8 Effective monitoring systems and formats for evaluation and reporting must be set up, as well as a time-frame for these activities. The monitoring information system should be used to modify the programme as required. Nutritional surveillance is necessary.

9 Food supplied for emergencies and relief should be fortified.

10 Targeted fortification by geography (regional development of fortified multi-mixes), age group (complementary feeding) and programme (e.g. school feeding) should be considered.

11 Subsidies to enhance consumption of iron-rich foods should be considered.

12 National food policies should be examined to identify ways of stimulating both supply and demand of iron-rich foods, including legumes and foods rich in enhancers of iron absorption; at present, subsidies tend to be placed only on staples (energy-providing foods).

13 Iron deficiency rather than iron deficiency anaemia should be targeted.

14 Food tables (including spices and condiments) should be updated to include data on iron (possibly including contamination iron), phytate, iron-binding polyphenols, vitamin A, biologically active carotenoids. Traditional methods to reduce phytate (by fermentation, germination, soaking) and polyphenols should be studied.

15 Any situation analysis for an iron deficiency control programme should include legislation, regulations, and focus group studies for developing effective information, education and communication activities.

16 Food preparation and child care and feeding practices are important determinants of iron status, therefore intervention should be based on a sound knowledge of these practices in the country concerned.

17 Communities and families should be empowered to increase the intake and bioavailability of iron-source foods within locally prevalent resources and circumstances; the entire family should be focused on.

18 Capacity building/training should be a part of any iron deficiency control programme.

19 Restoration and fortification should both be considered.

20 Public health measures should be strengthened to concentrate on endemic diseases (country specific).

21 Strategies for the control of iron deficiency should address increasing iron intake, improving bioavailability of dietary iron, and reducing iron loss.

Action on research in the Region

? ?????????There should be research specialization by country. Country-specific research agendas should be established.

? ?????????Social scientists should be involved.

? ?????????Study proposals should first be sent to the WHO Regional Office for the Eastern Mediterranean for review to ensure technical quality.

Areas for research include:

1 Whether supplementation should be weekly or daily through well monitored trials in low, middle and high income countries. The practical implications and the issue of noncompliance must be addressed.

2 Bioavailability studies on the iron in food; dietary guidelines on practical ways to increase bioavailability specified by food-specific region and country must be developed. There are two laboratories (in Gothenburg, Sweden, and Bangkok, Thailand) that can do bioavailability studies in food. For differences in meal content, however, countrywide research can be done.

3 Studies on the use of NaFeEDTA as a fortificant.

4 Food habits and their effect on iron content and absorption. The Consultation noted the ongoing state-of-the-art review of complementary feeding by WHO/UNICEF and leading scientists.

5 Improvement of food composition databases. This should be a regional activity, to avoid setting up duplicate laboratories in different countries.

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Annex 1

Findings of a multicentre study on anaemia and iron deficiency in the Eastern Mediterranean Region

Dr Saher Shuqaidef

The study methodology used was based on a review of the available literature on iron deficiency and on anaemia in the Region and focused on the study population, its physiological status, dietary factors, concomitant diseases, interventions and measurement. The population was studied with respect to age, sex and national representation, including geographic, administrative, rural–urban and socioeconomic variables. Physiological status referred to the women of child-bearing age in terms of whether they were menstruating, pregnant, lactating and users of contraceptive methods. Dietary factors covered quantity and quality of iron intake including habits that enhanced or inhibited absorption. In addition, traditional practices that affected dietary intake were examined. Status of morbidity as relevant to iron deficiency and anaemia were considered, such as malaria, hookworm, schistosomiasis and haemoglobinopathies. The presence of iron supplementation and/or fortification programmes was emphasized in determining the status of individuals and subpopulations in terms of their iron status. Furthermore, the screening method used affects the accuracy in determining the magnitude of the problem and its severity.

Examples of these methodological issues were drawn from the Region. The results of an iron supplementation trial conducted on schoolchildren in Jordan during 1994 showed that after one month of iron supplement, the children's mean haemoglobin level was significantly increased and the proportion of anaemic children was reduced. The sensitivity and specificity of haemoglobin and haematocrit screening method were compared when the iron response method was applied. The effect of adjustment for atmospheric oxygen content on the measurement of anaemia status was illustrated by the case of the Islamic Republic of Iran, where the diversity of altitudes necessitated taking this into account. The meeting was informed about a study in Oman that showed that the perception of the health providers of the severity of anaemia in terms of the measurement of haemoglobin level during routine maternity care in Oman resulted in inconsistency of the cut-off levels used by different providers. Physicians and nurse/midwives used different cut-off points to classify anaemia; these cut-off points were also not consistent with WHO criteria.

Multicentre study in the Islamic Republic of Iran

Dr Salehian, Principal Investigator

The study, conducted between December 1994 and January 1995, covered 1452 women of child-bearing age and adolescent girls (15–49 years) in 160 urban and 160 rural clusters. Definitions for anaemia (pregnant women: haemoglobin ? 11 g/dl; all other women and adolescent girls: haemoglobin ? 12 g/dl, both corrected for altitude), iron deficiency (serum ferritin ? 12 µg/dl), and iron-deficiency anaemia (anaemia + two or more of: serum ferritin ? 12 µg/dl, mean corpuscular volume ? 80 fl, transferrin saturation ? 16%). Anaemia prevalence was found to be 33.4%, iron deficiency 34.5% and iron-deficiency anaemia 16.6% in the total study population. There was no difference between rural and urban populations in prevalence of anaemia. However, anaemia increased after age 40, and iron-deficiency anaemia increased with increasing parity. Women eating less meat had a higher prevalence of iron-deficiency anaemia. Respondents receiving iron supplement tablets were less than 4% of the total sample and more than half of them were pregnant; they were more likely to be iron-deficient and anaemic.

Multicentre study in the Syrian Arab Republic

Dr Hisham Hourani, study team member

In this study the haematological profiles of 436 children were prepared—haemoglobin, haematocrit, red blood cell count, volume and mean corpuscular haemoglobin. The prevalence of anaemia was 27% when the cut-off haemoglobin level of 11 g/dl was used. The prevalence was 73% when the cut-off of 12 g/dl was used. There were geographical differences and higher prevalence of anaemia in refugee camps. On the other hand, preliminary results of the child-bearing age women study showed that parity and birth interval did not affect the prevalence of anaemia.

Annex 2

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Annex 3
Programme

Sunday, 22 October 1995

08:00–09.00	Registration of the participants
09:00–09:45	Opening Session
	Message from Dr Hussein A. Gezairy Regional Director for the World Health Organization Eastern Mediterranean Region
	Message from Ms Sarojini Vitachi Regional Director for the UNICEF Middle East and North Africa Region
	Official opening of the meeting by H.E. Alireza Marandi, Minister of Health and Medical Education, Islamic Republic of Iran
10:15–10:30	Election of officers
	Objectives and methods of work of the consultation
10:30–10:45	Iron deficiency and anaemia—a global problem *Dr Barbara Underwood*
10:45–11:45	The causality of iron deficiency anaemia—availability and bioavailability of dietary iron *Dr Leif Hallberg*

11:45–12:45 Functional consequences of iron deficiency and anaemia
Dr Fernando Viteri

12:45–13:45 Anaemia in the Region—a call for action
Dr Anna Verster

13:45–14:45 The multicentre studies: findings
Dr Saher Shuqaidef and others

Monday, 23 October 1995

08.30–14:30 Strategies for control

1. Dietary diversification
   Dr Leif Hallberg and others
2. Supplementation
   Dr Fernando Viteri and others
3. Fortification
   Dr Mahshid Lotfi, Dr David Alnwick, Dr Fernando Viteri, Dr Leif Hallberg
4. Public health measures
   Dr Barbara Underwood

Tuesday, 24 October 1995

08:30–14:30 Working group discussion on developing suitable mixture of strategies for control

Working groups divided according to subregions

Presentation of working group reports and discussion

Wednesday, 25 October 1995

08:30–14:30 The need for advocacy and IEC:

1. What are appropriate messages?

2. What are the target groups?

3. How best to reach them?
UNICEF, Dr Reza Husseini and others

Integrated control of multiple micronutrient deficiencies and integration with other programmes
Dr Barbara Underwood

Monitoring and evaluating needs
Dr Barbara Underwood

Thursday, 26 October 1995

8:30–10:30 Summary of regional strategies for control of iron-deficiency anaemia

11:00–12:00 Recommendations for action and identification of necessary research

12:00–12:15 Closing session