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In Touch

HEINZ NUTRITION FOUNDATION INDIA

VOLUME 13 | NUMBER 4 | JANUARY-MARCH 2012 | FOR PRIVATE CIRCULATION ONLY

Contents

Wish you all a very happy new year!

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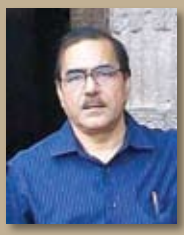
We are all aware that malnutrition in India is a serious challenge. That's why many of us were not surprised when the Prime Minister recently summed it up by saying *"The problem of malnutrition is a matter of national shame"*. We are all bothered about this silent crisis, which is bound to have long term repercussions not only for the individual's growth and development, but on the progress of the nation as a whole. If tomorrow's citizens have to be healthy and robust to build a stronger and progressive nation, their health and nutrition will have to be addressed today. While the term malnutrition categorically denotes deficiency caused by imbalanced or insufficient intake of macronutrients, we should not lose sight of equally important deficiency caused by poor and improper intake of micronutrients, which can be the root cause for many maladies. The national nutritional policy had taken cognisance of micronutrient deficiencies of vitamin A, iodine and iron to name just a few. While it is our prime responsibility to take care of the nutrition of the infant from six months onwards, greater responsibility is take care of the pregnant and lactating mothers. The role of iron in these stages is well documented but for some unfathomable reasons not fully taken care of. This issue of *In Touch* carries a series of articles by different authors viewing the problem from various angles starting with *"Combating Iron Deficiency Anemia Amongst Young Children: A Challenge to Scientific Community by Dr. Umesh Kapil"*, *"Iron Requirements in Infants and Toddlers by Dr. Idamarie Laquatra"*, *"Iron deficiency and Mental Development by Dr. David Yeung"* and *"Anemia – its prevalence – possible solution by Dr. P. Jagannivas"*. All these articles present us the actual ground realities of the need to correct the deficiency of this well-known and common element 'iron'. Generally the emphasis should be on adequate quantity, but when it comes to elements like iron and other micronutrients the superior quality of the actives will enhance better absorption, assimilation and utilisation. Now it is up to not only the Government, to find ways and means to rectify the situation by taking remedial measures, but for every one of us in medical, health and nutrition fields to rise to the occasion.

COMBATING IRON DEFICIENCY ANEMIA AMONGST YOUNG CHILDREN: A Challenge to Scientific Community



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Iron deficiency remains a major nutritional problem among infants and young children in India. The National Family Health Survey III, conducted in 2005-2006, documented that about 69.5 per cent children between the ages of 6-35 months were anemic(1). It was found that the prevalence of anemia in the five socioeconomic groups was i) Lowest group (76.4%) ii) Second group (73.6%), iii) Middle group (69.3%), iv) Fourth (64.8%), and v) in the Highest group (56.2%). More than half of the children in Highest group in whom there is adequate availability of all foods and materialistic resources were found suffering from anemia . Earlier studies from different regions in the country during the last three decades also reported a similar high prevalence(2-7).

During the last two decades, outstanding progress has been made towards eliminating iodine deficiency through universal salt iodization. Vitamin A deficiency is being aggressively addressed through nationwide bi-annual distribution of vitamin A solution to infants, young children and fortification of foods. However, during this same period, little progress has been made towards elimination of iron deficiency. Iodine and vitamin A deficiencies receive far greater attention and support due to more intense advocacy efforts by international and bilateral organizations. Simultaneously, an erroneous perception exists amongst the Indian health administrators and planners that effective and practical interventions are not available for preventing iron deficiency. Iron thus continues to remain the most 'neglected micronutrient' in spite of it's greater burden on health.

Evidence indicates that iron deficiency anemia is associated with impaired performance on a range of mental and physical functions in children including physical coordination and capacity, mental development, cognitive abilities, and social and emotional development(8). Other health consequences include reduced immunity, increased morbidity, increased susceptibility to heavy metal (including lead) poisoning. The precise effects vary with the age groups studied. Recent studies have documented that the iron supplementation at a later age may not reverse the effects of moderate to severe iron deficiency anemia that occurred during the first 18 months of life(9-12).

It is true that National Nutrition Anemia Control Program (NACP) was launched in the country in 1970. It was supposed to cater to children between 1-5 years of age. Under this program, fifty per cent of children were to be given 100 tablets of iron and folic acid (IFA) per year for prophylaxis against nutritional anemia(13). However, the children below 24 months cannot swallow the tablets. Recently, limited supplies of IFA liquid has been introduced in the program. But still the young children largely remained uncovered.

The health consequence of iron deficiency during first two years of life are not only serious but also irreversible. Paradoxically, during this critical 'window' no effectively functioning supplementation program is in place to prevent iron deficiency. It is evident that strong concerted efforts need to be undertaken to improve the scenario(14). Some of the possibilities in this context are enumerated below (i) inclusion of IFA liquid for all under-five children under the NACP and targeting iron supplementation to children in the age group of 6-35 months on a priority basis (ii) initiating iron supplementation of all anemic and non-anemic women/adolescent girls in the community so that they can enter pregnancy with adequate iron stores and give birth to infants with adequate iron stores, (iii) promotion of exclusive breast feeding for all infants as

it plays a significant role in preventing iron deficiency in both infants and their mothers, (iv) full term infants (of mothers with adequate iron stores), who are exclusively breastfed do not need supplemental iron until they are six months of age. After this age, breastfed infants should be given extra iron in the form of iron-fortified home made complementary foods. Where iron-fortified complementary foods are not widely or regularly consumed by young children, all infants should receive iron and folic acid supplements after six months of age.

IFA supplementation should be done through the peripheral health and Integrated Child Development Services Scheme functionaries at the village level. Home visit once in a month is a part of the routine responsibilities of Anaganwadi Worker and Auxiliary Nurse Midwife, which can be utilized for distribution of the IFA. Various contact points like measles immunization (9 months), DPT booster (16 months) and take home ration day in ICDS scheme (where ever followed) should be utilized for distribution of IFA. Other village level developmental functionaires/voluntary persons available in the community may also be utilized for IFA supplementation, monitoring the compliance and side effects and for counseling the mother about the benefits of IFA. An effective step would be to make the IFA available at the village level through the net work of health sub-centers and anganwadi centers.

In conclusion, there is an urgent need to initiate specific public health action to prevent iron deficiency in young children. The time for meticulous planning is over, what is needed is immediate action.

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IRON REQUIREMENTS IN INFANTS AND TODDLERS

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The mineral iron is vital to human function. It is involved in carrying oxygen throughout the body, transporting electrons and acting as part of critical enzyme systems (FAO and WHO, 2002). Most of the iron in the body is present in the red blood cells as hemoglobin, a molecule whose role is to transport oxygen from the lungs to the tissues for unloading. In infants and children, iron requirements take into account basal losses, growth, and storage, as well as bioavailability in the diet.

At birth, normal infants have high hemoglobin levels (Institute of Medicine, 2001), and an iron content of approximately 250-300 mg (FAO and WHO, 2002). The iron stores are a result of high iron accretion in the fetus during the third trimester. Infants born prematurely and those born of malnourished mothers do not have the iron stores of term infants from well-nourished mothers (Baker et al, 2010).

During the first two months of life, hemoglobin levels fall leading to a redistribution of iron from catabolized red blood cells to storage iron (FAO and WHO, 2002). The infant's stores of iron fulfill the infant's iron needs during the first six months of life (Butte et al, 2002). The Recommended Dietary Allowance for Indians 0-6 months of age is 0.315 mg/day, reflecting the amount of iron needed to maintain hemoglobin levels at 11 g/dL and to replace excretory loss (Indian Council of Medical Research, 2004).

With the exception of pregnancy, the iron requirement during the remainder of the first year and up to 18 months of age is one of the highest in the life cycle due to the rapid growth of the infant (Nair and Iyengar, 2009). In addition to growth, which includes an increase in hemoglobin and tissue masses, iron is needed to replace the obligatory losses that occur primarily from the gastrointestinal tract, the skin and in secretions (Fomon et al, 2005). During this time period, iron is also needed to contribute to the building of iron stores. Iron stores almost double in the first year of life (FAO and WHO, 2002), and then double again between one and six years.

Iron absorption from the diet varies according to iron stores; that is, when the stores are deficient, higher absorption occurs (Institute of Medicine, 2001). In addition, dietary iron varies in bioavailability depending on the source. There are two kinds of dietary iron, heme iron and non-heme iron. Heme iron comprises 40 per cent of the iron in meat, poultry, and fish (Nair and Iyengar, 2009), and is well-absorbed, with an average absorption rate of approximately 25 per cent (FAO and WHO, 2002). Non-heme iron, found in animal tissue and all plants such as cereals, pulses, legumes, fruits and vegetables is not as well absorbed as the heme form, and its absorption is influenced by several dietary factors. Ascorbic acid and meat, fish and poultry enhance non-heme absorption, and phytate and polyphenols are strong inhibitors.

In the Indian diet, the majority of iron provided is non-heme (Nair and Iyengar, 2009). Bioavailability is thought to be low due to the high phytic acid and polyphenol content along with a low consumption of meat and ascorbic acid. Non-heme bioavailability in the diet consumed by children in rural India has been found to average between 3.2 and 4.6 per cent daily (Rani et al, 2010).

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Considering that Indians consume a plant-based diet and the fact that they have reduced iron stores compared to peers in the developed world (Nair and Iyengar, 2009), an estimate of iron bioavailability based on a mathematical model was three to five per cent (Thankachan et al, 2011). These factors have been taken into consideration in setting the level of daily iron in the Recommended Dietary Allowances for Indians.

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IRON DEFICIENCY AND MENTAL DEVELOPMENT

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Having the full complement of essential nutrients in the right proportion is important to health, growth, development, intellectual function, work capacity and behaviour. Missing any one of the essentials can have dire effects at any time during one's life time.

There is scientific evidence that early nutrition is important to the child's health and development. It also has lasting consequences on physical development, mental development, economic productivity and long term health. Deficiency of any single nutrient or multiple essential nutrients can be a burden to life and society.

During early childhood, malnutrition can affect growth and development and may impact lifelong health consequences. Children who are malnourished may be at greater risk for chronic diseases in later life(1). This hypothesis was first raised on observation of European children who suffered from starvation and malnutrition during the Second World War. Tracing their health in their middle and old age revealed a higher risk of cardiovascular diseases and hypertension, etc. Animal studies conducted provided support for this concept.

In the previous article, in this issue of In-Touch, Prof. Umesh Kapil intimated that iron deficiency anaemia in early childhood adversely influenced mental and behavioural development which could have a lasting effect. The consequence of this impacts socio-economic status as well as economic productivity of the individual later on in life.

A number of nutrients, if deficient during the first 1,000 days of life, can have life-long adverse influences on mental development. These include iodine, folate, the B-vitamins, and iron(2). Among these, globally, iron deficiency has the highest prevalence, especially among pre-schoolers, pregnant and lactating women. The adverse cognitive defect of children who are anaemic from iron deficiency ins the first year of life was reported by Cantwell(3). Subsequently, this was verified in numerous studies(4, 5). Initially it was suggested that this occurred only if the child suffered severe iron deficiency-anaemia but not just iron deficiency. More recent studies imply that this effect can result from iron deficiency without anaemia (6,7).

Of importance is that the cognitive deficiency seems to have a

A number of nutrients, if deficient during the first 1,000 days of life, can have life-long adverse influences on mental development. These include iodine, folate, the B-vitamins, and iron (2). Among these, globally, iron deficiency has the highest prevalence, especially among preschoolers, pregnant and lactating women

lasting effect. Follow up studies at school age or early adolescence showed persistent lower IQ scores even though the iron deficiency had been successfully treated(4). Meta-analysis estimated that the long term effects on IQ to be 1.73 points lower for each 1.0 g/dL decrease in haemoglobin. When tested at 19 years of age, those individuals who suffered from chronic severe iron deficiency as infants, they did not catch up in cognitive test scores over time, 19 years of age, compared to those who were iron sufficient before and or after treatment in infancy(5).

Iron deficiency and iron-deficiency anaemia can be eliminated easily. Low dose iron supplementation can significantly improve language and motor development(8). This treatment must be provided from around six months onwards. Improvement of appetite, activity, behaviour, sleep, etc. has been observed in pre-schoolers in China, India, and Africa who were provided micronutrient powders containing iron (unpublished results).

A retrospective study in Latin America provided information that improved nutrition during early childhood can provide substantial impact on adult human capacity and economic productivity(9). The implication is that better nourished children might have higher learning capacity, school performance and choice of career, hence, economic productivity.

Iron deficiency is estimated to afflict billions of individuals especially pre-schoolers, adolescent girls, and pregnant women. Providing sufficient dietary iron and all essential nutrients in the first 1,000 days of life is a crucial, moral and health-care responsibility of society and the nation.

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ANEMIA – ITS PREVALENCE – POSSIBLE SOLUTION

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Anemia continues to be the most prevalent public health problem in India, and parents are encouraged to provide their children with iron-rich foods. Without overemphasizing one can safely state that reducing the level of anemia in children in the country will have far reaching consequences right up to improving the GDP in future. The government being aware of the fact that food sources of iron are scarce or unaffordable among the poor had taken corrective measures by distributing 100 pediatric iron tablets per child per year through well organized ICDS programme. The compliance levels unfortunately were not to the desired expectations.

In recent years, fortifying home-prepared food has been widely promoted as a way to address micronutrient deficiencies and particularly iron. "Home fortification" entails adding inexpensive but effective food supplements containing iron and other essential micronutrients to home-cooked foods. An innovative supplementation was introduced through Heinz Foundation in the powder form called 'Nurturemate' to provide iron and other essential micronutrients. It can also be used to treat acutely malnourished children. It was expected that Nurturemate will be more widely accepted due to its pleasing packaging, lack of side effects, ease-of-use, and resistance to humidity.

Nurturemate is packed in single-serve sachets and mixed with home-made foods without any appreciable change to colour, taste and flavour of the food. Nurturemate has been used to effectively and safely treat and prevent anemia among infants and young children in 11 countries in Asia and Africa including Cambodia, Pakistan, Bangladesh and India. In addition to addressing micronutrient deficiencies, introducing Nurturemate to the population provides a key opportunity for promoting appropriate feeding practices among infants 2 years and older. These practices include use of locally available, low-cost food items, and proper feeding frequency – all accomplished without affecting cultural food consumption practices and preferences.

EFFICACY STUDY

The study conducted in September 2004-August 2005 at KEM Hospital Research Centre among 432 children aged 6-18 months supported the efficacy of Sprinkles® (as Nurturemate was then called), as the number of anemic children decreased by 64 per cent over a period of two months.

These results are similar to findings from other countries, such as Indonesia, Ghana, Bangladesh, and Pakistan. Furthermore, the efficacy of this Multi-Micro-Nutrient Powder (MMNP) in controlling iron deficiency was found to be similar to that of iron drops, but without the problems typically faced when using drops, including resistance or rejection by children, due to bad taste and the staining of teeth and clothes.

EASE OF DISTRIBUTION AND FLEXIBILITY OF ADMINISTRATION

In mid 2007, the Foundation provided funding to design and implement a pilot distribution study for MMNP, in India to assess the effectiveness of using the country's Integrated Child Development Services (ICDS) program as a channel through which to address the problem of anemia in children and ease of distribution.

This study utilized a flexible administration model of MMNP which caregivers were instructed not to give more than one sachet to a child per day and to use all the 90 sachets provided to them within six months. The study found that the flexible administration model of MMNP (giving 60 sachets, each containing 12.5 mg iron, over a 120-day period) reduced anemia from 77 per cent to 30 per cent. The level of anemia reduction, with continued MMNP use, was sustained even during a six month post intervention follow-up period. Under this flexible administration approach, caregivers were able to decide how frequently to give MMNP over the time period, but not exceeding one sachet per day.

To assess the impact of distributing MMNP through Anganwadi Centers on reducing anemia levels, multi-stage cluster sampling was used to randomly select a sub-sample of beneficiary children for hemoglobin assessment using the Hemocue method at baseline (n= 1,373) before the intervention was implemented. After 120 days of intervention, a new sub-sample of 1,314 children was drawn using the same sampling methodology. The overall level of anemia (hemoglobin level below 11gm/dL in children <5 years and below 11.5gm/dL in children 5-6 years) dropped significantly ($P<0.001$) from 54 per cent at baseline to 39 per cent at end line. These findings suggest that flexibly administered MMNP is highly effective

in reducing anemia among young children when introduced through an ongoing child health program such as that offered by the ICDS' Anganwadi Centers.

COMPLIANCE STUDY

Having established the efficacy, it was decided to have comparative study of the compliance of the conventionally distributed iron tablets / syrup done by the ICDS and Nurturemate. The Directorate of Public Health and Preventive Medicine at Tamil Nadu undertook a study at Cuddalore District distributing Nurturemate and a comparative study at Dharmapuri where the regular administration of iron tablets was done. The final results are expected to be published shortly. In the meanwhile it is learnt that compliance with Nurturemate is very good and the feedback from consumers were very encouraging.

SOCIAL MARKETING MODEL

Last year we started a social marketing project for Nurturemate with the help of a Chennai based social enterprise called v-shesh. However, this project is being run by an NGO called IVDP based in Krishnagiri district in Tamil Nadu. They will cover 15,000 children in age group of 2-5 years in 2 phases. Phase one covering 1,000 children is nearing completion and we have positive feedback from mothers of the children consuming Nurturemate. This project is in line with the foundation's approach of looking for sustainable solutions to get Nurturemate to as many children as possible. Even as the effort in Krishnagiri starts working on phase 2 that covers 14,000 children, we are already discussing ways of replicating this in other locations and with other partners. A face book page has been created for the project and those that are interested in tracking the progress of this project can visit - http://tinyurl.com/hmc-v-shesh

In summary, India is faced with a gigantic problem of iron deficiency among young children of pre-school age. The problem is easily surmountable, if the stake holders are ready to accept iron-fortified MMNP, which are affordable, clinically-proven to be efficacious, easy to store and eat, and is compatible to usual feeding and eating habits of the children. Wide promotion of fortification of home-prepared foods for children significantly ensures anemia alleviation and promotion of the physical and mental health of our future generations.

MICRONUTRIENTS – SOME INTERESTING FACTS

A. DEFINITION

Micronutrients are vitamins and minerals that are needed by the body in very small amounts but are essential for the body to maintain its normal functions. According to WHO, micronutrients are "magic wands that enable the body to produce enzymes, hormones, and other substances essential for proper growth and development". As they cannot be synthesized in the body, they must be provided by the diet.

B. TYPES OF MICRONUTRIENTS

Broadly micronutrients can be divided into Vitamins and Minerals.

C. MICRONUTRIENT MALNUTRITION

Micronutrient malnutrition is a term used to refer to disease caused by a dietary deficiency of vitamins and minerals. It is widespread in developing countries and affect approximately two billion people worldwide which is equivalent to one-third of the total world population. According to WHO, iodine, vitamin A and iron are the most important in global public health terms; their lack represents a major threat to the health and development of populations the world over, particularly children and pregnant women in low-income countries.

- Iron deficiency is one of the top 10 causes of global disease and robs more than 2 billion children of their intellectual development, lowers their IQ, and contributes to about 25 per cent of maternal deaths in developing countries.
- Iodine deficiency is the leading cause of preventable mental retardation and causes brain damage in nearly 18 million newborns each year.
- Vitamin A deficiency produces blindness in about 500,000 children and claims the lives of almost 670,000 children aged 5 years and younger.

D. CAUSES OF IRON DEFICIENCY

1. Iron deficiency usually occurs when daily requirement for iron doesn't meet from the dietary sources.
2. Similarly, its deficiency occurs due to inadequate absorption of iron and excessive blood loss.
3. Deficiency of Vitamin A limits mobilization of iron from its stored site hence causing iron deficiency.
4. Gastrointestinal disorders that result in inflammation of small intestine may result in diarrhea, poor absorption of dietary iron, and iron depletion.
5. Heavy worm infestations in children decrease the level of blood hence increasing iron demand.
6. Exclusive breastfeeding beyond six months.
7. Premature and low birth weight.

E. EFECTS OF IRON DEFICIENCY

1. Iron deficiency anemia is common manifestation of iron deficiency in children.
2. Fatigue, decreased productivity, and reduced learning capacity
3. Impaired growth
4. Reduced appetite
5. Reduced immunity
6. Strange food cravings(pica) like eating dirt
7. Lethargy, breathlessness, repeated infections

SOURCE: MICRONUTRIENT POWDER (MNP) SUPPLEMENTATION – HAND BOOK VITA MISHRA

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IRON THE MOST NEGLECTED MICRONUTRIENT

While every nutrient is important for health, iron takes the front-stage due to its higher prevalence in Indian population and often subtle but irreversible impairment of mental functions, especially if deficiency exists in first two years of life. This issue of In-Touch brings you a summary of present state of iron deficiency in India. Dr. Idamarie highlights need for iron supplements in every infant and toddler, more so in premature neonates and those born to malnourished mothers. Dr. Umesh Kapil discusses ground reality in Indian children and stresses the need for immediate action to combat this menace. Dr. David has emphasized health consequences of iron deficiency during first few years of life in terms of reduced IQ scores and change in behaviour. Public health programs in India have failed so far in addressing this important issue and Dr. Jagannivas has suggested an alternative practical approach of multi-micronutrient powder supplement to routine family food and has provided evidence of its efficacy and safety. I am sure readers will be sensitized to take care of iron deficiency in their routine practice.

Correspondence is welcome. Please write to: Heinz Nutrition Foundation India, D-Shiv Sagar Estate, 7th floor, Dr. Annie Besant road, Worli, Mumbai 400 018. Tel.: (022) 40085555 Fax: (022) 40085551 E-mail: p.jagannivas@in.hjheinz.com

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