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National Iron Plus Initiative: Current status & future strategy

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Anaemia is a severe public health problem amongst all vulnerable age groups in India. The National Nutritional Anaemia Prophylaxis Programme initiated in 1970, was revised and expanded to include beneficiaries from all age groups namely children aged 6-59 months, 5-10 yr, adolescents aged 10-19 yr, pregnant and lactating women and women in reproductive age group under the National Iron Plus Initiative (NIPI) programme in 2011. The dose of iron, frequency and duration of iron supplementation and roles and responsibilities of the functionaries were described. At present, the coverage of beneficiaries with iron and folic acid has been poor at the national level. The prevalence of anaemia has continued to remain high during the last 60 years, and there has been no significant change in the scenario due to various reasons. The constraints in implementation and measures to improve the NIPI programme are discussed in the current article.

Key words Anaemia - haemoglobin - iron - National Family Health Survey - National Iron Plus Initiative Programme

Introduction

High prevalence of anaemia has been reported amongst all vulnerable age groups, especially mothers and children. According to the National Family Health Survey (NFHS)-4, 53 per cent of non-pregnant women, 50.3 per cent of pregnant women (in the age group of 15-49 yr) and 58.5 per cent of children in the age group of 6-59 months had anaemia[1]. Another study conducted in 16 districts of the country reported the prevalence of anaemia as high as 84.9 per cent among pregnant women and 90.1 per cent among adolescent girls[2].

The prevalence of anaemia has continued to remain high during the last 30 yr, possibly due to the provision of iron and folic acid (IFA) supplementation as the main intervention for the management of anaemia[1,3,4]. This was based on the assumption that the main cause of anaemia is iron deficiency. However, the proportion of anaemia associated with iron deficiency is reported to be only 14 per cent for preschool children and 16 per cent for women of reproductive age (WRA). The contribution of iron deficiency in the aetiology of anaemia is lower in countries where the prevalence of anaemia is more than 40 per cent, such as India and especially in rural populations[5]. In addition, the impact of IFA supplementation on the increase in haemoglobin (Hb) levels of anaemic individuals has been documented to be marginal as iron supplementation has been suggested to increase the mean blood Hb concentration by 8.0 g/l in children, 10.2 g/l in pregnant women and 8.6 g/l in non-pregnant women[6].

Deficiencies of other mineral and vitamins such as folate, vitamin B_{12}, vitamin A, and copper interfere with erythropoiesis[7,8]. The genetic Hb disorders also play an important role in the development of anaemia. The inflammation caused due to infections leads to poor nutrient absorption and increased nutrient losses. Infectious diseases such as malaria, tuberculosis, fevers, diarrhoea, parasitic infestations and other infections common in developing countries alsocontribute to anaemia[9]. Recent evidence suggests that unsafe water, sanitation and hygiene (WASH) in resource-poor settings promote the transmission of enteric pathogens, leading to diarrhoeal diseases and chronic inflammation[10-12]. Environmental enteric dysfunction due to poor WASH practices reduces the absorption of nutrients including iron[10-12].

In view of the multifactorial aetiology of anaemia, there is a need to undertake the prevention of vitamins and mineral deficiencies along with the prevention of communicable diseases and subclinical infections to control and reduce the prevalence of anaemia in the country.

Fallacy of evidence on reduction in anaemia

The drastic reduction in the prevalence of anaemia among pregnant mothers in selected States of India such as Chhattisgarh (63 to 41%), Assam (72 to 44%), Haryana (71 to 51%), Odisha (68 to 47%) and Kerala (62 to 45%)has been recorded between NFHS-3 and -4 surveys, in a span of 10 years[1,4]. This high reduction in the prevalence of anaemia was possibly not valid as the coverage of IFA supplementation was poor [Chhattisgarh (30.3%), Assam (32.0%), Haryana (32.5%), Odisha (36.5%) and Kerala (67.1%)] and also on the fact that less than 50 per cent of the population was amenable to iron. HemoCue® digital haemoglobinometer used as the method for the estimation of Hb in the NFHS surveys provided inconsistent results[13]. Hence, the error in Hb estimations may have been responsible for a reduction in the prevalence of anaemia rather than improvement in the anaemia due to IFA supplementation. Furthermore, all the NFHS surveys (2, 3 and 4) in which Hb estimation was done using HemoCue machine documented the lower prevalence of anaemia in pregnant mothers compared to non-pregnant mothers[1,3,4]. This finding is in contradiction to the existing knowledge according to which the prevalence of anaemia among pregnant mothers is always higher due to haemodilution during pregnancy. The WHO also recommended lower 'cut-off' for Hb by 0.5 g/dl, for defining anaemia among pregnant mothers[14].

Evolution of iron supplementation

The National Nutritional Anaemia Prophylaxis Programme (NNAPP) was initiated nation wide in 1970 as a measure to prevent anaemia in the country. The specific objectives of the programme[15] were to: (*i*) assess the baseline prevalence of nutritional anaemia in mothers and young children through the estimation of Hb levels; (*ii*) give prophylaxis and treatment doses of IFA to mothers and children; (*iii*) monitor the quality of the tablets, distribution and consumption of the IFA supplements continuously; (*iv*) assess the Hb levels of the beneficiaries periodically; and (*v*) motivate the mothers to consume tablets through relevant nutritional education (and also to give the appropriate dose to their children). The IFA interventions provided under NNAPP were: (*i*) Pregnant women - one big (adult) tablet (each tablet containing 60 mg of elemental iron and 500 µg folic acid) daily for 100 days; (*ii*) lactating women and intrauterine device acceptors - one big (adult) tablet (containing 60 mg of elemental iron and 500 µg folic acid) daily for 100 days; and (*iii*) preschool children (1-5 yr) - one small (paediatric) tablet (containing 20 mg elemental iron and 100 µg folic acid) daily for 100 days. For young children who could not swallow tablets, liquid syrup containing the same amount of IFA was given. Women with severe anaemia (<7 g/dl) were administered with one big (adult) tablet twice daily for 100 days. The programme was implemented through the network of primary health centres (PHCs) and subcentres. The paramedical staff was responsible for the distribution of IFA tablets[16].

Following the evaluation of the NNAPP in 1989 by the ICMR[17], an expert group meeting organized by the Ministry of Health & Family Welfare (MoHFW) recommended that the dose of iron in the adult may be increased to 100 mg elemental iron[17]. In 1991, the MoHFW revised the policy guidelines for the prevention and control of anaemia. The NNAPP programme was renamed as National Nutritional Anaemia Control Programme (NNACP). The emphasis was shifted from prevention to the management of anaemia. However, the objectives and service components essentially remained the same. An increased emphasis was laid on the health and nutrition education activities[18].

In 2007, the national policy of iron supplementation was again revised[19,20] to include provision of liquid formulation of ferrous sulphate and folic acid containing 20 mg elemental iron and 100 µg folic acid per millilitre for children (6-60

months). The liquid formulation was to be dispensed in bottles so that only 1 ml can be dispensed each time. The logistics of introducing dispersible formulation of IFA were to be expedited under the programme. School children aged 6-10 yr and adolescents aged 11-18 yr were included in the NNAPP. Children aged 6-10 yr were provided with 30 mg elemental iron and 250 µg folic acid daily for 100 days in a year. Adolescents aged 11-18 yr were given priority and supplemented at the same doses and duration as adults. Importance of multiple channels and strategies to address the problem of iron deficiency anaemia were suggested[18]. Use of newer products such as double-fortified salts/sprinklers/ ultra rice and other micronutrient candidates were suggested to possibly be explored as an adjunct or alternative supplementation strategy. In 2013, MoHFW expanded the NNACP and renamed it as a National Iron Plus Initiative (NIPI) programme. The dose of iron, frequency and duration of iron and roles and responsibilities of functionaries are detailed in Tables I-III[21-25].

Budget for NIPI programme

All States' estimation and request for funds for undertaking the activities under the NIPI programme in their annual programme implementation plans (PIPs) are submitted to the MoHFW under the National Health Mission[26]. Earlier, MoHFW was undertaking centralized procurement and distribution to States, but this has been decentralized since 2011. The States undertake the procurement of IFA supplies according to their requirement based on population estimates.

Coverage of beneficiaries

At the national level, the coverage of beneficiaries with IFA supplementation has been poor. As per the NFHS-4, the percentage of women who either received or bought IFA tablets was only 77.7 per cent[1]. Of these, only 33.3 per cent consumed IFA for atleast 100 days. Educational status and socio-economic status were found to have an effect on the overall coverage of IFA supplementation. Consumption of 100 IFA tablets was lower among illiterate women (15.7%) and those who belonged to the lowest wealth index (14.4%) as compared to women with higher schooling (46.7%) and highest wealth index (48.2%)[1]. Data on the coverage of IFA supplementation among children belonging to the age group of 6-59 months, 5-10, 11-19 yr were neither collected nor documented in NFHS surveys[1].

True-prevalence estimates of anaemia

The national-level estimates of the true prevalence of anaemia are not known. The present estimates are based on the data collected under NFHS-2, -3 and -4, which utilize HemoCue instrument for the assessment of Hb. The validity of results obtained by HemoCue has been debatable.

Workload of village-level functionaries

Under the NIPI programme, children aged 6-60 months are administered biweekly IFA supplementation by accredited social health activist (ASHA) workers. Similarly, children in the age group of 5-10 yr are administered weekly IFA supplementation in schools by teachers and out-of-school children by *Anganwadi* workers (AWWs) and ASHAs[25]. This mode and schedule of IFA service delivery by ASHAs and AWWs has not been operationally pilot tested. The possibility and success of continuous supplementation of each child in the age range of 6-60 months (biweekly) and 5-10 yr (weekly) throughout the year and to be continued till the age of 10 yr in a real-life situation, is not known. This is leading to fatigue amongst the peripheral health and Integrated Child Development Services (ICDS) functionaries.

Adverse effects of high dose of oral iron supplementation

A major reason for poor compliance for IFA tablets is adverse effects such as gastric irritation, nausea, epigastric discomfort, and constipation. The adverse effects increase with the administration of higher doses of iron[27]. Other adverse effects of high dose of iron such as the increased risk of damage to the intestinal epithelium due to the formation of free radicals and increased oxidative stress in the intestinal mucosa have also been documented[28-31]. High iron levels are also known to increase hepcidin levels, which in turn decreases the iron absorption[32]. Higher doses of iron supplementation (>60 mg elemental iron) during pregnancy have been linked with gestational diabetes mediated through increased oxidative stress, lipid peroxidation and/or DNA damage[33,34].

Weekly Iron and Folic Acid Supplementation (WIFS) programme

Under the Weekly Iron and Folic Acid Supplementation (WIFS) programme, supervised weekly administration of IFA and biannual helminthic control are undertaken among all school going adolescent girls and boys in 6th to 12th classes enrolled

Table I. Dose and frequency of iron for the prevention of anaemia under National Iron Plus Initiative (NIPI) programme and their comparison with global guidelines

Parameters	NIPI, 2013[25]	Global guidelines (WHO) 2016[21-24]
Infants aged 6-23 months		
Dose of iron	20 mg elemental iron and 100 µg folic acid	10-12.5 mg elemental iron/kg*
Frequency	Biweekly	Daily*
Duration	Throughout the year	3 consecutive months (90 days) in a year*
Children aged 24-59 months		
Dose of iron	20 mg elemental iron and 100 µg folic acid	30 mg elemental iron*
Frequency	Biweekly	Daily*
Duration	Throughout the year	3 consecutive months (90 days) in a year*
Children aged 5-10 yr		
Dose of iron	45 mg elemental iron and 400 µg folic acid	30-60 mg elemental iron*
Frequency	Weekly	Daily*
Duration	Throughout the year	3 consecutive months (90 days) in a year*
Children aged 10-12 yr		
Dose of iron	100 mg elemental iron and 500 µg folic acid	30-60 mg elemental iron*
Frequency	Weekly	Daily*
Duration	Throughout the year	3 consecutive months in a year*
Adolescents aged 12-19 yr		
Dose of iron	100 mg elemental iron and 500 µg folic acid	30-60 mg elemental iron*
Frequency	Weekly	Daily*
Duration	Throughout the year	3 consecutive months (90 days) in a year*
Pregnant women		
Dose of iron	100 mg elemental iron and 500 µg folic acid	30-60 mg of elemental iron and 400 µg of folic acid* Dose of 60 mg should be given when the prevalence of anaemia is ≥40%*
Frequency	Daily	Daily*
Duration	To be started after the first trimester, at 14-16 wk of gestation for 100 days	Throughout the pregnancy*
Lactating women		
Dose of iron	100 mg elemental iron and 500 µg folic acid	30-60 mg of elemental iron and 400 µg of folic acid*
Frequency	Daily	Daily*
Duration	100 days postpartum	6-12 wk postpartum*
Women of reproduction age group		
Dose of iron	100 mg elemental iron and 500 µg folic acid	30-60 mg of elemental iron and 400 µg of folic acid*
Frequency	Weekly	Daily*
Duration	Throughout the year	3 consecutive months (90 days)*

*Indicates variation in NIPI and global guidelines of iron supplementation.
Source: Refs 21-25; reproduced with permission

in government/government-aided/municipal schools and out-of-school adolescent girls. Administration of supervised WIFS of 100 mg elemental iron and 500 µg folic acid using a fixed-day approach is being undertaken. The programme has been initiated in all States/Union Territories. The programme covers over 11.2 crore beneficiaries including 8.4 crore in-school and 2.8 crores out-of-school beneficiaries[35]. Presently,

Table II. Dose and frequency of iron for the treatment of anaemia amongst children and adolescents under National Iron Plus Initiative (NIPI) programme

Children aged 6-59 months	
Hb level (g/dl)	NIPI, 2013[25]
Mild anaemia (10-10.9)	3 mg of iron/kg/day for two months
Moderate anaemia (7-9.9)	3 mg of iron/kg/day for two months
Severe anaemia (<7)	Refer urgently to DH/FRU
Children aged 5-10 yr	
Hb level (g/dl)	NIPI, 2013[25]
Mild anaemia (11-11.4)	3 mg of iron/kg/day for two months
Moderate anaemia (8-10.9)	3 mg of iron/kg/day for two months
Severe anaemia (<8)	Refer urgently to DH/FRU
Adolescents aged 10-19 yr	
Hb level (g/dl)	NIPI, 2013[25]
Mild anaemia (11-11.9)	60 mg of elemental iron daily for three months
Moderate anaemia (8-10.9)	60 mg of elemental iron daily for three months
Severe anaemia (<8)	Refer urgently to DH/FRU

Source: Ref 25, reproduced with permission DH/FRU, district hospital/first referral unit; Hb, haemoglobin

Table III. Dose and frequency of iron for the treatment of anaemia for pregnant women under National Iron Plus Initiative (NIPI) programme and their comparison with global guidelines

Hb level (g/dl)	NIPI, 2013* (same for lactating women)[25]	Global guidelines (WHO) 2016*[24]
9-11*	Dose of iron: 200 IFA tablets (1 in the morning and 1 in the evening) Frequency: Daily Duration: At least 100 days	If pregnant woman found to be anaemic* Dose of iron: 120 mg elemental iron and 400 µg folic acid Frequency: Daily Duration: Until Hb level rises to normal (Hb 11 g/dl or higher)
8-9*	Dose of iron: 200 IFA tablets (1 in the morning and 1 in the evening) Frequency: Daily Duration: At least 100 days	
7-8*	If pregnant woman found to be anaemic* Injectable IM iron preparations (parenteral iron) should be given if iron deficiency is found to be the cause of anaemia	
	IM - Test dose of 0.5 ml given deep IM and woman observed for one hour. Iron dextran or iron sorbitol citrate complex given as 100 mg (2 ml) deep IM in gluteal region daily. Recommended dose is 1500-2000 mg (IM in divided doses) depending on the body weight and Hb level	
5-7*	Continue parenteral iron therapy as for Hb level between 7 and 8 g/dl	
<5*	Immediate hospitalization irrespective of the period of gestation in hospitals	

*Indicates variation in NIPI and global guidelines of iron supplementation. IM, intramuscular; Hb, haemoglobin; IFA, iron and folic acid. *Source*: Refs 24, 25; reproduced with permission

IFA is given under supervised administration through school approach. However, IFA can be administered under supervision to children, only for about 26-28 wk (out of 52 wk in a year) due to: (*i*) summer (5 wk), and winter vacations (2 wk), (*ii*) half-yearly (5 wk) and annual examinations, (5 wk) and (*iii*) government holidays (2 wk). Hence, the WIFS programme may only administer about half of the recommended total doses of IFA. The same can be true for children aged 5-10 yr studying in schools.

Enteric-coated (EC) tablets under WIFS

Under the WIFS programme, enteric-coated (EC) tablets of IFA are administered to adolescents having poor bioavailability of iron. The absorption of iron is best in the upper part of the duodenum, where the

presence of acid from the stomach helps the absorption. Iron from EC tablets is released in the lower parts of the intestine, where absorption is low. A recent clinical trial, using state-of-the-art stable isotopic methods, was conducted to assess the relative absorption of iron from EC versus non-EC tablets, in iron-deficient Indian women. It was found that the absorption of iron from EC tablets was substantially lower than that from non-EC tablets (4.3 vs. 12.1%)[36]. Another comparative study found that iron absorption from the sugar-coated tablet of ferrous sulphate was significantly higher than EC IFA tablets as it did not bypass the acidic environment of the stomach[37]. Regulatory bodies such as the United Kingdom National Health Services have recommended that the modified-release iron formulations (EC) should not be used for the treatment of anaemia[38].

Evaluation of National Nutritional Anaemia Prophylaxis Programme (NNAPP)

The Indian Council of Medical Research (ICMR) conducted an evaluation of the NNAPP in 11 States[17]. About 7346 pregnant and 34,914 lactating mothers, 88,119 under-five children and 13,955 women acceptors of family planning method were included. It was found that (*i*) Only 19 per cent of the pregnant women and about one per cent of child beneficiaries received IFA tablets. The poor coverage was due to the inadequate and irregular supplies and lack of orientation and training of health functionaries about the objectives and services of the programme, (*ii*) The chemical analysis of the IFA tablets revealed that about 30 per cent had low iron content and almost all lacked folic acid, (*iii*) The impact of IFA tablets on Hb was low, (*iv*) The funds sanctioned at the MoHFW were inadequate to cover all groups of beneficiaries, (*v*) The midcourse corrections to improve the programme were not undertaken as there was no monitoring and supervision, (*vi*) There was lack of community participation as members were not aware of services of the programme, (*vii*) The nutrition education to improve the dietary intake of iron-rich foods was poor, (*viii*) One hundred IFA tablets were to be given to women in three instalments of 30 each. However, only the first instalment was received by the majority of the pregnant woman, and (*ix*) Majority of health functionaries including medical officers were not aware of the beneficiaries of the programme[17].

Modifications required in the NIPI programme

The Government of India (GOI) accords high priority and included reduction in anaemia among young children, women and adolescent girls (by 3% per annum) in the National Nutrition Mission which is being implemented during 2017-2018 to 2021-2022[39,40].

Challenges in the implementation of anaemia control programme

At present, there are many constraints in the effective implementation of programme for anaemia control: (*i*) The States do not accord priority as anaemia is a hidden and silent disease unlike measles, diarrhoea, *etc*., which have explicit sign and symptoms, (*ii*) There is little or no counselling to the beneficiaries or the caretaker about the benefits and possible minor side effects after consumption of IFA leading to poor compliance, (*iii*) State governments are still in the process of organizing the procurement and distribution of IFA supplements utilizing their own system (earlier, all the IFA supplements were received as GOI supplies), (*iv*) Forecasting of IFA tablet requirement according to the number of beneficiaries in each village is a major challenge faced by the medical officers, (*v*) The transportation of IFA supplements from district warehouses/stores to the block-level community health centres, subcentres and schools remains a major challenge, especially in remote rural and tribal areas, (*vi*) The weekly IFA supplementation to children aged 6-19 yr is a relatively newer component of the programme. The village-level health and ICDS functionaries and school teachers are yet to have orientation and training about the beneficiaries, mechanics, and process of distribution. The voluntary workers of ASHA have been given the major responsibility in the programme. They have to implement the activities of the NIPI programme with the existing burden of work and other competing priorities. The existing burden of responsibilities and priorities of ASHAs keeps on increasing with newer responsibilities of NIPI programme allotted by the MoHFW and other ministries on an incentive basis, (*vii*) For school teachers, the WIFS programme is an additional responsibility and their motivation level to take the additional responsibility is poor due to lack of adequate counselling. They are reluctant to participate in the procurement, distribution of IFA and monitoring of the programme, (*viii*) There is poor intersectoral coordination and convergence between various ministries such as Ministries of Health and Family Welfare, Women and Child Human Resource, Tribal Affairs, Rural Development and Urban Development[25], (*ix*) In the WIFS programme adoption of 'test and treat' strategy, screening for moderate/severe anaemia and referring these cases to an appropriate health facility is

yet to get operationalized, and (*x*) Inadequate efforts are directed towards effective information and counselling and behaviour change communication for improving dietary intake and for taking actions for the prevention of intestinal worm infestation[35].

Need for strengthening of NIPI programme

The need for strengthening of NIPI programme is also required in the following aspects: (*i*) The NIPI guidelines on iron supplementation need to be revised for dose, frequency and duration, based on global scientific evidence, (*ii*) The iron doses administered to the pregnant mothers for the prevention and treatment of anaemia are high. There is a need to lower the iron doses in view of adverse effects, (*iii*) The beneficiaries do not collect or consume supplements regularly simply because the majority of them are not given proper nutrition counselling. There is a need to improve the compliance in the consumption of IFA tablets by giving high priority to interpersonal counselling to beneficiaries, (*iv*) The budget provision for the scheme should be increased. The State-level programme officers should be trained to calculate the requirement of IFA for each group of beneficiaries and cost of supportive activities of NIPI so that they can make provision in the PIP submitted to MoHFW for sanctioning of the budget accordingly, (*v*) In regions with high prevalence of anaemia, regular mass deworming of under-five children should be undertaken for the prevention of anaemia, (*vi*) Malaria, being an important cause of anaemia, requires an efficient implementation of National Vector Borne Control Programme in malaria-hyperendemic regions, (*vii*) Interventions for other causes of anaemia such as haemoglobinopathies (sickle cell anaemia and thalassaemia) and chronic inflammation and interventions to prevent the deficiencies of zinc, copper, vitamin B_{12} and vitamin A need to be included and implemented on priority under the NIPI, (*viii*) IFA administration to children aged 5-10 yr should be initiated in the majority of States, (*ix*) More than 50 per cent of pregnant mother suffer from anaemia[1]; however, under NIPI, almost all are provided prophylactic dose of IFA tablets for 100 days. This will possibly improve their Hb level but not make them non-anaemic. In actual practice, all beneficiaries are given the same number of tablets irrespective of the degree of anaemia, (*x*) The test-and-treat strategy of the programme requires estimation of Hb. However, the functionaries are not provided with facilities to carry out the Hb estimation, (*xi*) The supervision and monitoring of programme are given a low priority at all the levels: central, state, district, block and PHC levels, (*xii*) The performance reporting of the programme requires improvement. The States submit reports about the number of individuals who initiated the prophylaxis course rather than who have completed the consumption of 100 tablets. This type of format of reporting does not reflect the correct status of performance achievements, (*xiii*) The status of compliance and supervision issues of weekly IFA administration with IFA tablets in schools has not been documented in detail to improve the programme. There is a need to document this process, and (*xiv*) All beneficiaries or their caregivers need to be counselled on appropriate infant and young child feeding with emphasis on timely initiation of complementary foods.

There is an urgent need to consider the following: (*i*) EC tablets may be discontinued, (*ii*) Frequency of IFA supplementation amongst adolescents may be revised from weekly to daily supplementation, (*iii*) Doses of iron may be reduced to prevent possible adverse effects and improved compliance, (*iv*) Higher allocation of resources (workforce, money and material) for the implementation of NIPI, (*v*) Development of strong monitoring and supervision system, (*vi*) Orientation for the health functionaries about the programme services and activities, (*vii*) Community mobilisation in awareness generation and IFA supplementation, and (*viii*) Collection of data for true estimates of anaemia in the country.

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