

6-10 yrs. The nutritional status was positively correlated with the cognition of figural classes. Among these children it was found that parental education did not show any significant correlation with both measures of child's outcome, implying that for the school age child, external stimuli (outside the home) could play a more important role in relation to mental development, than in the case of the pre-school age. Even so, it was found that children of educated parents had better mean cognitive and home scores than the children of uneducated parents. Also, children of educated mothers had better mean cognitive and home scores than those of uneducated mothers.

These observations show that in early childhood i.e. between the ages of 3 and 6 years, children's mental development is influenced by both the home environment and the child's nutritional status, the latter essentially influencing the former. The findings revealed that parental education (especially maternal education), even upto primary school, contributed to improving the quality of home environment and children's cognitive functioning during the pre-school age, thus underlining the importance of maternal education from the point of both nutritional status, environment and cognitive development in the early years.

MICRONUTRIENT NUTRITIONAL STATUS

Anaemia in pregnancy and lactation

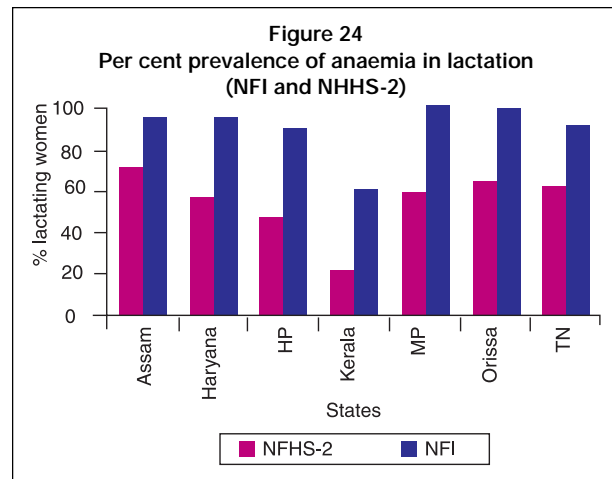
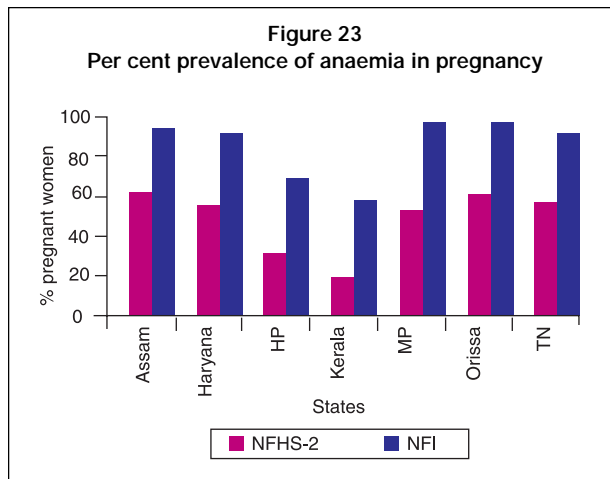
Nutritional anaemia due to iron and folate deficiency is a major global Public Health problem. Low dietary intake and poor iron and folic acid intake are major factors responsible for high prevalence of anaemia in India. Poor bioavailability of iron in phytate fibre rich Indian diet aggravates the situa-



Haemoglobin estimation being done.

tion. Hospital and community based studies conducted by ICMR and other research agencies have shown that prevalence of anaemia is highest in pregnant women – estimated prevalence range between 50-90 per cent. Association between anaemia and adverse pregnancy outcome including increase in maternal morbidity and mortality, higher incidence of pre-term and low birth weight deliveries and associated high neonatal morbidity and mortality have been demonstrated when maternal haemoglobin level falls below 8g/dl.

The National Health Survey (NFHS-2) was the first national survey to undertake measurement of haemoglobin levels of all ever-married women in the age group 15-49 years and their children under three years of age in a representative sample of the population using the same technique for haemoglobin estimation. Data from NFHS-2 showed that prevalence of anaemia among



pregnant women was 49.7 per cent. The reported prevalence was substantially lower than earlier reports from smaller community surveys. There was an uncertainty, whether this lower prevalence was due to the improvement in haemoglobin levels following improved antenatal coverage or difference in the method used for estimation of haemoglobin. Data from NFHS-2 indicated that there was substantial interstate difference in prevalence of anaemia. Prevalence of anaemia was substantially lower in Kerala as compared to adjoining Tamil Nadu; Himachal Pradesh had markedly lower prevalence of anaemia as compared to neighbouring Haryana.

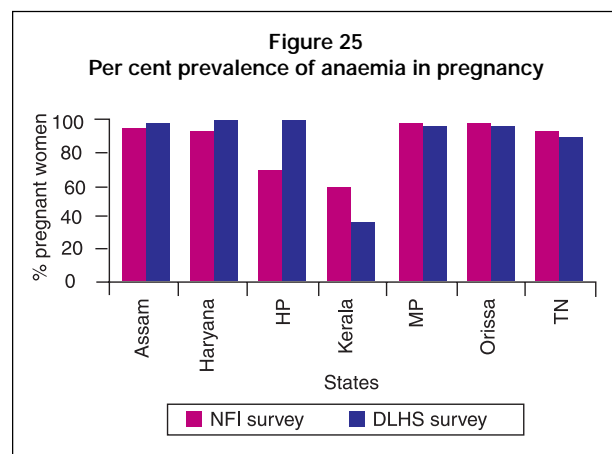
The Department of Family Welfare funded NFI to carry out a research study in seven states

- to estimate haemoglobin (Hb) levels, using classical cyanmethaemoglobin method, in reproductive age women, and compare them with Hb values reported in the NFHS-2 survey
- to obtain data on dietary intakes and food consumption patterns in the selected households and individuals
- to assess access to and utilization of health services including receipt and consumption of iron-folic acid tablets

- to identify the possible factors underlying the interstate differences with reference to the prevalence of anaemia.

The study was taken up by NFI as a Task Force study in seven states – Assam, Haryana, Himachal Pradesh, Kerala, Madhya Pradesh, Orissa and Tamil Nadu. Pregnant and lactating woman from the villages in which NFHS has earlier conducted the survey were enrolled for the study. Detailed information on socio-economic status, reproductive performance and dietary intake was collected in all women. Physical examination findings including anthropometric indices were recorded. Haemoglobin estimation was done by cyanmethaemoglobin method in all women.

The data from the study showed that the prevalence of anaemia is higher both in

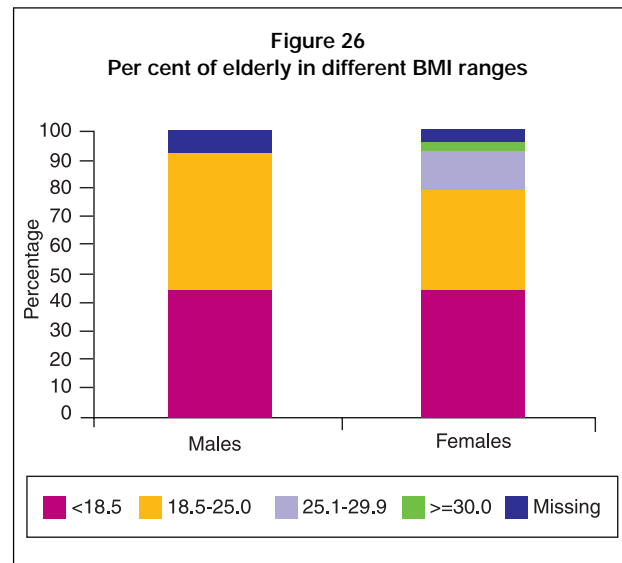


pregnant and lactating women as compared to the reported levels in NFHS-2 survey in every state (Figures 23 and 24). In spite of the significantly higher haemoglobin level and lower prevalence of anaemia reported in the NFHS-2 survey, the pattern of inter-state differences in prevalence of anaemia was similar in NFI and NFHS surveys; prevalence of anaemia was lowest in Kerala while Madhya Pradesh had the highest prevalence of anaemia.

Comparative data on prevalence of anaemia among pregnant women in seven states from NFI and DLHS (2002) Survey Phase I in which cyanmethaemoglobin method was used for the estimation of haemoglobin are shown in Figure 25. Both DLHS and NFI survey reported higher prevalence of anaemia than NFHS-2. NFI, DLHS, NNMB, ICMR micronutrient surveys have clearly shown that the filter paper collection of samples and Hb estimation by cyanmethaemoglobin method represents the most economical and accurate method of estimation of Hb in community based surveys.



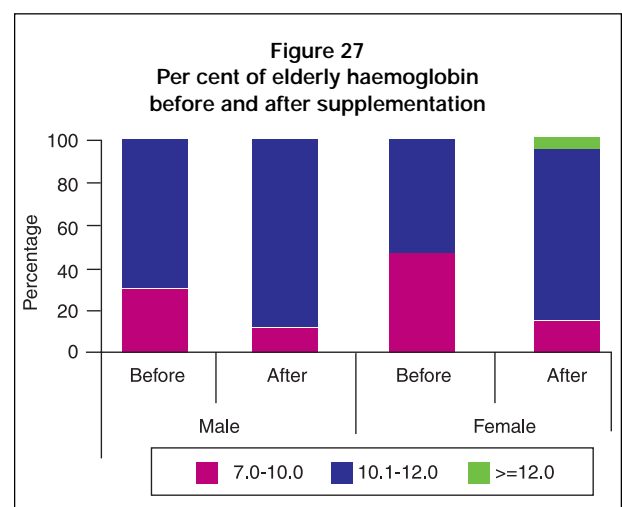
Examining a woman for anaemia



Higher dietary intake of iron and folic acid, better family formation patterns (higher age at marriage, lower parity, higher inter birth intervals) and better utilisation of antenatal care (higher coverage, better quality of care and higher level of consumption of IFA tablets during pregnancy) were some of the major factors responsible for the lower prevalence of anaemia in Kerala and Himachal Pradesh.

Anaemia in the elderly

Elderly men and women living in slums face several adverse factors and are vulnerable from health and nutritional point of view. NFI undertook an in-depth study to:



- collect data related to socio-economic status and living conditions of the families of the aged
- investigate their health and nutrition status
- examine dietary intakes to identify shortcomings and deficiencies
- identify practical inexpensive ways of improving the quality of the diet and health and productivity of the aged.

The study was carried out in two slum units of the Nutrition Foundation of India in Kirby Place and Brar Square. A total of 100 men and 100 women in the age group of 60 years and above were investigated.

Dietary intake of elderly men and women was low with respect to energy, protein and all macro and micro nutrients. Mean dietary intake of iron was about 10 mg per day and vitamin C intake was about 50 mg/day.

Nearly 40 per cent of elderly men and women were undernourished (Figure 26). Prevalence of over weight and obesity was low. All of the elderly men and women were anaemic; however prevalence of severe anaemia was less than 10 per cent both in men and women.

Oral iron and folic acid supplementation for eight weeks resulted in an increase in haemoglobin levels in most patients suggesting that anaemia was mainly due to low dietary intake (Figure 27). It is therefore imperative that there should be dietary diversification so that iron and folate intake doubles.

Control of Anaemia in adolescent girls of poor communities

In India, anaemia in adolescent girls is very common and antedates anaemia in pregnancy. In view of the fact that teenage pregnancies are common, iron supplementation

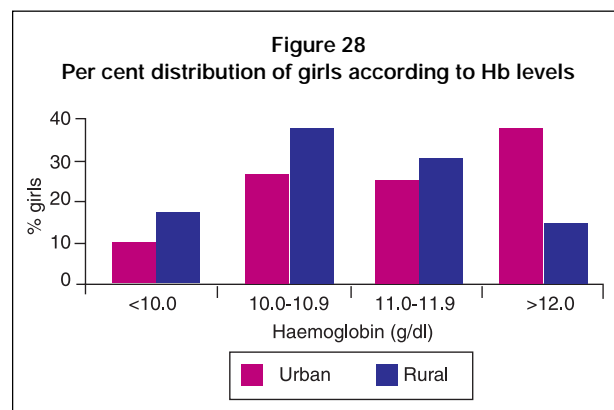
in adolescent girls may be a useful intervention to reduce anaemia in pregnancy. The bioavailability of iron is low in predominantly cereal based diets because of their high phytate content. It has been suggested that the bioavailability of iron may be significantly improved by ascorbic acid supplementation. Studies had shown that with continued daily administration, iron absorption could decrease due to "tiredness" of the intestinal mucosa.

NFI conducted a study to

- obtain baseline data on haemoglobin (Hb) levels of adolescent girls belonging to low socio-economic groups
- investigate the comparative efficacy of once 'weekly' and 'daily' administration of IFA tablets in improving the Hb levels and
- find out the effect of added ascorbic acid supplementation.

Adolescent girls of poor communities in urban areas of Delhi (Delhi Government school) and rural parts of Bharatpur (Rajasthan) formed the study subjects. Urban girls were school going and rural girls were predominantly out of school. They were divided into the following three treatment groups:

Group 1: One tablet of ISA (100 mg elemental iron + 500 µg folic acid) once



Initial Hb and change in Hb in Study Groups				
S.No	Study Groups	Initial Haemoglobin (g/dl)	Change in Haemoglobin(g/dl)	
			0-3 months	0-6 months
Urban				
(a)	Folic acid (weekly)	10.8 ^a ±0.70(55)	0.62 ^a ±0.65 (55)	0.79 ^a ±0.80 (54)
(b)	Folic acid/Vitamin C (weekly)	10.5 ^b ±0.95(57)	1.05 ^b ±0.91 (57)	1.17 ^b ±1.06 (55)
(c)	Control	10.8 ^a ±0.78 (55)	-0.06 ^c ±0.88 (55)	0.63 ^a ±0.85 (55)
	'F' ratio (df)	3.56 (2,164)	25.53 (2, 164)	4.98 (2, 161)
	Level of significance	0.0306	0.0001	0.0080
Rural				
(a)	Folic acid (weekly)	10.8 ^a ±0.63 (28)	0.71 ^a ±0.81 (28)	0.98 ^a ±0.52 (22)
(b)	Folic acid/Vitamin C (weekly)	10.7 ^a ±0.70 (38)	0.76 ^a ±0.90 (38)	1.30 ^{ab} ±0.81 (32)
(c)	Folic acid (daily)	10.4 ^a ±0.82 (37)	0.99 ^c ±0.92 (37)	1.57 ^b ±0.78 (28)
	F' ratio (df)	2.88 (2,100)	0.99 (2, 100)	4.10 (2, 79)
	Level of significance	0.0600	0.3800	0.0200

Difference in superscripts between the group indicates that the difference is statistically significant ($p < 0.05$); values represent mean \pm SD (sample size)

weekly;

Group 2: One tablet of ISA and Vitamin C (100 mg elemental iron + 500 µg folic acid + 25 mg vitamin C) once weekly;

Group 3: One tablet of ISA (100 mg elemental iron + 500 µg of folic acid) daily.

The subjects in both the urban and rural areas were randomly allocated to three groups. In the school the tablets were distributed to the subjects by a research worker immediately after lunch time. In the rural area, two field workers were responsible for the distribution and ensuring intake of tablets by the subjects after the mid-morning meal.

The urban adolescent girls were taller, heavier and had higher haemoglobin levels than the rural girls (Figure 28). Part of the difference could be attributed to income differences and better access to health care.

Data from the study showed that:

- the IFA supplementation given weekly

brought about significant improvement in the mean haemoglobin level of urban subjects, both at 3 months and at 6 months, as compared to the control group

- the response obtained with IFA given daily was superior to that obtained with IFA supplemented weekly and
- with the inclusion of vitamin C once-weekly supplementation, improvement in Hb levels was comparable to daily administration of IFA.

Thus, from the point of view of feasibility, cost and compliance, once-weekly IFA vitamin C administration to the adolescent girls through school system may be suitable as a public-health measure for the control of anaemia in adolescent girls.

Studies on Green Leafy Vegetables (GLVs)

Vitamin A deficiency in India ranks among the four major public health nutritional

problems affecting not only children but also women of the reproductive age group and others. However, over the last two decades there has been marked decline in keratomalacia and nutritional blindness. The problem to contend with now is the less severe but more widespread moderate deficiency such as night-blindness and/or Bitot's spots and low serum levels of vitamin A, with their attendant functional impairment. In the long run, improvement in dietary intakes of β -carotene is the most promising approach to combat milder form of vitamin A deficiency. Against this backdrop, the NFI conducted two multicentric studies.

NFI carried out the study on green leafy vegetable in Guwahati, Baroda, New Delhi and Coimbatore.

Objectives of the study were:

- to obtain as complete a listing as possible of all key carotene-rich foods available in the markets, homegrown and plucked from nearby areas in the four regions of India in different seasons.
- to prepare a seasonal calendar of carotene-rich foods, and provide estimates of the quantity and cost of these foods to meet the RDA of vitamin A for the pre-school children, pregnant women and nursing mothers in India.
- to study the consumption pattern of carotene-rich foods, especially GLVs in urban and/or rural and tribal households in the four regions
- to study the social, cultural and economic influences on dietary behaviour related to the consumption of carotene-rich foods in the four regions
- based on the above, to identify the constraints to adequate consumption of carotene-rich foods and suggest strategies for overcoming them

- to estimate β -carotene content of the different GLVs and the losses that occur in common household processing methods by HPLC
- to standardise recipes that will contain adequate quantities of β -carotene per commonly eaten portion sizes, using cooking methods that retain β -carotene
- to carry out a field trial (educational/social marketing) to increase the consumption of carotene-rich foods.

The Centres identified 52 carotene-containing foods. In all regions, 60 per cent or more of these were green leafy vegetables (GLVs). Household consumption patterns revealed that preformed vitamin A intake from animal foods was low. The consumption of β -carotene containing foods contributed to 60 per cent or more of the total vitamin A intake at the household level. The frequency of consumption of β -carotene-rich foods varied widely depending on seasons, which in turn was related to availability, cost and quality of the vegetables and fruits. The intake of β -carotene-rich GLVs was very infrequent in summer season all over the country and in the monsoon season in the Northern and Western regions. Mangoes formed a part of the diet during summer, although consumption was infrequent due to its high cost. Retention of β -carotene was higher in sautéing and shallow frying, followed by pressure cooking and steaming. Cooking in vessels uncovered or covered with the lid resulted in considerable losses.

A seasonal calendar of common and uncommon β -carotene-rich foods has been prepared. The calendar lists all available β -carotene rich foods separately for each season – winter, summer and monsoon along with the quantity necessary for a pre-school child, pregnant women and lactating women to meet their β -carotene requirements. The