

## **Prevention of Micronutrient Deficiencies in Young Children: Consensus Statement from Infant and Young Child Feeding Chapter of Indian Academy of Pediatrics**

**KETAN BHARADVA<sup>1</sup>, SUDHIR MISHRA<sup>2</sup>, SATISH TIWARI<sup>3</sup>, BALRAJ YADAV<sup>4</sup>, URMILA DESHMUKH<sup>5</sup>, KE ELIZABETH<sup>6</sup> AND CR BANAPURMATH<sup>7</sup>**

*From Departments of Pediatrics; <sup>1</sup>Masoom Children's Hospital, Surat, <sup>2</sup>Tata Main Hospital, Jamshedpur; <sup>3</sup>Dr PDM Medical College Amravati; <sup>4</sup>Smt Santra Devi Health and Educational Trust Gurgram, <sup>5</sup>Biotrak Research Foundation Akola, <sup>6</sup>Sree Mookambika Institute of Medical Sciences, Kulasekharam, Kanyakumari, Tamilnadu, and <sup>7</sup>JJM Medical College, Davangere, Karnataka; India.*

*Correspondence to: Dr Satish Tiwari, Professor and Head, Department of Pediatrics, Dr PDM Medical College, Amravati Yashodanagar No. 2, Maharashtra 444 606, India. drsatishtiwari@gmail.com*

**Justification:** Micronutrient deficiencies have significant impact on the overall health and well-being of society and potential targets for supplementations. It is important to formulate a consensus statement in view of current evidence, and put in place strategies to meet targets. **Objectives:** To formulate by endorsement or adoption and disseminate a consensus statement for prevention of micronutrient deficiencies in young children for office practices from an Indian perspective. **Process:** A National Consultative Meeting was convened by Infant and Young Child Feeding Chapter (IYCF) of Indian Academy of Pediatrics (IAP) on 17 December, 2016 at Mumbai. IYCF chapter, IAP, United Nations Children Fund, National Institute of Nutrition and Government of India were the participating agencies; and participants representing different parts of India were included. **Conclusions:** Micronutrient deficiencies are widespread. For its prevention proper maternal and infant-young child feeding strategies need to be practiced. Encourage delayed cord clamping, dietary diversification, germinated foods, soaking and fermentation processes. Existing Iron, Vitamin A, Zinc supplementation and universal salt iodization programs need to be scaled up, especially in high risk groups. Universal vitamin D supplementation need to be in place; though, the dose needs more research. Vitamin B<sub>12</sub> deficiency screening and supplementation should be practiced only in high-risk groups. Availability of appropriately fortified foods needs to be addressed urgently.

**Keywords:** *Dietary diversification, Food fortification, Trace elements, Sustainable developmental goals, Multiple micronutrient powder.*

---

**M**icronutrients (vitamins and trace elements) are needed in amounts <100 mg/day and are crucial in development, production and functioning of enzymes (Zinc, Copper, Manganese, Selenium, Magnesium, Molybdenum); hormones (Iodine, Chromium) and growth regulator proteins; reproductive and immune system; bone and membrane structure (Calcium, Phosphorus, Magnesium, Vitamin D); oxygen binding (Iron), etc.

Micronutrient deficiencies ('hidden hunger') are highly prevalent and affect far beyond the known effects like anemia, goiter, asymptomatic to devastating, often hard to recognize, mimic many diseases, have fewer signs but gamut of symptoms, and can involve multiple system. Only few have practicable laboratory diagnosis. Hence they need high index of suspicion and a detailed dietary history for diagnosis. It has potential to affect economic and overall development, as affected populations are unable to achieve full mental and physical potentials, have low work capacity, and are prone to infections [1].

Global health risk estimates in low income countries reveal 7% deaths and 10% total disease burden in children attributable to underweight, micronutrient deficiencies (especially iron, vitamin A and zinc) and suboptimal breastfeeding triage, almost equivalent to entire disease and injury burden of high-income countries [2]! National Nutrition Monitoring Bureau (NNMB) report reveals high micronutrient deficiency in rural population of major States. National nutrition program in the past have failed to achieve the five year plan goals of Government of India (GOI) [3]. Currently, apart from programmatic approach by GOI, with Iron-folic acid, Universal salt iodization (USI), Zinc in diarrhea management, and vitamin A supplementation; Food Safety and Standards Authority of India (FSSAI) standards of fortification of foods with iron, zinc, iodine, vitamin A and D, vitamin B<sub>12</sub> and other B-vitamins ensure micronutrient supply [4,5].

**Objectives:** Increasing awareness and information mandates need of consensus statement on micronutrient

supplementation in making informed decisions on the appropriate nutrition actions; to achieve the Sustainable Development Goals (SDGs) and the global targets set in the Comprehensive Implementation Plan on Maternal, Infant and Young Child Nutrition and the Global Strategy for Women's, Children's, and Adolescents' Health.

### PROCESS

A National Consultative Meeting was convened by Infant and Young Child Feeding Chapter (IYCF) of Indian Academy of Pediatrics (IAP) on 17 December, 2016 at Mumbai. IYCF chapter, IAP, United Nations Children Fund, National Institute of Nutrition and Government of India were the participating agencies; and participants representing different parts of India were included.

*Methods of search:* Cochrane database, e-Library of Evidence for Nutrition Actions (eLENA), MEDLINE through Pubmed, and Google Scholar were searched with preference to recent systematic reviews, using combination of key words "iron (and other micronutrients) status, India, complementary feeding, children, deficiency and supplementation" and further expanded through "related articles" and reference lists of the articles.

### RECOMMENDATIONS

#### *Iron Deficiency*

*Clinical presentations:* Apart from anemia, iron deficient young children are vulnerable to socio-emotional behavior issues; irreversible effects on psychomotor skills and cognition and later attention deficits. Presentation with pagophagia, dysphagia, decreased effort tolerance, pica, cold intolerance, altered immunity or cerebral vein thrombosis is known.

*Deficiency status and Risk factors:* Irrespective of age, geography and socioeconomic status, iron deficiency is still high, underestimated, under-treated and the commonest cause of disability in children [2].

Dietary factors which may result in decreased iron absorption and ultimately iron-deficiency include high phytates (cereals-legumes, roots-tubers, maize, beans, whole wheat flour and sorghum), low ascorbic acid (fruits-vegetables); high animal milk intake; regular tea-coffee with major meals; low consumption of iron supplementation; and low consumption of animal origin foods (meat, fish and poultry) [6]. Cow's whole milk is a risk factor due to low iron content, poor bioavailability due to high casein and calcium; and increased loss of blood in intestines [7]. However, authors do not suggest exclusion of these from the diet for improving iron status. Parental dietary history per se does not qualify as first stage screening tool for iron deficiency state [8].

Additional risk factors are poor maternal stores; prematurity or low birth weight; exclusive breastfeeding beyond 6 month without iron rich/fortified foods or supplements; worm infestations (hookworm, ascaris and schistosomiasis); low socioeconomic status; migrant worker parents; bottle feeding; and a mother who is currently pregnant [9,10]. Greater than 95th percentile weight and height, and obesity are emerging risk factors for iron-deficiency [11].

### Screening

Iron-deficiency and iron deficiency anemia (IDA) are incorrectly used synonyms. In healthy appearing infants, anemia is neither a sensitive nor a specific screen for iron-deficiency [12], except for severe cases. In view of high prevalence of iron deficiency, we should have a high index of suspicion even in presence of normal hemoglobin level. Hemoglobin levels as surrogate marker of IDA underestimates iron-deficiency in up to 12-27% [13]. Red cell distribution width should be seen as it is the earliest marker of iron deficiency. It is recommended to treat children with subclinical iron deficiency even in absence of anemia. Serum ferritin <12 ng/mL is sensitive, with high false negative rates being common as it is a acute phase reactant. Transferrin receptor1 and Total iron binding capacity (TIBC) are good to establish iron-deficiency, especially in cases without anemia [14]. Usually a combination of tests is used to diagnose iron deficiency for certain. A cost-effective strategy is a therapeutic trial [15].

For asymptomatic and not at risk children aged 6 to 24 months undergoing primary preventive actions, the current evidence is insufficient to recommend routine screening for IDA [16]. Hemoglobin is the only practical screening test in field settings. All 6 to 36 month children without primary preventive actions should be screened at 9 to 12 months, 6 months later and at 2 year age [17]. At prevalence of anemia <5%, screening is not fruitful as majority of cases are unrelated to iron-deficiency. Screening for programatic purposes should be considered where anemia prevalence is between 5-20% and whole of India comes under this category [18].

### Recommended Interventions

*Diet:* Beyond the age of 6 months, more than 90% of the iron requirements of a breast-fed infant must be met by complementary food rich in bio-available iron [6]. Dietary diversification must be encouraged. Vegans should be monitored closely and treated early. It is advisable to avoid consumption of beverages like tea and coffee with food as tannin contained in these may interfere with iron absorption. Foods containing ascorbic acid may enhance iron absorption.

Infants with IDA should be screened for cow's milk protein allergy. Data from Western countries suggest that early introduction of cow's milk is associated with increased gastrointestinal blood loss [7]. In the absence of Indian data, we do not recommend avoiding whole cow's milk after 6 months age.

*Cooking in cast iron vessels:* Cooking of soups containing vegetables of low pH by simmering (heating for a long below boiling point) in cast iron vessels helps in increasing iron intake. This practice should be encouraged. Frying in iron vessels does not usually have similar effect [19].

*Food fortification:* It is difficult to meet full iron requirements in young children through diet without fortifying complementary feeds or iron supplements. As a public health measure, food fortification can play a major role in decreasing the prevalence of iron deficiency. Except for wheat flour or rice in some state government distribution systems, iron fortified foods are uncommon in India. Multiple Micronutrient Powder (MMNP) fortification should be considered in high-risk settings where above interventions are difficult to implement [20]. Fortification and supplementation together might breach the tolerable upper limit (TUL) for iron intake [21]; though, the clinical significance of this is not clear.

#### *Iron supplementation*

*a) In infants >6 month age (Public health measure guidelines):* Iron supplementation should be given to children aged 6-60 months in the dose of 10-30 mg /day, three months a year wherever prevalence of anemia is >20% [Strong recommendation, moderate quality evidence]. This comes to about 1-2 mg/kg/day [22] as most of India has >40% prevalence of anemia.

National Health Mission (NHM) guidelines [23] recommend bi-weekly 100 doses/year of 20 mg Fe + 100 mcg FA supplementation in 6-60 months age as syrup. Iron should be withheld in acute illness (fever, acute diarrhea, pneumonia, etc.), severe acute malnutrition (SAM) and hemoglobinopathy or history of repeated blood transfusion. In malaria endemic areas, public health measures to manage malaria must be in place [Strong recommendation]. Folic acid should not be used in malaria endemic areas where antifolate malaria medications are used [24].

*b) In infants <6 month age (Individual case based supplementation):* Low birth weight [LBW] babies should be supplemented with iron 2-3 mg/kg/day, beginning from 2 weeks for babies with birthweight <1500 g, and 6-8 weeks for babies with birthweight >1500

g [25], till toddlerhood when diet meets the iron requirements. Babies who received multiple transfusions during neonatal care should be clinically and biochemically assessed for need of supplementation at 6-8 weeks [14].

Since large number of term babies (21.4% at 4 months and 36.4% at 5 months) [26] suffer from iron deficiency, it is recommended that iron supplementation be started at 4 months in exclusively breastfed babies, especially where there is high risk of low iron transfer from mothers suffering from malnutrition, anemia, hypertension (with growth retardation) and diabetes.

#### *Ancillary measures*

- Promote delayed cord clamping as it helps to improve iron store in newborns [27].
- Since the prevalence of worm infestation in various parts of our country high, we recommend twice a year universal deworming in the dose of 400 mg for children above two years and 200 mg for children 1-2 years [23,28].
- *Behavior change:* Hand washing, prompt malaria treatment, diarrhea management and nutrition education also have an important role to play. WASH (Water, sanitation and hygiene) program, implemented well, will go a long way to achieve the required behavioral change.

#### *Zinc Deficiency*

*Clinical presentations:* There are no pathognomonic features for zinc deficiency except in acrodermatitis enteropathica. Zinc deficiency presents as growth failure, hypogonadism, skin lesions, impaired olfactory and gustatory sense, and impaired resistance to infection. It is pronounced in protein-energy malnutrition, Crohn's disease, sickle cell anemia and nephrotic syndrome [29].

*Deficiency status and risk factors:* About 43.8% under-five children in five Indian states have significant zinc deficiency [30]. Zinc is not well conserved in body as there is no conventional tissue reserve. Its status depends on regular dietary zinc intake. Low intake of zinc rich foods (animal or sea products); high intake of inhibitors (phytates) and losses in diarrhea contribute to widespread zinc deficiency.

#### *Screening*

Laboratory markers are inadequate for practical use due to cost and methodological obstacles even in developed countries, so indirect method of estimating zinc status of diets in various geographic areas are used [31].

Prevalence >20% is indication for public health intervention. Low height for age >20% is a surrogate indicator [32].

### Recommended Interventions

**Diet:** In view of high prevalence of zinc deficiency in population, we recommend food rich in zinc (additional milk, eggs, grains, legumes, nuts and seeds).

**Food fortification:** Fortification with zinc only has shown to improve serum zinc status [33]. We recommend it to control/eliminate zinc deficiency despite lack of unequivocal evidence on benefits. It is recommended that zinc fortified foods be available.

**Adjunct in therapy:** Zinc should be prescribed as adjunct therapy for diarrhea as India has high prevalence of zinc deficiency and also malnourished children [34]. The dose recommendation is 10 mg/day for babies below six months and 20 mg/day for babies above six months, using any water soluble zinc salt [35]. In view of vomiting seen with zinc administration we recommend that it can be administered in two divided doses. Zinc should be prescribed as adjunct therapy for conditions like sickle cell disease, preterm babies, protein energy malnutrition, chronic diarrhea, Wilson disease, Thalassemia major.

**Supplementation:** Zinc supplementation does not have significant impact on all-cause mortality but prevents pneumonia and diarrhea significantly [36-38]. Zinc supplementation in deficient pre-pubertal children shows a significant increment in height and weight, but not weight-for-height, when there was low weight for age and height-for-age [39]. Preterm babies are recommended 2 mg/kg/day supplemental zinc till 3 months corrected age [40]. We recommend co-administration of zinc and iron as it is equally effective [39], contrary to popular belief, for ease of administration.

### Iodine Deficiency

**Clinical presentations:** Iodine deficiency disorders (IDD) presents as goiter, cretinism, hypothyroidism, brain damage, abortion, still birth, mental retardation, psychomotor defects, hearing-speech impairment or neuropsychological deficits as subclinical manifestation. It constitutes the largest cause of preventable brain damage worldwide. Children from iodine-deficient areas have lower intelligence quotient by average 10-15 points. Majority of consequences of IDD are invisible and irreversible, but preventable.

**Deficiency status and risk factors:** WHO estimates a worldwide 37% prevalence of iodine deficiency in school-aged children. The IDD control goal was prevalence <10% in India by 2012 but 325 districts

surveyed revealed 263 as endemic [41]. Smoking reduces iodine in breastmilk and needs consideration for supplementation [29].

### Screening

Median urinary iodine >100 µg/L indicates sufficiency. Ultrasound measurements of thyroid volume are better than clinical assessment. Filter paper TSH test is recommended for neonatal screening. However, its role and cost effectiveness in screening for community iodine deficiency is not established. Filter paper Thyroglobulin (Tg) test is a promising method [42].

### Recommended Interventions

**Universal Salt Iodization:** USI is the most cost effective and sustainable method of iodine supplementation for controlling IDD; we support a ban on availability of non-iodized salt. Iodine is a volatile compound hence the iodized salt should be stored in air-tight containers. Since method of cooking and duration of cooking affect iodine salt content of cooked food, it is advisable to sprinkle salt after cooking or towards end of cooking, wherever possible [43].

In areas of moderate and severe iodine deficiency (median urinary iodine <50 µg/L or total goiter rate >20%) approaches for iodine supplements are described in **Table I** [44].

A high iodine intake with urinary levels >300 µg/L is to be discouraged, especially in previously deficient populations as it can have an adverse effect of iodine induced hyperthyroidism [42].

### Vitamin A Deficiency

Vitamin A deficiency (VAD) is most important preventable cause of blindness in low- and middle-income countries.

**Deficiency status and risk factors:** Zinc, Iron and protein-calorie deficiencies; recurrent clinical and

**TABLE I** WHO-RECOMMENDED DOSAGES OF DAILY AND ANNUAL IODINE SUPPLEMENTATION

Population group	Daily dose of iodine (µg/d)	Single dose of iodized oil (mg/y)
Pregnant women	250	400
Lactating women	250	400
Women 15-49 year	150	400
Children <2 year <sup>*#</sup>	90	200

<sup>\*</sup>For exclusively breastfed 0-6 month child, lactating mother receives supplementation as above; <sup>#</sup>For situations where complementary food fortified with iodine is not available.

subclinical infections; and parasitic infestations, adversely affect vitamin A absorption, transport and utilization. Habitual low dietary intake of vitamin A rich animal food or beta carotene-rich vegetables-fruits is the major factor for the poor vitamin A status among the South East Asia Region (SEAR) population. >0.5% Bitot's spots, >1% night blindness and >0.01% keratomalacia prevalence among under-five children indicates a public health issue.

The NNMB 2006 data from rural India shows 62% prevalence of VAD Disorders (Serum retinol <20 µg/L) in preschoolers [45]. Despite non-significant improvement in dietary intake and vitamin A program coverage, there is decline in clinical VAD in under-5 children in most/countries of SEAR. Keratomalacia is no longer a major public health problem with improved health care, nutrition and measles vaccination, although cases are reported from remote areas [46]. Reappraisal of the prevalence of VAD is warranted at present [47].

### Screening

Serum retinol, dark adaptometry and Rose-Bengal eye test are useful in detecting VAD. Serum retinol measurements alone, if not adjusted by C-reactive protein (CRP) levels for subclinical infections, can overestimate VAD burden. It may not be an operationally feasible indicator for community use [47].

### Recommended Interventions

**Diet:** Pediatricians should provide guidance to promote vitamin A rich foods routinely (milk products like butter, ghee, yogurt, curd, cheese, eggs, liver and yellow/orange colored vegetables and fruits); more so during diarrhea, measles and respiratory infections [48].

**Supplementation:** Vitamin A prophylaxis program was started with a view to control blindness due to keratomalacia. Later in 2006, age group was extended to 5 years from initial 3 years. Every six months a mega dose of 2 lakh units (1 lakh for < 8 kg or < 1 year age) of oil based vitamin A is given [48]. Mega dose vitamin A supplementation is not recommended in infants below 6 months age.

Recent data suggests a sharp reduction in the incidence of overt vitamin A deficiency across the country [47], and therefore there is a need for a relook at this program. On basis of possible adverse effects, overdosing, increase in acute respiratory infections, vitamin D and zinc antagonism, and reducing prevalence of deficiency, there is an opinion to adopt a targeted rather than universal mega dose vitamin A supplementation in preschool children [47]. Indian Academy of Pediatrics

recommends supplementation till 3 years of age to all, and to older children only in severe malnutrition and measles [49].

Mega dose vitamin A supplementation is recommended in children with severe acute malnutrition (SAM), measles and cholestasis; in addition to those with signs of deficiency like xerotic conjunctiva, Bitot's spots and keratomalacia. When water soluble injectable preparation is given, oral fat soluble preparation is recommended to replenish stores.

Vitamin A supplementation coverage rate has increased from 16% (NFHS-3, 2005) to 27%-90% in different states (NFHS-4, 2015-16) with a national average of 60.2%. The large dose is well absorbed and stored in the liver, and mobilized over 4-6 months depending on dietary content and utilization rate [50].

Transient side-effects usually disappearing within 24 hours, like headache, nausea, vomiting and diarrhea are reported in 3%-7%, with no long term consequences [50]. There are no known deaths. As overdosing can lead to hypervitaminosis A, special training of field staff is recommended. The supply is irregular and oral syrup is available only to the Government sector, hence many children do not get regular supplementation.

**Effects of supplementation:** A cochrane review in 2017 found that VA supplementation at 0-6 month does not significantly reduce overall, diarrheal or pneumonia related mortality and morbidity, but increases benign raised fontanel cases [51,52]. VA supplementation in 6-59 month children in low-and middle-income countries with a high prevalence of VAD has shown [50]:

- (a) Reduced all-cause mortality by 12%-24% and diarrhea-related mortality risk by 12% but no difference in cause-specific mortality of measles, respiratory disease or meningitis.
- (b) Reduced diarrhea and measles risk, but no effect on respiratory disease or hospitalizations for diarrhea or pneumonia.
- (c) Significantly increased vomiting in 48 hours.
- (d) Supplementation at 6 or 9 months did not affect measles vaccine seroconversion.
- (e) No significant effect when the data were stratified by National child mortality rates.

### Vitamin D Deficiency

**Clinical presentations:** Role of vitamin D in bone mineralization and calcium-phosphorus homeostasis is well established with deficiency manifesting as infantile

hypocalcemia, rickets, delayed growth and dentition. Lower levels of vitamin D and its binding proteins were seen in children with severe sepsis.

*Deficiency status and risk factors:* Based on serum levels, vitamin D deficiency is prevalent, largely subclinical, across the country from 70-100% at various times in life cycle, irrespective of gender, region or dietary habits [53]. In infants aged three months and their mothers, prevalence of vitamin D insufficiency was found in 92.6% and two third infants were exclusively breastfed [54]. Prevalence of VDD (serum 25-hydroxyvitamin D <25-30 nmol/L) >20% in whole population or in at-risk population subgroups constitutes a public health issue warranting intervention.

Infants depend upon the vitamin D transferred from mother prenatally. In every deficient mother, evaluate child for calcium and vitamin D and also *vice versa*. Most infants are born with low vitamin D stores and are dependent on breast milk (containing <25 IU/L), sunlight or supplements as vitamin D sources in initial months of life. Sun exposure may be restricted due to many reasons. Vitamin D deficiency is also prevalent among infants in countries with food fortification and year-round sun exposure.

### Screening

Laboratories use different methods for assessment. Wide variation in reports on same sample are noted [55]. Based on the observations of relation with calcium absorption and parathormone levels with vitamin D levels most authorities consider >30 ng/ml as sufficient, 20-30 ng/ml as relative insufficiency and <20 ng/ml as deficiency.

### Recommended Interventions

*Supplementation:* Vitamin D supplementation is recommended for children at risk of vitamin D deficiency, especially where sun exposure is not available or is avoided for some reasons.

Recent Cochrane reviews [56] and WHO [57] do not recommend routine supplementation of vitamin D to term infants for preventing rickets or respiratory and diarrheal infections. Cochrane has some evidences for vitamin D supplementation for asthma prevention [58].

There is no national program for prevention of VDD in India. FSSAI has issued recommendation [5] for fortification of vegetable oil with 25 IU/g vitamin A and 4.5 IU/g vitamin D, which cannot meet daily requirements. European Food Safety Authority has set the upper limit of safety at 1000 IU/day for infants and 2000 IU/day for children ages 1 to 10 years [59]. Considering variable

concentrations of available preparations, it is imperative to monitor the supplementation to avoid hypervitaminosis D.

*Sun exposure:* Encourage the socially accepted practice of oil massage under sunlight and promote outdoor activities under sun for older children and adolescents. Skin is a more efficient source for providing vitamin D than ingested form despite slow initial rise in plasma levels [60]. There are no defined recommendations on sunlight exposure. Generally, face, arms, hand and legs should be exposed twice or thrice a week, for the duration causing minimal sunburn [61].

*Diet:* Encourage children to consume more vitamin D rich or fortified foods. Dietary sources are scarce like fatty fish (wild salmon, mackerel, eel, anchovy, sardines, swordfish, tuna), and lesser extent in egg yolk and fortified foods, milk and dairy products, margarine, *etc.* [59].

### Vitamin B-Complex Deficiency

*Clinical presentations:* Deficiency of B-vitamins can lead to glossitis, angular stomatitis, dermatitis, anemia, hyper-pigmentation or brain dysfunction. Cobalamin stores are so large that clinical deficiency is uncommon without predisposing factors like malabsorptive states; it takes years of inadequate intake or absorption before clinical symptoms. Niacin deficiency is encountered only as epidemic during emergencies in population with maize as staple food and high incidence of infectious diseases and malnutrition; and children may not present with skin changes although diarrhea can occur [62].

*Deficiency status and risk factors:* Folic acid and cobalamin are relatively more studied than rest. Significant deficiency of vitamin B<sub>12</sub> has been reported in exclusively breastfed <6 month infants and their mothers [63] and infants and preschoolers [64]. Vegan diets are risk factors as there are no plant sources of cobalamin. Maternal deficiency is the strongest predictor of low cobalamin in neonates. Continued low intake because of low content in mother's milk; delayed introduction of animal based complementary foods; prolonged breastfeeding in populations with food insecurity; and cultural and economic factors play determinant roles in promoting a deficient state in childhood [65].

In a biochemical study from Hyderabad in residential school with students from middle income families [66], Folic acid deficiency was present in almost all children, while deficiencies of B<sub>2</sub> and B<sub>6</sub>, vitamin C, vitamin A and B<sub>12</sub> were reported in 44%-66% of the children. B<sub>1</sub> and Zinc deficiency was less.

**KEY MESSAGES**

1. Improve nutritional status of pregnant women using supplements.
2. Practice delayed cord clamping.
3. Encourage breastfeeding including colostrum feeding.
4. Supplement lactating women.
5. Supplement children by programatic (vitamin A, iron-folic acid, and zinc), and Case-based (vitamins K, B12, D, B<sub>1</sub>, B<sub>3</sub>, B<sub>6</sub>, E, and Multiple micronutrient powder) approaches
6. Control infectious disease (De-worming, malaria control)
7. Dietary strategies [70]:
  - a. *Dietary diversification*: Enhance food with ascorbic acid (for iron), other organic acids, cellular animal protein (for iron and zinc), Fat (for retinol and provitamin-A carotenoids) by encouraging inclusion of fresh fruits (e.g., citrus fruits), vegetables (e.g., tomatoes, green leaves), legumes (e.g., ground nut flour) or small amounts of flesh foods (animal muscle, fatty fish, fish flesh with bones and fish flour) in food
  - b. *Mild heat treatment* (like preparation of porridges) to releases bound carotenoids
  - c. Home Food processing:
    - i. Soaking (reduces phosphates and phytates)
    - ii. Fermentation (improves B12, improves phytase activity)
    - iii. Germination (increase endogenous phytase, reduce polyphenols and tannins in some legumes)
  - d. *Use Staple food fortification* (iodized salt, flour, sugar, oils) & fortified complementary foods
  - e. *Cook food in cast iron vessels* by simmering

**Screening**

Low serum B<sub>12</sub> and folate levels are not final evidence of deficiency. True B<sub>12</sub> tissue deficiency is present if serum methylmalonic acid (MMA) is high and for folic acid deficiency if homocysteine levels are high. However, B<sub>12</sub> deficiency also causes rise of serum homocysteine. Levels of B<sub>12</sub> between 200-300 pg/mL and folate between 3-4 ng/mL indicate deficiency [67]. In selected cases non nutritional deficiency should be ruled out, e.g. genetic metabolic pathways defects.

**Recommended Interventions**

*Diet*: Family education on balanced diet *i.e.* inclusion of food from vegetable and animal source should be provided. Promote consumption of foods rich in B-vitamins. A useful source is National Institute of Nutrition, Hyderabad manual, which lists the dietary sources and RDA of dietary components [68].

*Supplementation*: B<sub>12</sub> deficiency is not considered as a public health problem in India. The current policy is folic acid supplementation as Fe-FA supplementation program. It is yet unresolved whether folic acid supplementation can be harmful in population groups with a high prevalence of B<sub>12</sub> deficiency.

Current evidence supports use of B<sub>12</sub> supplements in

pregnant and lactating women in low socio-economic strata, and in vegetarian population with poor intake of animal source food [69,70] with 50 µg/day B<sub>12</sub>, in addition to Iron and Folic acid presently practiced.

All children suffering from nutritional anemia should be prescribed iron, folic acid and vitamin B<sub>12</sub>. Routine prescription of vitamin B complex with antibiotics is not recommended.

*Fortification*: WHO recommends point-of-use fortification of foods with MMNP consumed by 6-23 months children [20], and we suggest adding one RDA of vitamin B<sub>12</sub> to it. It is suggested to prioritize research to add to the evidence of impact of multiple micronutrient (including B-vitamins) supplementation or fortification strategies on morbidity, developmental outcomes and mortality in Indian children.

**Other Micronutrients**

There is very little data on other micronutrients from India. It is felt that the research activity in this area be encouraged to collect evidence for recommendation.

Intramuscular vitamin K administration at birth is recommended.

Routine use of vitamin E for preterm babies is not recommended.

**Contributors:** All authors approved the final version of manuscript, and are accountable for all aspects related to the study.

**Funding:** The cost of travel of the members for the consultative meeting for their recommendations was borne by Sun Pharmaceuticals.

**Competing interests:** None stated.

**Acknowledgments:** We thankfully acknowledge the help, cooperation, assistance and guidance from Dr. Ajay Khera Deputy Commissioner (Child Health and Immunization) MOHFW, Dr. Sila Deb (Deputy Commissioner - Child Health, MOHFW), Dr. Nimisha Goel (MoHFW Govt of India), Ms. Raji Nair (UNICEF), Dr Pramod Jog (President IAP), WHO, UNICEF, Sun Pharmaceuticals and Smt. Santra Devi Health and Educational Trust for designing and technical assistance.

**Disclaimer:** These consensus statements are prepared for assisting pediatricians in accordance with current scientific evidence and guidelines for prevention of micronutrient deficiencies in young children; however, many areas are still not clearly defined. These statements cannot establish a standard of care, and decisions about treatment should be based on the judgment of the Pediatricians on merits of individual cases dealt by them.

**Revision and Updating:** These guidelines were drafted in 2017 and updated in May- June 2018 through email suggestions by the EB members of Central IAP and the writing committee. The recommendations shall be revised after three years i.e. in 2020- 21.

## REFERENCES

- Plessow R, Arora NK, Brunner B, Tzogiou C, Eichler K, Brügger U, *et al.* Social costs of iron deficiency anemia in 6–59-month-old children in India. *PLoS One* 10:e0136581. Available from: <https://doi.org/10.1371/journal.pone.0136581>. Accessed February 10, 2018.
- World Health Organization. Childhood and maternal undernutrition. *In: Global Health Risks: Mortality and burden of disease attributable to selected major risks.* Geneva: WHO Library Cataloguing-in-Publication Data; 2009. P.9.
- National Nutrition Monitoring Bureau Technical report no. 22. Executive Summary. *In: Prevalence of micronutrient deficiencies.* Hyderabad: National Institute of Nutrition; 2003. pg. i.
- Guidelines - Government of India. NHM Components: Child Health Guidelines. 2013. Available from: <http://nhm.gov.in/nrhm-components/rmnch-a/child-health-immunization/child-health/guidelines.html>. Accessed February 10, 2018.
- Food and Safety Standards Authority of India; 2017. Available from: [https://www.fssai.gov.in/dam/jcr.../Direction\\_Food\\_Fortification\\_19\\_05\\_2017.pdf](https://www.fssai.gov.in/dam/jcr.../Direction_Food_Fortification_19_05_2017.pdf). Accessed February 10, 2018.
- Iron. *In: Human Vitamin and Mineral Requirements: Report of a joint FAO/WHO expert consultation.* Bangkok: Food and Nutrition Division FAO Rome; 2001. P. 195–223. Available from: <http://www.fao.org/3/a-y2809e.pdf>. Accessed July 16, 2018.
- American Academy of Pediatrics Committee on Nutrition. The use of whole cow's milk in infancy. *Pediatrics.* 1992;89:1105.
- Bogen DL, Duggan AK, Dover GJ, Wilson MH. Screening for iron deficiency anemia by dietary history in a high-risk population. *Pediatrics.* 2000;105:1254-9.
- World Health Organization. Vulnerable groups. *In: Nutritional Anemias: Tools for effective prevention and control.* Geneva: World Health Organization; 2017. P. 4. Available from: <http://apps.who.int/iris/bitstream/10665/259425/1/9789241513067-eng.pdf?ua=1>. Accessed July 16, 2018.
- Sant-Rayn Pasricha, Black J, Muthayya S, Shet A, Bhat V, Nagaraj S, *et al.* Determinants of anemia among young children in rural India. *Pediatrics.* 2010;126:126.
- Abd-El Wahed MA, Mohamed MH, Ibrahim SS, El-Naggar WA. Iron profile and dietary pattern of primary school obese Egyptian children. *J Egypt Public Health Assoc.* 2014;89:53-9.
- White KC. Anemia is a poor predictor of iron deficiency among toddlers in the United States: for heme the bell tolls. *Pediatrics.* 2005;115:315-20.
- Ekwochi U, Odetunde O, Maduka I, Azubuike J, Obi I. Iron deficiency among non-anemic under-five children in enugu, South-East, Nigeria. *Ann Med Health Sci Res.* 2013;3:402-6.
- Baker RD, Greer FR. Diagnosis and prevention of iron deficiency and iron-deficiency anemia in infants and young children [0-3 Years of Age]. *Pediatrics.* 2010;126:1040-50.
- Lanzkowsky P. Problems in diagnosis of iron deficiency anemia. *Pediatr Ann.* 1985;14:618,622-3.
- Albert Sui. Screening for Iron Deficiency Anemia in Young Children: USPSTF Recommendation Statement. *Pediatrics.* 2015;136:746-52.
- Kazal LA. Prevention of iron deficiency in infants and toddlers. *Am Fam Physician* 2002;66:1217-25.
- Assessment, surveillance and indicators. *In: Iron Deficiency Anemia Assessment, Prevention and Control: A guide for program managers.* World Health Organization; 2001. p. 29. Available from: [http://www.who.int/nutrition/publications/en/ida\\_assessment\\_prevention\\_control.pdf](http://www.who.int/nutrition/publications/en/ida_assessment_prevention_control.pdf) Accessed July 16, 2018.
- Geerligs PDP, Brabin BJ, Omari AAA. Food prepared in iron cooking pots as an intervention for reducing iron deficiency anaemia in developing countries: A systematic review. *J Hum Nutr Diet.* 2003;16:275-81.
- WHO. Guideline: Use of multiple micronutrient powders for home fortification of foods consumed by infants and children 6–23 months of age. Geneva: World Health Organization; 2011. Available from: [http://www.who.int/about/licensing/copyright\\_form/en/index.html](http://www.who.int/about/licensing/copyright_form/en/index.html). Accessed July 16, 2018.
- Ghosh S, Sinha S, Thomas T, Sachdev HS, Kurpad AV. Revisiting dietary iron requirement and deficiency in Indian women: Implications for food iron fortification and supplementation. *J Nutr.* 2019;149:366-71.
- Guideline: Daily iron supplementation in infants and children. Geneva: World Health Organization; 2016. Available from: <http://apps.who.int/iris/bitstream/10665/204712/1/>



- 9789241549523\_eng.pdf. Accessed July 16, 2018.
23. Supplementation through the Life Cycle. *In: Guidelines for Control of Iron Deficiency Anemia*. National Health Mission, Ministry of Health and Family Welfare, Government of India; 2013. P. 17–9. Available from: <http://nhm.gov.in/nrhm-components/rmnch-a/child-health-immunization/child-health/guidelines.html>. Accessed July 16, 2018.
  24. Secretariat WHO. Conclusions and recommendations of the WHO Consultation on prevention and control of iron deficiency in infants and young children in malaria-endemic areas. *Food Nutr Bull.* 2007;28:S621–7. Available from: <http://www.who.int/nutrition/publications/micronutrients/FNBvol28N4supdec07.pdf>. Accessed February 10, 2018.
  25. Sheno A, Nair SI, Prasad V. Management of Feeding in Low Birth Weight Infants Summary. *In: Praveen Kumar, ON Bhakoo, Naveen Jain, Rhishikesh Thakre, Srinivas Murki SV, editor. Evidence Based Clinical Practice Guidelines*. Delhi: National Neonatology Forum India; 2010. p. 31.
  26. Krishnaswamy S, Bhattarai D, Bharti B, Bhatia P, Das R, Bansal D. Iron deficiency and iron deficiency anemia in 35 months-old, breastfed healthy infants. *Indian J Pediatr.* 2017;84:505-8.
  27. McDonald SJ, Middleton P, Dowswell T, Morris PS. Effect of timing of umbilical cord clamping of term infants on maternal and neonatal outcomes. *Cochrane Database Syst Rev.* 2013; CD0040740.
  28. Guideline: preventive chemotherapy to control soil-transmitted helminth infections in at-risk population groups. Geneva: World Health Organization. Licence: CC BY-NC-SA 3.0 IGO.; 2017. 3 p. Available from: <http://apps.who.int/iris/bitstream/10665/258983/1/9789241550116-eng.pdf>. Accessed July 16, 2018.
  29. LD Suskind. Nutritional Deficiencies During Normal Growth. *In: Praveen S. Goday, editor. Pediatric Clinics of North America*. New Delhi: Reed Elsevier India Pvt. Ltd.; 2009. p. 1035-53.
  30. Kapil U, Jain K. Magnitude of zinc deficiency amongst under five children in India. *Indian J Pediatr.* 2011;78: 1069-72.
  31. Caulfield LE, Black RE. zinc deficiency. *In: Majid Ezzati, Alan D. Lopez AR, Murray and CJL, editors. Comparative qualifications of health risks: Global and regional burden of disease attributable to selected major risk factors*. Geneva: World Health Organization; 2004. p. 257-79. Available from: [http://apps.who.int/iris/bitstream/10665/42792/1/9241580348\\_eng\\_Volume1.pdf](http://apps.who.int/iris/bitstream/10665/42792/1/9241580348_eng_Volume1.pdf). Accessed February 10, 2018.
  32. De Benoist B, Darnton-Hill I, Davidsson L, Fontaine O, Hotz C. Conclusions of the Joint WHO/UNICEF/IAEA/IZiNCG Interagency Meeting on Zinc Status Indicators. *Food Nutr Bull.* 2007 Sep;28[3\_suppl3]:S480–4. Available from: <http://journals.sagepub.com/doi/10.1177/15648265070283S306>. Accessed February 10, 2018.
  33. Shah D, Sachdev HS, Gera T, De-Regil LM, Peña-Rosas JP. Fortification of staple foods with zinc for improving zinc status and other health outcomes in the general population. *Cochrane Database Syst Rev.* 2014;CD010697.
  34. Lazzarini M, Wanzira H. Oral zinc for treating diarrhoea in children. *Cochrane Database Syst Rev.* 2016;12: CD005436.
  35. Christa L. Fischer Walker and Robert E. Zinc supplementation for diarrhoea treatment. e-Library of Evidence for Nutrition Actions [eLENA]. World Health Organization; Mar 2014. Available from: [http://www.who.int/elena/titles/commentary/zinc\\_diarrhoea/en/](http://www.who.int/elena/titles/commentary/zinc_diarrhoea/en/). Accessed February 10, 2018.
  36. Dhingra U, Hiremath G, Menon VP, Dhingra P, Sarkar A, Sazawal S. Zinc deficiency: Descriptive epidemiology and morbidity among preschool children in peri-urban population in Delhi, India. *J Health Popul Nutr.* 2009;27:632-9.
  37. Lassi ZS, Moin A, Bhutta ZA. Zinc supplementation for the prevention of pneumonia in children aged 2 months to 59 months. *Cochrane Database Syst Rev.* 2016; CD005978.
  38. Sazawal S, Black RE, Ramsan M, Chwaya HM, Dutta A, Dhingra U, *et al.* Effect of zinc supplementation on mortality in children aged 1–48 months: a community-based randomised placebo-controlled trial. *Lancet.* 2007;369: 927-34.
  39. Szymlek-Gay EA, Domellöf M, Hernell O, Hurrell RF, Lind T, Lönnerdal B, *et al.* Mode of oral iron administration and the amount of iron habitually consumed do not affect iron absorption, systemic iron utilisation or zinc absorption in iron-sufficient infants: a randomized trial. *Br J Nutr.* 2016;116:1046-60.
  40. Mathur NB, Agarwal DK. Zinc Supplementation in Preterm Neonates and Neurological Development: A Randomized Controlled Trial. *Indian Pediatr.* 2015;52: 951-5.
  41. Pandav CS, Yadav K, Srivastava R, Pandav R, Karmarkar MG. Iodine deficiency disorders (IDD) control in India. *Indian J Med Res.* 2013;138:418-33.
  42. WHO Library Cataloguing-in-Publication Data. Indicators of Impact. *In: Assessment of iodine deficiency disorders and monitoring their elimination: a guide for program managers*. 3rd ed. Geneva: World Health Organization; 2007. p.32-33. Available from: [http://apps.who.int/iris/bitstream/10665/43781/1/9789241595827\\_eng.pdf](http://apps.who.int/iris/bitstream/10665/43781/1/9789241595827_eng.pdf). Accessed July 16, 2018.
  43. Runa R, Raghuvanshi RS. Effect of different cooking methods on iodine loss. *J Food Science Technol.* 2013;50:1212-6.
  44. Reaching Optimal Iodine Nutrition in Pregnant and Lactating Women and Young Children. Geneva: Joint Statement by WHO and UNICEF; 2007. Available from: [http://www.who.int/nutrition/publications/micronutrients/WHOStatement\\_\\_IDD\\_pregnancy.pdf](http://www.who.int/nutrition/publications/micronutrients/WHOStatement__IDD_pregnancy.pdf). Accessed July 16, 2018.
  45. NNMB Technical Report No. 23. Prevalence of vitamin A deficiency among rural preschool children. Hyderabad: National Institute of Nutrition; 2006. p.ii. Available from: <http://nnmbindia.org/vad-report-final-21feb07.pdf>. Accessed February 10, 2018.
  46. Vitamin A deficiency. *In: Regional Nutrition Strategy: Addressing malnutrition and micronutrient deficiencies [2011-2015]*. New Delhi: World Health Organization;

2012. p. 32–5. Available from: <https://apps.who.int/iris/handle/10665/205804>. Accessed July 16, 2018.
47. Kapil U, Sachdev HPS. Massive dose vitamin A program in India—need for a targeted approach. *Indian J Med Res.* 2013;138:411-7.
  48. Policy on Micronutrient - Vitamin-A. New Delhi: Child Health Division, Dept of Family Welfare, MoH and FW; document No. Z.28020/30/2003-CH. Available from: [http://nhm.gov.in/images/pdf/programmes/child-health/guidelines/goi\\_vit\\_a.pdf](http://nhm.gov.in/images/pdf/programmes/child-health/guidelines/goi_vit_a.pdf). Accessed February 10, 2018.
  49. Recommendations: Eligibility of Children for Vitamin A Supplementation Program. *Indian Pediatr.* 2005;42:1011-2.
  50. WHO Library Cataloguing-in-Publication Data. Guideline: Vitamin A supplementation in infants and children 6–59 months of age. Geneva: World Health Organization; 2011. p.3. Available from: [https://apps.who.int/iris/bitstream/handle/10665/44664/9789241501767\\_eng.pdf?sequence=1](https://apps.who.int/iris/bitstream/handle/10665/44664/9789241501767_eng.pdf?sequence=1). Accessed July 16, 2018.
  51. Haider BA, Sharma R, Bhutta ZA. Neonatal vitamin A supplementation for the prevention of mortality and morbidity in term neonates in low and middle income countries. *Cochrane Database Syst Rev.* 2017;CD006980.
  52. Imdad A, Ahmed Z, Bhutta ZA. Vitamin A supplementation for the prevention of morbidity and mortality in infants one to six months of age. *Cochrane Database Syst Rev.* 2016;CD007480.
  53. Gupta R, Gupta A. Vitamin D deficiency in India: prevalence, causalities and interventions. *Nutrients.* 2014;6:729-75.
  54. Jain V, Gupta N, Kalaivani M, Jain A, Sinha A, Agarwal R. Vitamin D deficiency in healthy breastfed term infants at 3 months and their mothers in India: seasonal variation and determinants. *Indian J Med Res.* 2011;133:267-73.
  55. Lucas R, Neale R. What is the optimal level of vitamin D? *Aust Fam Physician.* 2014;43:119-22.
  56. Wagner CL, Greer FR. Prevention of rickets and vitamin D deficiency in infants, children, and adolescents. *Pediatrics.* 2008;122;1142-52.
  57. Braegger C, Campoy C, Colomb V, Decsi T, Domellof M, Fewtrell M, *et al.* Vitamin D in the Healthy European Pediatric Population: Consensus Statement. *J Pediatr Gastroenterol Nutr.* 2013;56:692-701.
  58. Munns C, Zacharin MR, Rodda CP, Batch JA, Morley R, Cranswick NE, *et al.* Prevention and treatment of infant and childhood vitamin D deficiency in Australia and New Zealand: A consensus statement. *Med J Aust.* 2006; 185:25-729.
  59. Khadilkar V. Prevention and Treatment of Vitamin D and Calcium Deficiency in Children and Adolescents: Indian Academy of Pediatrics Guidelines. *Indian Pediatr.* 2017;54:567-73.
  60. Yakoob MY, Salam RA, Khan FR, Bhutta ZA. Vitamin D supplementation for preventing infections in children under five years of age. *Cochrane Database Syst Rev.* 2017;CD008824.
  61. WHO | Vitamin D supplementation in infants. WHO. 2017; Available from: [https://www.who.int/elena/titles/vitamin\\_d\\_infants/en/](https://www.who.int/elena/titles/vitamin_d_infants/en/). Accessed July 16, 2018.
  62. Martineau AR, Cates CJ, Urashima M, Jensen M, Griffiths AP, Nurmatov U, *et al.* Vitamin D for the management of asthma. *Cochrane Database Syst Rev.*; 2016;9:CD011511.
  63. Haddad JG, Matsuoka LY, Hollis BW, Hu YZ, Wortsman J. Human plasma transport of vitamin D after its endogenous synthesis. *J Clin Invest.* 1993;91:2552-5.
  64. Holick MF. Sunlight and vitamin D: both good for cardiovascular health. *J Gen Intern Med.* 2002;17:733-5.
  65. Pellagra and its prevention and control in major emergencies. Geneva: World Health Organization; 2000. 1-6 p. Available from: [http://www.who.int/nutrition/publications/en/pellagra\\_prevention\\_control.pdf](http://www.who.int/nutrition/publications/en/pellagra_prevention_control.pdf). Accessed July 16, 2018.
  66. Mittal M, Bansal V, Jain R, Dabla PK. Perturbing status of Vitamin B12 in Indian infants and their mothers. *Food Nutr Bull.* 2017;38:209-15.
  67. Kapil U, Toteja GS, Bhadoria A. Cobalamin and folate deficiencies among children in the age group of 12-59 months in India. *Biomed J.* 2015;38:162-6.
  68. National Institute of Nutrition, Hyderabad. Dietary Guidelines for Indians – A Manual. II edition, 2011.
  69. Pasricha SR, Shet AS, Black JF, Sudarshan H, Prashanth NS, Biggs BA. Vitamin B-12, folate, iron, and vitamin A concentrations in rural Indian children are associated with continued breastfeeding, complementary diet, and maternal nutrition. *Am J Clin Nutr.* 2011;94:1358-70.
  70. Wadia RS, Bandishti S, Kharache M. B12 and folate deficiency: incidence and clinical features. *Neurol India.* 2000;48:302-4.

## ANNEXURE I

### Members of the National Consultative Meet

Dr RK Agrawal (President IYCF chapter), Dr Rajkishor Maheshwari, Dr Satish Tiwari, Dr Balraj Singh Yadav, Dr Ketan Bharadva, Dr Sanjay Prabhu, Dr KE Elizabeth, Dr K Raghunath, Dr. Nimisha Goel (From MoHFW Govt of India), Dr Urmila Deshmukh, Dr BR Thapa, Dr Sushma Malik, Dr Hima Bindu Singh, Dr Sudhir Mishra, Dr CM Chhajer, Dr Jayant Shah, Dr Rajinder Gulati, Dr Mallikarjuna, Dr Somasekara, Dr S. Laishram, Dr Kritika Malhotra.

*Invited but could not attend:* Dr Promod Jog (President IAP 2016), Dr Bhavneet Bharati, Dr Ajay Khera (From MoHFW Govt of India), Ms. Raji Nair (UNICEF), Dr. Radhika (NIN), Dr Kanya Mukhopadhyay, Dr Vishesh Kumar (WHO).

## RECOMMENDATION

### Infant and Young Child Feeding Guidelines, 2016

SATISH TIWARI, KETAN BHARADVA, BALRAJ YADAV, SUSHMA MALIK, PRASHANT GANGAL, CR BANAPURMATH, ZEEBA ZAKA-UR-RAB, URMILA DESHMUKH, VISHESHKUMAR AND RK AGRAWAL, FOR THE IYCF CHAPTER OF IAP

Correspondence to: Dr Satish Tiwari, Yashodanagar No. 2, Amravati 444 606, Maharashtra, India. drsatishtiwari@gmail.com

**Justification:** Shaping up the post-2015 development agenda is of crucial importance in the development process around the Globe as 2015 was the last year of millennium development goals. It is the right time to assess our own progress *vis-a-vis* the Millennium Development Goals and these Guidelines are an attempt in that regard.

**Process:** The Infant and Young Child Feeding (IYCF) chapter of Indian Academy of Pediatrics invited a group of experts for National Consultative Meet for discussing and contributing on latest scientific advances and developments. Various partners from WHO, UNICEF, Ministry of Child Welfare Department, Ministry of Health and Family Welfare, Ministry of Chemical and Fertilizers of Govt of India, Human Milk Banking Association (of India), Indian Medico-Legal and Ethics Association (IMLEA), non-governmental organizations and academicians from various states of India contributed to these guidelines. The guidelines were finalized during the IYCNCON 2015 at New Delhi in August 2015.

**Objectives:** To formulate, endorse, adopt and disseminate guidelines related to Infant and Young Child feeding from an Indian perspective (including human milk banking, infant feeding in the HIV situation, and micro-nutrients).

**Recommendations:** Early initiation of breastfeeding within first hour of birth, exclusive breastfeeding for the first six months followed by continued breastfeeding for up to two years and beyond with appropriate complementary foods after completion of 6 months is the most appropriate feeding strategy. Micro-nutrient supplementation in infants, and adequate nutrition and anemia control for adolescent girls, pregnant and lactating mothers is advocated. Concepts and need for human milk banks in India has also been incorporated.

**Keywords:** Early Initiation, Exclusive breastfeeding, Complementary feeding, Hand washing, Human milk banking, Malnutrition, Micronutrients.

The under-five population of India stands at a staggering 112.8 million [1]. However, despite all the advances in health, education and agriculture sectors as well as vast improvements in the country's economy, India figures in the list of countries that have made insufficient progress towards meeting the Millennium Development Goals [2]. It has the largest numbers of under-five children who are moderately or severely stunted, accounting for 38% of the global burden. India also has the highest numbers of children with moderate and severe wasting.

According to National Family Health Survey-3 data, about 20 million children are not able to receive exclusive breastfeeding (EBF) for the first six months, and about 13 million do not get good, timely and appropriate complementary feeding along with continued breastfeeding. Over the past several years, India has failed to witness any remarkable progress in infant feeding practices, with only a small increment being recorded in EBF rates amongst infants 0-6 months of age – from 41.2% in 1998-99 (NFHS-2) to 46.3% in 2005–2006 (NFHS-3) [3]. The rate of early initiation of breastfeeding stands abysmally low at 24.5%, while the median duration of EBF among last-born children is as brief as two months. Further,

the rate of EBF drops progressively from 51% at 2-3 months of age to 28% at 4-5 months of age. In a recent Annual Health Survey conducted in India from 2010 to 2013 covering all the 284 districts (as per 2011 census) of 8 Empowered Action Group (EAG) States (Bihar, Uttar Pradesh, Uttarakhand, Jharkhand, Madhya Pradesh, Chhattisgarh, Odisha and Rajasthan) and Assam [4], the percentage of children breastfed within one hour of birth was observed to vary from 30% in Bihar and Uttar Pradesh to around 70% in Assam and Odisha. Children exclusively breastfed for at least 6 months ranged from 17.7% in UP to 47.5% in Chhattisgarh. Complementary feeding is introduced in only 53% infants between 6–8 months, with only about 44% of breastfed children being fed at least the minimum number of times recommended [3]. Overall, only 21% of breastfeeding and non-breastfeeding children are fed in accordance with the infant and young child feeding (IYCF) recommendations.

#### TECHNICAL GUIDELINES

##### *Breastfeeding*

WHO/UNICEF have emphasized the first 1000 days of life *i.e.*, the 270 days *in-utero* and the first two years after birth as the critical window period for nutritional interventions.

As the maximal brain growth occurs, malnutrition in this critical period can lead to stunting and suboptimal developmental outcome. The optimal and appropriate infant and young child nutrition practices and strategies are enumerated in **Box 1**; the others are:

- (a) Breastfeeding should be promoted as the gold standard feeding options.
- (b) Antenatal counseling individually or in groups organized by maternity facility or mother support group (MSG) should prepare expectant mothers for successful breastfeeding.
- (c) For all normal newborns (including those by caesarean section) skin-to-skin contact should be initiated in about 5 minutes of birth in order that baby initiates breastfeeding in an hour of birth. The method of 'Breast crawl' can be adopted for early initiation [5]. In case of operative birth, the mother may need extra motivation and support. Skin-to-skin contact between the mother and new born should be encouraged by 'bedding in the mother and baby pair'. Mother should communicate, look into the eyes, touch and caress the baby while feeding. The new born should be kept warm by promoting Kangaroo Mother Care and promoting local practices to keep the room warm [6].
- (d) Baby should be fed "on cues". The early feeding cues include sucking movements and sucking sounds, hand to mouth movements, rapid eye movements, soft cooing or sighing sounds, lip smacking, restlessness *etc.* Crying is a late cue and may interfere with successful feeding. Babies should be breastfed at least 8 to 10 times in 24 hours till lactation is established (1 to 2 weeks) indicated by frequent urination, stooling and adequate weight gain. A sleepy baby can be easily woken up by removing blankets, removing clothes,

**BOX 1** THE OPTIMAL AND APPROPRIATE INFANT AND YOUNG CHILD NUTRITION PRACTICES AND STRATEGIES

- EBF should be practiced till end of six months (180 days).
- After completion of six months, introduction of optimal complementary feeding should be practiced preferably with energy dense, home-made food.
- Breastfeeding should be continued minimum for 2 years and beyond.
- Mother should communicate, look into the eyes, touch and caress the baby while feeding. Practice responsive feeding.
- WHO Growth Charts recommended for monitoring growth.

changing loin cloth if wet, skin-to-skin contact in kangaroo position and gently massaging the back and the limbs. Periodic feeding is practiced in certain situations like in the case of a very small infant who is likely to become hypoglycemic unless fed regularly, or an infant who 'does not demand' milk in initial few days. Adequacy of breastfeeding in this critical period should be monitored by clinical parameters complemented by weighing on digital weighing scale (minimum sensitivity of 5 g) on Day 1, 4, 7, 14 and 28. Maternity service should have a protocol to manage post-discharge follow ups along with protocols for management of excessive weight loss (>10%) and weight-faltering.

- (e) Every mother, especially the primipara, should receive support from doctors, nursing staff or community health workers (in case of non-institutional birth) with regards to correct positioning, latching and treatment of problems, such as engorgement, nipple fissures and delayed 'coming-in' of milk. If available, dedicated skilled supports like Lactation Consultants/ Mother Support Counselors/ Peer Counselors should be facilitated to support the mother in the antenatal, immediate postnatal period, post discharge follow-ups and in neonatal care units.
- (f) Mothers need skilled help and confidence-building during all health contacts and at home through home visits by trained community worker, especially after the baby is 3 to 4 months when a mother may begin to doubt her ability to fulfill the growing needs and demands of baby.
- (g) The main reason given by majority of working mothers for stopping breastfeeding is their return to work following the maternity leave. Mothers who work outside should be assisted with obtaining adequate Maternity/ Baby Care/Breastfeeding leave, should be encouraged to continue EBF for 6 months by expressing milk while they are out at work. They may be encouraged to carry the baby to a work place/ crèche wherever such facility exists. The concept of "Hirkani's rooms" may be considered at work places (Hirkani's rooms are specially allocated room at the workplace where working mothers can express milk and store in a refrigerator during their work schedule). Every such mother leaving the maternity facility should be taught manual expression of her breast milk; however, for a working mother this skill would prove invaluable.
- (h) If the breastfeeding was temporarily discontinued due to an inadvertent situation, re-lactation should be tried as soon as possible [7]. Supplemental Suckling Technique (SST) is a technique which can be used as a

strategy to initiate re-lactation in mothers who have developed lactation failure or Mother's Milk Insufficiency (MMI). WHO recommends re-lactation through Supplemental Suckling technique. The drip and drop method helps to sustain the infant's interest of suckling at the breast [8].

- (i) The possibility of induced lactation shall be explored according to the situation *e.g.* adoption, surrogacy. It helps to create mother-infant bonding apart from security and comfort for the baby. The technique involves motivating the surrogate mother, having a willing and vigorously sucking infant, and an adequate support group. Prolactin and oxytocin, the hormones which govern lactation, are pituitary and not ovarian. Hence, stimulation of nipple and areola and repeated suckling by the baby are important. Lact-aid as nursing trainer is also useful [9]. A course of prolactin enhancing drugs such as Metoclopramide or Domperidone is initiated [10]. Non-puerperal lactation in surrogate mothers has been successfully demonstrated among Indian mothers [11].
- (j) Nursing in Public (NIP): Mothers should feel comfortable to nurse in public. All efforts should be taken to remove hurdles impeding breastfeeding in public places, special areas / rooms shall be identified/ constructed or established in places like Bus stands, Railway stations, Air ports etc.
- (k) Adoption of latest WHO Growth Charts is recommended for monitoring growth [12].

### **Complementary Feeding [13]**

- (a) Appropriately thick homogenous complementary foods home-made from locally available foods should be introduced at six completed months while continuing breastfeeding *ad libitum* [14,15]. During this period, breastfeeding should be actively supported and the term 'weaning' should be avoided [16]. Complementary feeding should be projected as the bridge that the mother has to make between liquid to solid transition and to empower the baby to 'family pot feeding'.
- (b) To address the issue of a small stomach size, each meal must be made energy dense by adding sugar / jaggery and ghee/butter/oil. To provide more calories from smaller volumes, food must be thick in consistency—thick enough to stay on the spoon without running off, when the spoon is tilted [17]
- (c) Foods can be enriched by making a fermented porridge, use of germinated or sprouted flour and toasting of grains before grinding [16, 18].

- (d) Adequate total energy intake can also be ensured by addition of one to two nutritious snacks between the three main meals. Snacks are in addition and should not replace meals. They should not to be confused with foods such as sweets, chips or other processed foods [18].
- (e) Parents must identify the staple homemade food (as these are fresh, clean and cheap), comprising of cereal-pulse mixture in the ratio 2:1, and make them caloric and nutrient rich with locally available products.
- (f) Research has time and again proved the disadvantages of bottle feeding. Hence bottle feeding shall be discouraged at all levels.
- (g) The food should be a balanced diet consisting of various (as diverse as possible) food groups / components in different combinations. Easily available, cost-effective seasonal uncooked fruits, green and other dark colored vegetables, milk and milk products, pulses/ legumes, animal foods, oil/ butter, sugar/ jaggery may be added in the staples gradually [16,17].
- (h) Hygienic practices are essential for food safety during all the involved steps *viz.* preparation, storage and feeding. Hand washing with soap and water at critical times- including before eating or preparing food and after using the toilet [17,18].
- (i) Practice responsive feeding. Self-feeding should be encouraged despite spillage. Each child should be fed under supervision in a separate plate to develop an individual identity. Forced feeding, threatening and punishment interfere with development of good/ proper feeding habits [17]. Along with feeding, mother and care givers should provide psycho-social stimulation to the child through ordinary age-appropriate play and communication activities to ensure early childhood development.
- (j) Consistency of foods should be appropriate to the developmental readiness of the child in munching, chewing and swallowing. 'Neophobia' is the rule in them and any item may have to be offered several times for acceptance. Avoid foods which can pose choking hazard. Introduce lumpy or granular foods and most tastes by about 9 to 10 months. The details of food including; texture, frequency and average amount are summarized in **Table II**.

### **HIV AND INFANT FEEDING**

The following guidelines of HIV and infant feeding are based on recommendations given by WHO and NACO in 2013:

- (a) The best time to counsel HIV-positive mothers is during antenatal period. They should be informed about infant feeding options, *viz.* exclusive breastfeeding or exclusive replacement feeding that is recommended by the national authority so to improve HIV free survival of exposed infants. Exclusive breastfeeding is superior to exclusive replacement feeding in developing countries because it maximizes the chances of survival of the infant [20].
- (b) Prevention of parent-to-child transmission (PPTCT) interventions should begin early in the pregnancy for all HIV infected pregnant women [21].
- (c) In resource-limited settings, HIV-infected mothers of HIV-uninfected infants often have difficulty in deciding about feeding options, breastfeeding risks transmission of HIV to their infants and formula feeding is not always a feasible option due to high cost, lack of clean water or stigma associated with not breastfeeding. Recent clinical studies have proven that the risk of transmission through breastfeeding is minimal provided mother and the infant receive appropriate antiretroviral prophylaxis.
- (d) WHO 2013 guidelines recommend two options:
- Providing lifelong antiretroviral treatment (ART) (one simplified triple regimen) to all pregnant and breastfeeding women regardless of CD4 count or clinical stage.
  - To provide ART to pregnant and breastfeeding women with HIV during the period of risk of mother-to-child HIV transmission and then continuing lifelong ART only for those women who are eligible according to their own health [20,22].
- (e) The global target is “elimination of new HIV infections among children” by 2015 and government of India is actively working towards it. Following the new guidelines from WHO (June 2013), National AIDS control organization (NACO) has decided to provide life-long ART (triple drug regimen) to all pregnant and breastfeeding women living with HIV. With this step, all pregnant women living with HIV should receive a triple drug ART regimen regardless of CD4 count or WHO clinical stage. This would also help in increasing the coverage for those needing treatment to keep them alive and for their own health, avoiding stopping and starting drugs with repeat pregnancies, provide early protection against mother-to-child transmission in future pregnancies and avoiding drug resistance. These recommendations can potentially reduce the risk of mother-to-child-transmission to less than 5% in breastfeeding populations. These guidelines have been implemented across India from January, 2014 [21].
- (f) Providing an optimized, fixed-dose combination once daily first-line ARV regimen of Tenofovir (TDF), Lamivudine (3TC) (or Emtricitabine [FTC]) and Efavirenz (EFZ) to all pregnant and breastfeeding women HIV has important programmatic and clinical benefits. Where access to CD4 testing is limited, WHO prefers that all pregnant and breastfeeding HIV-infected women, regardless of CD4 cell count, should continue antiretroviral treatment for life (sometimes called “Option B+”) [22-24].
- (g) Exclusive breastfeeding is the recommended infant feeding choice in the first 6 months, irrespective of the fact that mother is on ART early or infant is provided with anti-retroviral prophylaxis for 6 weeks.
- (h) No Mixed Feeding is to be done during the first 6 months.
- (i) Mothers known to be infected with HIV and whose infants are HIV uninfected or of unknown HIV status should exclusively breastfeed their infants. Complementary foods should be appropriately introduced thereafter, and breastfeeding should be continued for the first 12 months of life. Initiate maternal ART and give Nevirapine (NVP) for 6 weeks. The treatment options, if mother is known to be infected with HIV, are presented in **Table I**.
- (j) Mothers known to be infected with HIV and whose infants are HIV infected should exclusively breastfeed for the first 6 months of life, complementary foods should be appropriately introduced thereafter, and breastfeeding should be continued for 24 months of life. Initiate maternal ART and give NVP for 6 weeks.
- (k) Mothers who are diagnosed with HIV during labor or in the immediate postpartum period and are planning to breastfeed, such mothers should be initiated on ART and their infants should receive extended NVP prophylaxis for 12 weeks.
- (l) Mothers who are diagnosed with HIV during labor or in the immediate postpartum period and are planning exclusive replacement feeding (ERF) should be referred for evaluation and treatment of HIV. Infants of these mothers should be given NVP prophylaxis for 6 weeks.
- (m) Mothers who are HIV-infected and insist on not breastfeeding and opt for exclusive replacement feeding (ERF) should be explained that they are doing so at their own risk and this is contrary to the WHO/NACO’s guidelines of giving exclusive breastfeeds. When taking choice for exclusive replacement

**TABLE I** AMOUNTS OF FOODS TO OFFER [18,19]

Age	Texture	Frequency	Average amount each meal
6-8 mo	Start with thick porridge, well mashed foods	2-3 meals per day plus frequent BF	Start with 2-3 table spoonfuls
9-11 mo	Finely chopped or mashed foods, and foods that baby can pick up	3-4 meals plus on appetite offer 1-2 snacks	½ of a 250 mL cup/ bowl
12-23 mo	Family foods, chopped or mashed if necessary	3-4 meals plus BF. Depending on appetite offer 1-2 snacks	¾ to one 250 mL cup/bowl

If baby is not breastfed, give in addition: 1-2 cups of milk per day, and 1-2 extra meals per day.

The amounts of food included in the table are recommended when the energy density of the meals is about 0.8 to 1.0 Kcal/g. If the energy density of the meals is about 0.6 Kcal/g, recommend to increase the energy density of the meal (adding special foods) or increase the amount of food per meal. Find out what the energy content of complementary foods is in your setting and adapt the table accordingly.

feeding, they should fulfill the AFASS (A – Affordable F – Feasible A – Acceptable S – Sustainable S – Safe) criteria [21]. Explain the advantages of ERF as (i) No risk of HIV transmission; and (ii) ERF milk can be given by other persons. Also enumerate the disadvantages like (i) Animal milk is not a complete food for baby; (ii) Formula milk may be complete but is expensive; (iii) Baby has more risk of infections-diarrhea, respiratory and ear infection and malnutrition; and (iv) Careful and hygienic preparation required each time to sterilize feeding cups, using boiled water and fresh preparation of all feeds 12-15 times in the first 4 months of baby's life.

- (n) Mother who is receiving ART but interrupts ART regimen while breastfeeding (due to toxicity, stock-outs or refusal to continue etc); determine an alternative ART regimen or solution for mother and counsel her regarding continuing ART without interruption. NVP should be given to infant until 6 weeks after maternal ART is restarted or until 1 week after breastfeeding has ended.
- (o) The preferred feeding option for HIV-exposed infants <6 months of age is exclusive breastfeeding. However, in certain situations like maternal death and severe maternal illness breastfeeding may not be possible, in such cases ERF should be done only when AFASS criteria is fulfilled.
- (p) Breastfeeding should stop once a nutritionally

adequate and safe diet without breast milk can be provided. Breastfeeding should not be stopped abruptly. Gradually wean from breast milk over a one month period.

- (q) Mothers known to be HIV infected may consider expressing and heat-treating breast milk as an interim feeding strategy in special circumstances such as:
- When the infant is born with low birth weight or is otherwise ill in the neonatal period and unable to breastfeed; or
  - When the mother is unwell and temporarily unable to breastfeed or has a tempo-rary breast health problem such as mastitis; or if antiretroviral drugs are temporarily not available.
- (r) Nevirapine should be given as prophylaxis for six weeks daily to infants of HIV-infected mothers who are receiving ART and are breastfeeding. Those infants who are receiving replacement feeding should be given four to six weeks of infant prophylaxis with daily NVP (or twice-daily Zidovudine [AZT]). Infant prophylaxis should begin at birth or when HIV exposure is recognized postpartum [20, 21]. The recommended dose of Nevirapine is shown in **Table III**.
- (s) Infants who are identified as HIV-exposed after birth (through infant testing [at 6 weeks or after] or maternal HIV antibody testing) and are breastfeeding, in such cases maternal ART should be initiated and the infant should receive NVP prophylaxis. Perform infant DNA/PCR test if child is 6 weeks or older, immediately initiate 6 weeks or longer of NVP and strongly consider extending this to 12 weeks. The treatment options and baby's HIV status is discussed in **Table IV**.
- (t) Infant identified as HIV-exposed after birth (through infant or maternal HIV antibody testing) and are not breastfeeding. Refer mother to ART Centre after CD4 tests and baseline test and treatment should be started. No NVP needs to be given to infants. Do HIV DNA/PCR test in accordance with national recommendations on early infant diagnosis and initiate treatment if the infant is infected.
- (u) For breastfeeding infants who have been diagnosed HIV positive, pediatric ART should be started and breastfeeding to be continued ideally until the baby is 2 years old [25].
- (v) For breastfeeding infants, diagnosed HIV-negative, breastfeeding should be continued until 12 months of age ensuring the mother is on ART as soon as possible. The Early Infant diagnosis (EID) is repeated for the 3<sup>rd</sup>

**TABLE II** OPTIONS OR TREATMENT PLANS IF MOTHER IS KNOWN TO BE HIV EXPOSED

	<i>Mother Exposed to HIV</i>					
	<i>Infant Uninfected/ Status unknown</i>	<i>Mother diagnosed during labor / post-partum</i>	<i>Infant diagnosed after birth</i>	<i>Infant diagnosed after birth</i>	<i>Mother's ART regimen getting interrupted</i>	
EBF	Six months	Six months	Not Breastfeeding	Six months	Not Breastfeeding	EBF Six months
Complementary feeding	Start at six months	Start at six months	Start at six months	Start at six months	Start at six months	Start at six months
Maternal ART	Yes	Yes	Yes	Yes	Yes	Counseling for regular ART. Consider alternative ART
Infant Prophylaxis	NVP six weeks	NVP twelve weeks	NVP six weeks	NVP twelve weeks	No NVP	NVP six weeks after restarting Maternal ART
Continue breastfeeding	Yes, For 1 year in EID negative infants	Yes, For 1 year in EID negative infants and 2 years for EID positive infants	No BF	Yes, For 2 years for EID positive infants	No BF	Yes, For 1 year in EID negative infants and 2 years for EID positive infants
Infant Evaluation and Treatment	EID: Do DBS (Dried Blood Spot) for DNA/PCR at 6 weeks for all HIV exposed babies; if positive do WBS (Whole blood specimen). If WBS positive, start Paediatric ART irrespective of CD4% for babies less than 2 years. Final confirmation of the HIV status in the baby should be done at 18 months by doing all 3 Rapid Tests irrespective of earlier EID status					

*EBF: exclusive breastfeeding; NVP: Nevirapine; ART: Antiretroviral treatment; EID: early infant diagnosis.*

time (when previous 2 EIDs have been negative) after 6 weeks of stopping breast feeds. If rapid test is positive, then do Dried Blood Spot (DBS). If DBS is positive, then do, Whole Blood Sample (WBS) test. If WBS test is positive, Pediatric ART should be initiated. However, confirmation test for HIV has to be done at 18 months using 3 rapid antibody tests for all babies irrespective of the earlier EID status or the fact that Pediatric ART has already been initiated.

### Concept and Need of Human Milk Banks in India

(a) Human Milk Banks should be promoted considering the large number of babies needing pasteurized donor

**TABLE III** DOSES OF NEVIRAPINE

<i>Infant age</i>	<i>Dose</i>
Birth to 6 wks (Birth weight 2000-2499 g)	10 mg once daily
Birth to 6 wks (Birth weight ≥2500 g)	15 mg once daily
>6 wks to 6 mo	20 mg once daily
>6 mo to 9 mo	30 mg once daily
>9 mo to end of breastfeeding	40 mg once daily

human milk when mother's own milk is not available. In 1980 the WHO and UNICEF jointly declared: "Where it is not possible for the biological mother to breastfeed, the first alternative, if available, should be the use of human milk from other sources" [26].

(b) Cost effectiveness of using banked human milk in neonatal intensive care units has been documented in Western countries, largely due to reduction in rates of necrotizing enterocolitis [27,28], reduction in severe infections [29-31] and decreased length of hospital stay [32]. Given the high incidence of sepsis and a large burden of premature births, this intervention has a potential to result in substantial saving for the nation in terms of finances and human capital.

(c) Presence of human milk bank is also a factor promoting breastfeeding.

- Use of pasturized donor human milk in NICU is associated with increased breastfeeding rate at discharge from the hospital for very low birth weight (VLBW) infants [33].
- The novel approach of promoting human milk banks



**TABLE IV** OPTIONS FOR HIV EXPOSED BABIES AFTER BIRTH

	<i>HIV Negative</i>	<i>HIV Positive</i>
Breastfeeding	Exclusive breastfeeding for six months Continue breastfeeding for one year. The stoppage of breastfeeding after one year should be gradual and not abruptly	Exclusive breastfeeding for six months Continue breastfeeding for two years The stoppage of breastfeeding should be gradual and not abruptly
Complementary feeding	At six months	At six months
NVP Prophylaxis	NVP for 6 weeks extending to twelve weeks if breastfeeding	NVP for 6 weeks if breastfeeding No NVP if not breastfeeding
ART	ART to mother only and NVP prophylaxis to the baby	ART to mother and start Pediatric ART also

*ART: antiretroviral treatment; NVP: Nevirapine.*

through mode of collecting breast milk donations in form of camps can be a strong means of promoting breastfeeding in the society.

- (d) It is recommended that there should be a human milk bank in each sick newborn care units (SNCU) and neonatal ICU initially preferably in government set-up, and subsequently in private and corporate sectors.

### 5. Feeding in Other Specific Situations

- (a) *Feeding during sickness* is important for recovery and for prevention of under nutrition. Even sick babies mostly continue to breastfeed and the infant can be encouraged to eat small quantities of nutrient rich food more frequently and by offering foods that the child likes to eat.

(b) *Infant feeding in maternal illnesses*

- (i) Painful and/ or infective breast conditions like breast abscess, mastitis and psychiatric illnesses which pose a danger to the child's life *e.g.* postpartum psychosis, schizophrenia may need a temporary cessation of breastfeeding.
- (ii) Chronic infections like tuberculosis, leprosy, or medical conditions like hypothyroidism need treatment of the primary condition and do not warrant discontinuation of breastfeeding.
- (iii) Breastfeeding is contraindicated when the mother is receiving certain drugs like anti-neoplastic agents, immuno-suppressants, antithyroid drugs like thiouracil, amphetamines, gold salts, *etc.* Breastfeeding may be avoided or continued with caution when the mother is receiving following drugs—atropine, reserpine, psychotropic drugs. Other drugs like antibiotics, anesthetics, antiepileptics, antihistamines, digoxin, diuretics, prednisone, propranolol *etc.* are considered safe for breastfeeding [34].

(c) *Infant feeding in various conditions related to the infant*

- (i) Breastfeeding on demand should be promoted in normal active babies. However, in difficult situations like VLBW, sick, or depressed babies, alternative methods of feeding can be used based on neuro-developmental status. These include feeding expressed breastmilk through intra-gastric tube or with the use of cup and spoon. For very sick babies, expert guidance should be sought. If the baby is transferred to SNCU/NICU, mothers should be supported to start breastmilk expression within initial hours, continue at least 3 hourly during the day time and at least once at night.
- (ii) Ensure early transfer of mothers with the baby in SNCU/NICU and that has arrangement to accommodate the mothers in the immediate vicinity and that mothers are permitted to visit, hold and touch the baby at will if the baby's condition permits.
- (iii) Ensure that majority of babies are on exclusive breastfeeding or on breastfeeding plus expressed breastmilk at discharge from the SNCU/NICU.
- (iv) Gastro-Esophageal Reflux Disease (GERD) is often treated conservatively when it is mild, through thickening of the complementary foods, frequent small feeds and upright positioning for 30 minutes after feeds.
- (v) Primary Lactose Intolerance is congenital and may require long term lactose restriction. Secondary Lactose Intolerance is usually transient and resolves after the underlying condition has remitted. Most of the cases of diarrhea do not require stoppage of breastfeeding.
- (vi) Various Inborn Errors of Metabolism warrant restriction of specific offending agent and certain dietary modifications *e.g.* in galactosemia, dietary

lactose and galactose should be avoided. This is probably the only absolute contraindication to breastfeeding.

- (vii) During emergencies, priority health and nutrition support should be arranged for pregnant and lactating mothers. Donated or subsidized supplies of breastmilk substitutes (e.g. infant formula) should be avoided, must never be included in a general ration distribution, and must be distributed, if at all, only according to well-defined strict criteria. Donations of bottles and teats should be refused, and their use actively avoided.

### **Micronutrient in infant Feeding**

- (a) Breastmilk has usually adequate amount of iron, calcium, phosphorus and vitamin A for a normal newborn. Preterm infants who are breastfed should receive 2 mg of supplemental iron per kg of body weight each day after one month of age [35]. Preterm and low birth weight infants may also need calcium and multivitamin supplements.
- (b) Breastfed infants can maintain normal vitamin D status in the early post-natal period only when their mother's vitamin D status is normal and /or the infants are exposed to adequate amount of sunlight. Corroborative evidences of high prevalence of vitamin D deficiency in Indian infants suggest that they should be given routine vitamin D supplementation of 400 IU daily, especially in those with higher risk of getting less of vitamin D. Even those on formula feed needs supplementation unless they consume more than 1000 mL of formula daily [36,37]. VLBW infants should be given vitamin D supplements at a dose ranging from 400 to 1000 IU per day until six months of age [38].
- (c) Food items that supply micronutrients should be encouraged like GYOR (green, yellow, orange and red) vegetables and fruits, Use of food fortification like iron-fortified foods, iodized salt, vitamin A enriched food etc. are to be encouraged.

### **Junk Food and Infant Feeding**

- (a) Consumers are often bewildered by nutritive and health claims, while children are highly influenced by advertisements enticing them to buy a product which may be unhealthy or in fact detrimental [39].
- (b) The parents should understand that though the companies are promoting many foods as "Magic food" in reality such products do not exist.
- (c) Avoid Junk and Commercial food which are high in SSFAP (sugar, salt, fat, additives/preservatives and pesticides). Avoid giving ready-made, processed

commercial food from the market.

- (d) Junk foods are one of the important reasons for the increasing incidence of childhood obesity. There is need to restrict consumption of junk food especially in and around educational institutions and remote areas of the country.
- (e) The provisions of The Food Safety and Standards Act 2006 should be implemented and monitored regularly [40].

### **Maternal Nutrition**

- (i) In India, 22% babies born each year have low birth weight (LBW), which has been linked to maternal under-nutrition and anemia among other causes. Half of adolescents (boys and girls) have below normal body mass index (BMI) and almost 56% of adolescent girls aged 15-19 years have anemia.
- (ii) Optimal nutrition of adolescent girls, pre-pregnant women and pregnant mothers is critical to intrauterine growth, fetal well-being and to prevent malnutrition in the postnatal period [41].
- (iii) There is growing evidence that maternal nutritional status can alter the epigenetic state (stable alterations of gene expressions through DNA methylation and histone modifications) of the fetal genome. This may provide a molecular mechanism for the impact of maternal nutrition on both fetal programming and genomic imprinting. Just as the damaging effects of malnutrition, pass from one generation to the next, so can benefits of good nutrition [42].
- (iv) The maternal nutrition should also be balanced, fresh and preferably home-made and there should not be any unscientific restrictions.

### **OPERATIONAL GUIDELINES**

#### ***Recommendations for Governmental and International Agencies***

- (a) Global legislation, binding to all states and private organizations including labor benefits, 6 months maternity and appropriate paternity leave is strongly recommended. Maternity leave, day care facilities and paid breastfeeding breaks should be available to all employed women in all sectors including those engaged in atypical forms of dependent work.
- (b) Breastfeeding is a human right both for the mother as well as baby. With due weightage and respect to National Family Planning Policies and Program, the benefits should be given to mother and the child (even after 2 issues) born out of unplanned pregnancy (Family planning method failure) or as a result of

accidental death of previous child.

- ↓
- (c) Scientific and unbiased IYCF practices must be promoted through regular advertisements in state, public or private owned audiovisual and print media. Public should be made aware that artificial, junk or packaged food can be injurious to the health of the children.
  - (d) Necessary and adequate arrangements should be made for propaganda and implementation of the provisions of Infant Milk Substitute (IMS) Act which prevents advertising or promoting infant milk substitutes, feeding bottles and teats. In addition, further strengthening of the existing Act must be tried.
  - (e) Adopt a National policy to avoid conflict of interests in the areas of child health and nutrition. Popularization of “unscientific health claims” by commercial ads through media needs to be restricted. UN agencies shall help in promoting the home made/ available food (especially through various media) with the help of their brand ambassadors/endorsers.
  - (f) There should be a board, commission or committee to monitor, evaluate and censor food product before it is released in the market. Such board or committees shall have a sensitized pediatrician and/ or other equivalent health care expert/ nutrition expert. A pediatrician shall also be involved in the commission/ committee/ board entrusted with drafting of any code, bill, laws, rules/ regulations related to food, nutrition, drinks, food products, etc.
  - (g) Human milk banks shall be promoted, established and maintained at least in District/ Civil hospitals and Medical colleges.

#### **Role of Non-Government Organizations**

- (a) Various programs or community projects should be initiated to provide home care and counseling on IYCF through formation of mother support groups especially by women’s organizations.
- (b) The voluntary organizations should understand and advocate important recommendations at all levels. Various like-minded organizations should work preferably on the same platform and co-ordinate with each-other in promoting the IYCF practices.

#### **Recommendations for Media**

The media can have a vital role to play in strengthening the knowledge chain, serving as a link between the stakeholders and the community as community is exposed to images, articles and ideas in innumerable ways from television, newspaper headlines, magazine covers, movies,

websites, video games and road side signboards. Media has a great power but it is high time that it recognizes its responsibility towards child nutrition:

- (a) Media has to take concrete steps to avoid directly or indirectly glamorizing/promoting bottle feeding, artificial, commercial and ready to use food. Instead, the risks involved in artificial feeding and other suboptimal feeding practices should be advertised prominently in bold prints.
- (b) Media support is even more important on certain occasions, celebrations, and social mobilization activities such as World Breastfeeding Week and Nutrition Weeks.
- (c) The companies and media should have self-regulatory pledge for responsible advertising/ marketing. They should help in promoting healthier dietary choices and a more active life style for Indian children.
- (d) Sportsman, celebrities should not promote various nutritional products; only evidence-based scientifically sound and authentic information shall be provided.

#### **Recommendations for Training**

- (a) It is recommended that all the community health workers, PPTCT counselors, and other personnel caring for children including doctors should undergo three days skill training on IYCF (including IMS Act). In situations where three day training is not feasible, some impact can be made with short duration sensitization programs of half day or one day.
- (b) IYCF should also be included in the curriculum of undergraduate and postgraduate medical education, nursing education, home science, child nutrition courses *etc.*
- (c) State, National and International level workshops on IYCN should be organized at regular intervals for capacity building of IYCN Resource Personnel.
- (d) In addition to above measures dedicated skilled breastfeeding (IYCN) support is critical to achieve IYCF goals. Hence there is a need to launch an ambitious program to create a spectrum of such resources [Lactation consultants, IYCF counselors and Peer counselors).

#### **Baby Friendly Concepts**

Baby Friendly Hospitals Initiatives (BFHI) is recommended to be spread to all especially medical college hospitals departments. The revised and expanded version of BFHI has been implemented by UNICEF and WHO in 2009 [43]. BFHI was implemented partially in some states of India in 1992 but over the years it has not been reinforced

**Box 2** KEY MESSAGES RELATED TO INFANT AND YOUNG CHILD NUTRITION

- Initiation of breastfeeding as early as possible after birth, preferably within one hour.
- Exclusive breastfeeding in the first six months of life and no other foods or fluids.
- Appropriate and adequate complementary feeding after completion of six months. Complementary foods should not be confused with supplementary foods.
- Hand washing with soap and water at critical times – including before eating or preparing food and after using the toilet.
- Avoid junk food. Home food should be preferred over artificial, commercial, tinned or packaged food.
- Promote and establish Human Milk Banks.
- Full immunization and Vitamin-A supplementation with deworming.
- Effective home based care and treatment of children suffering from severe acute malnutrition.
- Adequate nutrition and anemia control for adolescent girls, pregnant and lactating mothers.
- Effective implementation and monitoring of IMS Act and other laws related to child nutrition.

or reevaluated. Strengthening of this initiative in the community would lead to better child survival.

**Box 2** Summarises key recommendations related to infant and young child feeding.

*Acknowledgments:* We thankfully acknowledge the help, co-operation, assistance and guidance from the Hon. Shri J P Naddaji, Union Minister, Ministry of Health- Family Welfare, Hon. Shri Hansrajji Ahir, Minister of State for Chemicals and Fertilizers and Ministry of Women Child - Development. We thank Dr Rakesh Kumar (Joint Secretary-MOHFW), Dr. Ajay Khera Deputy Commissioner (Child Health and Immunization) MOHFW, Dr. Sila Deb (Deputy Commissioner - Child Health, MOHFW), Dr Anupam Sachdeva, WHO, UNICEF, Ms. Ruchika Sachdev (PATH) and Smt. Santra Devi Health and Educational Trust for designing and technical assistance.

*Funding:* None; *Competing interests:* None stated.

**REFERENCES**

1. C-14 Population in five year age-group by residence and sex. New Delhi; Office of the Registrar General and Census Commissioner, Ministry of Home Affairs, Government of India; 2011. Available from: <http://www.censusindia.gov.in/2011census/C-series/C-14.html>. Accessed July 11, 2015.
2. Improving Child Nutrition. The achievable imperative for global progress. New York: United Nations Children's Fund (UNICEF); c 2013. Available from: [www.unicef.org/](http://www.unicef.org/)

[publications/index.html](http://publications/index.html). Accessed July 11, 2015.

3. Arnold F, Parasuraman S, Arokiasamy P, Kothari M. Nutrition in India. National Family Health Survey (NFHS-3), India, 2005-06. Mumbai. Available from: [hetv.org/india/nfhs/index.html](http://hetv.org/india/nfhs/index.html). Accessed September 15, 2015.
4. Presentation on Annual Health Survey Fact Sheet Key Findings. New Delhi; Office of the Registrar General and Census Commissioner, Ministry of Home Affairs, Government of India; 2011. Available from: <http://www.censusindia.gov.in/2011-Common/AHSurvey.html>. Accessed July 11, 2015.
5. Ten steps to successful Breastfeeding- UNICEF/WHO Baby Friendly Hospital Initiative (BFHI). Initiation of breastfeeding by breast crawl. Available from: <http://breastcrawl.org/10steps.shtml>. Accessed September 15, 2015.
6. World Health Organization. Kangaroo Mother Care: A Practical Guide. Geneva: Department of Reproductive Health and Research, World Health Organization; 2003. Available from: [http://www.who.int/maternal\\_child\\_adolescent/documents/9241590351/en/](http://www.who.int/maternal_child_adolescent/documents/9241590351/en/). Accessed September 15, 2015.
7. WHO. Relactation: review of experience and recommendations for Practice. Available from: [http://www.who.int/maternal\\_child\\_adolescent/documents/who\\_chs\\_cah\\_98\\_14/en/](http://www.who.int/maternal_child_adolescent/documents/who_chs_cah_98_14/en/). Accessed July 21, 2015.
8. Kesaree N. Drop and Drip method. *Indian Pediatr.* 1993;30:277-8.
9. Auerbach KG, Avery JL. Induced Lactation: A study of adoptive nursing by 240 women. *Am J Dis Child.* 1981;135:340-3.
10. Kramer P. Breastfeeding of adopted infants. *Br Med J.* 1995;310:188.
11. Banapurmath CR, Banapurmath S, Kesaree N. Successful induced non-puerperal lactation in surrogate mothers. *Indian J Pediatr.* 1993;60:639-43.
12. WHO Child Growth Standards: Methods and Development: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age. Geneva: World Health Organization; 2006. Available from: <http://www.who.int/childgrowth/en/>. Accessed September 15, 2015 .
13. Infant and Young Child Feeding: Model Chapter for Textbooks for Medical Students and Allied Health Professionals, Geneva: World Health Organization; 2009. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK148955/>. Accessed September 15, 2015.
14. Dewey K, Lutter C. Guiding Principles for Complementary Feeding of the Breastfed Child. Washington DC, USA: PAHO/WHO, Division of Health Promotion and Protection/Food and Nutrition Program; 2003. Accessed September 15, 2015.
15. Report of the Expert Consultation of the Optimal Duration of Exclusive Breastfeeding. Geneva: World Health Organization; 2001.
16. Family Nutrition Guide. Burgess A, Glasauer P. Rome: Publishing Management Service, Information Division, Food and Agriculture Organization, Viale delle Terme di Caracalla; 2004.

17. Saadeh R, Martines J. Complementary Feeding: Family foods for Breastfed Children. Geneva: World Health Organization; 2000.
18. Teacher's Guide. Complementary Feeding Counseling: A Training Course. Geneva: World Health Organization; 2004.
19. Complementary Feeding: Report of the Global Consultation and Summary of Guiding Principles for Complementary Feeding of the Breastfed Child. Geneva: World Health Organization; 2002.
20. World Health Organization, Consolidated Guidelines on the Use of Antiretroviral Drugs for Treating and Preventing HIV Infection. Recommendations for a Public Health Approach, June 2013.
21. NACO-Updated Guidelines for Prevention of Parent to Child Transmission (PPTCT) of HIV using Multi Drug Anti-retroviral Regimen in India December, 2013.
22. World Health Organization (WHO) PMTCT Guidelines for Pregnant and Breastfeeding Women Living with HIV. Available from: [www.avert.org/world-health-organisation-who-pmtct-guidelines.htm](http://www.avert.org/world-health-organisation-who-pmtct-guidelines.htm). Accessed September 15, 2015.
23. Global update on HIV treatment 2013: Results, Impact and Opportunities: WHO Report in Partnership with UNICEF and UNAIDS: June 2013.
24. NACO-ART guidelines for HIV-Infected Adults and Adolescents: May 2013.
25. Pediatric NACO Guidelines 2013. Available from: [http://naco.gov.in/upload/2014%20mslms/CST/Pediatric\\_14-03-2014.pdf](http://naco.gov.in/upload/2014%20mslms/CST/Pediatric_14-03-2014.pdf). Accessed September 15, 2015.
26. WHO/UNICEF meeting on infant and young child feeding. J Nurse Midwifery. 2015;25:31-9. .
27. Arnold LDW. The cost-effectiveness of using banked donor milk in the neonatal intensive care unit: prevention of necrotizing enterocolitis. J Hum Lact. 2002;18:172-7.
28. Lucas A, Cole TJ. Breast milk and neonatal necrotizing enterocolitis. Lancet. 1990;336:1519-23.
29. Hylander MA, Strobino DM, Dhanireddy R. Human milk feedings and infection among very low birth weight infants. Pediatrics. 1998;102:E38.
30. El-Mohandes AE, Picard MB, Simmens SJ, Keiser JF. Use of human milk in the intensive care nursery decreases the incidence of nosocomial sepsis. J Perinatol. 1997;17:130-4.
31. Narayanan I, Prakash K, Bala S, Verma RK, Gujral VV. Partial supplementation with expressed breast-milk for prevention of infection in low-birth-weight infants. Lancet. 1980;2:561-3.
32. Schanler RJ, Shulman RJ, Lau C. Feeding strategies for premature infants: Beneficial outcomes of feeding fortified human milk versus preterm formula. Pediatrics. 1999;103:1150-7.
33. Arslanoglu S, Moro GE, Bellu R, Tuoli D, De NG, Tonetto P, *et al.* Presence of human milk bank is associated with elevated rate of exclusive breastfeeding in VLBW infants. J Perinat Med. 2013;41:129-31.
34. American Academy of Pediatrics. The transfer of drugs and other chemicals into human milk. Pediatrics. 2001;108:776-89.
35. Armstrong C. Practice Guidelines, AAP Reports on Diagnosis and prevention of Iron deficiency anemia. Am Fam Physician. 2011;83:624.
36. Jain V. Vitamin D deficiency in healthy breastfed term infants at 3 months and their mothers in India; seasonal variation and determinants. Indian J Med Res. 2011;133:267-73.
37. Balasubramanian S, Vitamin D deficiency in breastfed infants and the need for routine vitamin D supplementation. Indian J Med Res. 2011;133:250-2.
38. Guidelines on Optimal Feeding of Low Birth Weight Infants in Low and Middle Income Countries. WHO 2011.
39. Tiwari S. Legislations and infant feeding. *In:* Gupte S, Editor; Text Book of Nutrition. New Delhi: Peepee brothers, 2006. p. 126-134.
40. Mallick MR. Food safety and Standards Act, 2006. *In:* Criminal Minor Acts. 1<sup>st</sup> edition New Delhi, Professional book publishers, 2006. p. 1549-80.
41. Sethi GR, Sachdev HPS, Puri RK. Women's health and fetal outcome. Indian Pediatr. 1991; 28:1379-92.
42. Kuthe A, Shah PK, Patil V. Maternal nutrition and fetus. *In:* Bharadva K, Tiwari S, Chaturvedi P, Bang A, Agarwal RK (eds). Feeding Fundamentals: A handbook on Infant and Young Child Nutrition. First edition, Jaipur Pedicon. 2011. p. 27-32.
43. Baby-Friendly Hospital Initiative. Revised Updated and Expanded for Integrated Care. Geneva: World Health Organization; 2009.

#### ANNEXURE

**Members of the National Consultative Meet:** Dr. RK Agarwal (Chairperson IYCF Chapter of IAP); Dr. Satish Tiwari (Convener); Dr. AP Dubey (Co-ordinator); Dr. Rajesh Mehta, WHO (could not attend), Dr. Balraj Yadav; Dr. Vishesh Kumar; Dr. CR Banapurmath; Dr. ML Agnihotri; Dr. Akash Bang; Dr. Sailesh Gupta; Dr. Sanjay Prabhu; Dr. Prashant Gangal; Dr. Ketan Bharadva; Dr. Rajinder Gulati; Dr. S Aneja; Dr. Sarath Gopalan; Dr. Zeeba Zaka-Ur-Rab, Dr. Urmila Deshmukh, Dr. Elizabeth KE, Dr. Sushma Malik, Dr. Pankaj Vaidya, Dr. Raghunath, Dr. Ashish Jain, Dr. Hima Bindu, Dr. MMA Faridi, Dr. BR Thapa, Dr. Alka Kuthe, Dr. RK Maheshwari, Dr. VP Goswami, Dr. Jayant Shah, Dr. Anurag Singh, Dr. Pankaj Garg, Dr. Anupam Sachdev, Dr. SS Kamath President IAP 2015, Dr. Vijay Yewale- President IAP 2014, Dr. CP Bansal- President IAP 2013, Dr. Pravin Mehta- Secretary Gen IAP 2015, Dr. Kanya Mukhopadhyay.

**Writing Committee:** Dr. Satish Tiwari; Dr. Balraj Yadav, Dr. Ketan Bharadva; Dr. Prashant Gangal, Dr. Sushma Malik, Dr. CR Banapurmath, Dr. Zeeba Zaka-Ur-Rab, Dr. Urmila Deshmukh, Dr. A P Dubey, Dr. Pankaj Garg, Dr. Vishesh Kumar, Dr. R K Agrawal and Dr. Sarath Gopalan.