

**A STUDY OF POLICY ALTERNATIVES TO IMPROVE THE
LEVEL OF MICRONUTRIENT DEFICIENCY IN WOMEN AND
CHILDREN IN INDIA**

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ABSTRACT

The deficiency of micronutrients is a serious problem in India, particularly among children under two and women of childbearing age. Expectant and nursing mothers are especially vulnerable to micronutrient deficiencies. Effects of micronutrient deficiencies such as weakened immune systems, overall morbidity, and stunted childhood growth are reversible in the critical age group of 0 to 2. Providing children with the essential nutrients lacking in their diets during infancy is essential as it can lead to long-lasting health benefits. Understanding this framework will help in identifying gaps in current efforts to address micronutrient deficiencies and improve the current situation. At present, India has Integrated Child Development Services (ICDS) program along with National Health Mission (NHM) to address these requirements of pregnant and lactating women (PLW) and children under the age of six, especially in resource poor population. These interventions have not been very successful in eradicating multi micronutrient deficiencies as the scope is limited to only a few micronutrients such as Vitamin A, iron and folic acid (IFA) etc. The present interventions also reflect a missed opportunity to effectively address this vital issue having an intergenerational impact on the growth and development of the nation. Micronutrient deficiency is called 'hidden hunger' as it is not experienced as food hunger by an individual but affects the proper functioning of the body adversely. An individual's working capacity, productivity and life chances are largely determined by it. This is directly related to morbidity and mortality in children. This paper have discussed the causes of deficiency and policy alternatives to remove the deficiency. The four policy alternatives includes status quo, fortification, supplementation and food coupon were discussed and analyzed on the basis of evaluation criteria. This criteria included effectiveness, efficiency and equity.

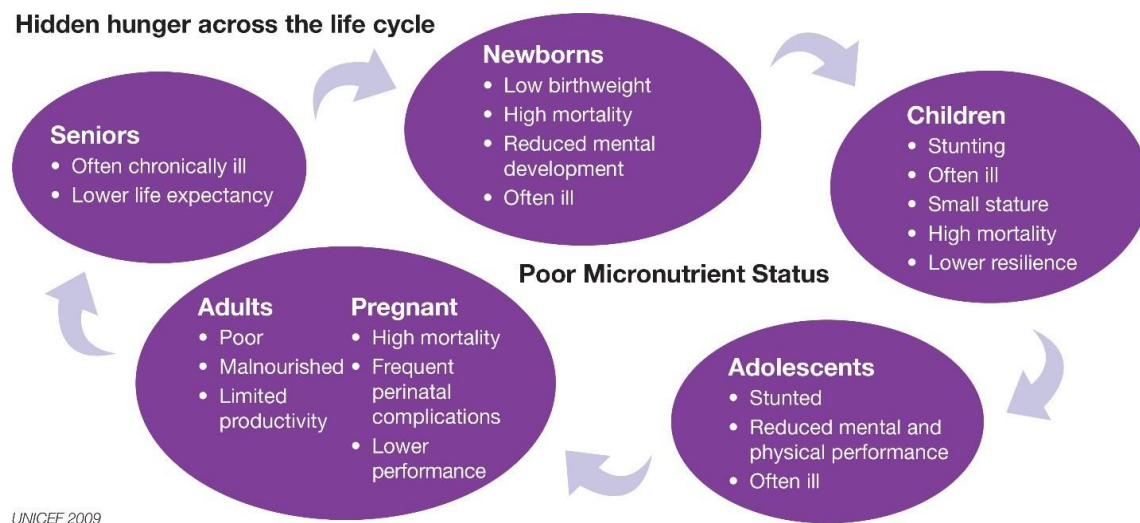
Keywords: Micronutrients, Children, women, policy

INTRODUCTION

The Problem of deficiency of micronutrients is a problem of public health in India. It denotes a missed opportunity to reap the demographic dividend from the abundance of human resources in India as it is the main cause of wide spread poor health and high disease burden in the population. It causes sub-optimal physical growth and cognitive abilities of the children. Iron, zinc, iodine, folic acid, vitamin A, B complex, C, D, calcium, selenium etc., are micronutrients that are required in small quantities for human body but have a lifelong impact on productivity and efficiency of a human being. At present, India has Integrated Child Development Services (ICDS) program along with National Health Mission (NHM) to address these requirements of pregnant and lactating women (PLW) and children under the age of six, especially in resource poor population. These interventions have not been very successful in eradicating multi micronutrient deficiencies as the scope is limited to only a few micronutrients such as Vitamin A, iron and folic acid (IFA) etc. The present interventions also reflect a missed opportunity to effectively address this vital issue having an intergenerational impact on the growth and development of the nation. Micronutrient deficiency is called 'hidden hunger' as it is not experienced as food hunger by an individual but affects the proper functioning of the body adversely. An individual's working capacity, productivity and life chances are largely determined by it. This is directly related to morbidity and mortality in children. It is manifested in form of diseases like anemia, blindness, neural tube defects, goiter, diarrhea etc. and increases the DALY¹s for a nation. Its reduction is a part of United Nations' Millennium Development Goals. The life-long effects of these deficiencies and its intergenerational transfer through undernourished mothers can be seen from the figure below².

¹A DALY is Disability adjusted Life Year. It is the loss of one year of healthy life due to disease or any kind of disability.

²<https://www.thechicagocouncil.org/basic-page/outrageinspire-infographics>



About six thousand children under the age of five die daily in India and 50% of these deaths are attributed to micronutrient deficiencies³. Micronutrient deficiencies contribute significantly to stunting⁴, wasting⁵ and under-weight⁶ of children. It is worth noting that twenty percent of children in India are wasted, forty eight percent are stunted and forty three percent are underweight. According to a World Bank report⁷, India loses US\$ 12 billion in GDP every year due to vitamins and mineral deficiencies. It is important to have an effective public intervention to address this problem.

Causes of micronutrient deficiency in India:

The underlying cause of micronutrient deficiency in India is low intake of multi micronutrients through food by the most vulnerable group i.e. the pregnant and lactating women and children. This can be due to wide spread poverty, food insecurity, and lack of diet-diversity in majority of

³ Kotecha, Prakash V. "Micronutrient Malnutrition in India: Let Us Say 'No' to It Now." Indian Journal of Community Medicine, 33.1 (2008): 9–10. PMC. Web. 20 Nov. 2017, www.ncbi.nlm.nih.gov/pmc/articles/PMC2782240,

⁴ Stunting (moderate and severe) is defined by UNICEF as below minus two standard deviations from height for age of reference which is median for children population.

⁵Wasting is defined by UNICEF as years below minus two standard deviations (moderate and severe **wasting**) and minus three standard deviations (severe **wasting**) from the weight for Height which is at median in the reference children population from the age of six months to five as per UNICEF

⁶ Underweight in children is defined by UNICEF as below minus two standard deviations from weight for age of median of reference population (moderate) or below minus three standard deviations from weight for age of median of reference children population(severe) .

⁷ Nutrition at a Glance-India report , Internet Source-

<http://siteresources.worldbank.org/NUTRITION/Resources/281846-1271963823772/India.pdf>

the population. In women, this deficiency is exacerbated due to low socio-economic status and resultantly, less access to resources and nutritional food. Children of undernourished mothers develop deficiencies in- vitro, kicking off a life cycle of under-nutrition.

As per Global hunger index , 2017, India ranks 100 out of 119 nations in the category of having a 'serious' hunger problem .About 25% population of the 1.3 billion live below poverty line of \$1.25 per day income. The Indian diet is mainly vegetarian. The highest concentration of bio-available micronutrients is found in animal source food such as meat, eggs, fish, milk, milk products, vegetables and fruits. The consumption of these food groups is very low. More than 70% of population consumes lesser than 50% of recommended dietary allowance (RDA) of micronutrients⁸. However, the most affected population group, the PLW and children under the age of two needs to be targeted on priority as the first 1000 days after conception present the most critical window of opportunity for impacting optimum growth and development in a child.

Based on this diagnosis of the problem, the **objective of the proposed policy** is -:

- To increase intake of adequate multi micronutrients by the target population consisting of pregnant and lactating women and children below the age of two years.

Policy alternatives:

A) Status quo: The Indian government has launched various programs to alleviate malnutrition. Integrated Child development Services program (ICDS), started in 1975, and provides safety net in terms of conditional cash transfer or provision of nutrition to supplement their diets to the PLW and children (below the age of six). It provides iron folic acid (IFA) tablets to PLW and IFA syrup to the children . It also provides counseling and referral to acute mal- nourished children. The National Prophylaxis Program against Nutritional Blindness due to Vitamin A deficiency (NPPNB due to VAD) was initiated in 1970 to address VAD. Promotion of Infant & Young Child Feeding Practices (IYCF) and deworming are supplementary interventions. The scope and duration of the outreach are very limited. Research has established the necessity of metabolic interaction between various micronutrients for their efficacy. For example, the absorption of iron from non-heme sources (as in vegetarian diets) requires presence of vitamin C. Further hematopoietic vitamins such as vitamin B12, folic acid, etc. are required for production of hemoglobin even if sufficient iron is present in the body. This is perhaps the reason that despite IFA supplementation for the last forty years, problem of anemia is still present in more than 53% women and 58 %

⁸ Kotecha, Prakash V. ,Micronutrient Malnutrition in India

children as per latest National Family and Health survey (NFHS)⁹. Therefore, a new comprehensive approach is essential to success.

B) Fortification: This intervention improves access to nutrient rich diverse diet by ensuring easy availability of micronutrient-enriched food to target population through fortification¹⁰ or bio-fortification¹¹. Fortification of staple foods commercially with micronutrients needs no diet change. It is more universal than a targeted approach. The government can either make it mandatory through legislation or incentivize food and Agro –research companies through tax-incentives to fortify food and crops. Point of use or home fortification involves use of multi-micronutrient sprinkles which can be added to home cooked food. Cereal flours, grains, condiments, milk etc. fortified with nutrients have evidence of significant impact. Iodization of salt is an example of successful intervention in India. Mandatory labeling and social marketing campaigns improve nutrition awareness. Bio-fortification of food crops has similar benefits.

C) Supplementation: Multi- micronutrient supplements (MMS) administered as part of health care or specific nutrition campaigns can replace the presently given iron and folic acid (IFA) tablets to pregnant and lactating women (PLW). Studies suggest that prenatal supplementation with multi micronutrients was associated with a significantly reduced risk of low-birth-weight infants and with improved birth weight when compared with iron–folic acid supplementation.¹² Quality control of supplement can be a challenge to overcome.

D) Food Coupons: Food packages of pre-selected items from diverse food groups having adequate content of macro and micro nutrients can be provided to the vulnerable group through food coupon system. These food packages could be obtained from the market and will include fortified food along with baby food. This intervention can be a public-private partnership initiative. In USA, WIC program is a successful example of food stamp based intervention.

Criteria for evaluation:

Efficiency: This evaluates the cost effectiveness of the chosen alternative. World Health Organization has devised a CHOICE (Choosing Interventions that are Cost Effective) tool. This

⁹ <http://rchiips.org/NFHS/pdf/NFHS4/India.pdf>

¹⁰Fortification of food with micronutrients implies commercially adding bioavailable form of micronutrients to staple foods such as flour, oil, condiments, milk, salt ,breakfast cereal etc. by food companies

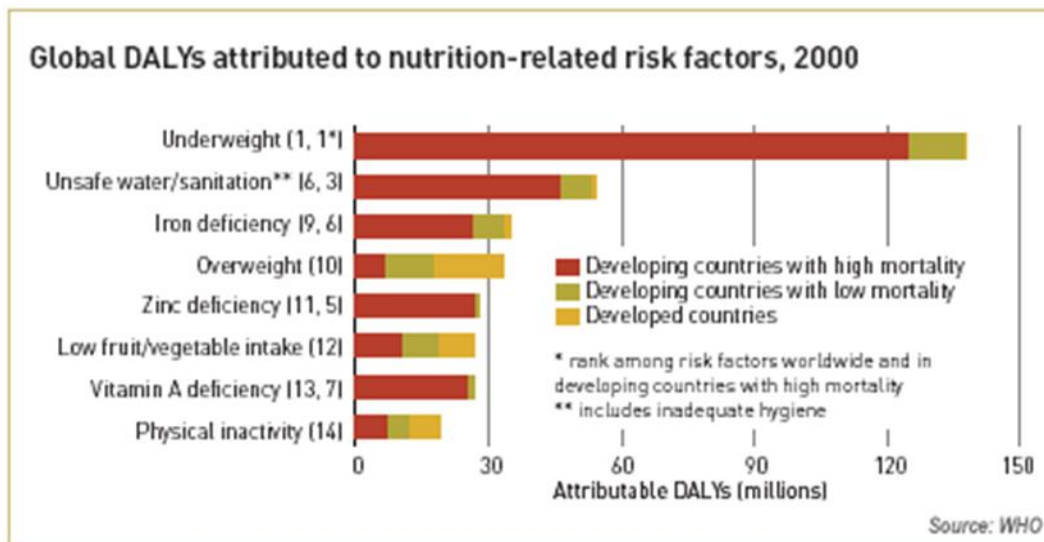
¹¹ Bio-fortification means fortifying food crops with nutrients through agronomical, plant breeding practices and biotechnology .Vitamin A enriched Golden rice in Indonesia, Zinc enriched rice in Bangladesh, Iron enriched wheat varieties are some examples.

¹²Shah P. S. and Arne O. "Effects of Prenatal Multimicronutrient Supplementation on Pregnancy Outcomes: A Meta-Analysis." CMAJ 180.12 (2009): E99–E108. PMC. Web. 20 Nov. 2017.

tool gives estimates for cost effectiveness of micronutrient interventions by incorporating known costs of intervention, its effectiveness as per deficiency status and morbidity/mortality outcomes. The costs relating to production, delivery and distribution for fortification / bio fortification are considered.

For supplementation, the cost of production, delivery and distribution of multi-micronutrient supplements to the identified population are considered. Benefits-cost ratio can also be calculated enumerating all the monetary and opportunity costs along with benefits of the intervention. Cost per unit of Disability adjusted life years (DALY) saved is a widely used measure.

Effectiveness: This evaluates the achievement of the intended outcomes. The effectiveness criteria can be measured in terms of DALYs saved. From the figure below, it can be seen that India falls in the category of developing countries with high mortality and thereby, has very high risk in terms of DALYs.



Along with DALYs saved, the parameters in the present context can be reduction in percentage of anemic, stunted, wasted and underweight population. Other parameters can be a reduction in morbidity, especially deficiency related diseases like blindness, goiter, diarrhea, neural tube defects etc. Reduction in maternal /infant mortality rate and reduction in under five children deaths are other indicators of effectiveness.

Equity: This criterion takes into account differential in socio-economic status, vulnerability, health outcomes and impact for evaluating outreach of the program. PLW and children are the most affected population with greatest probability of long-term consequences of deficiency.

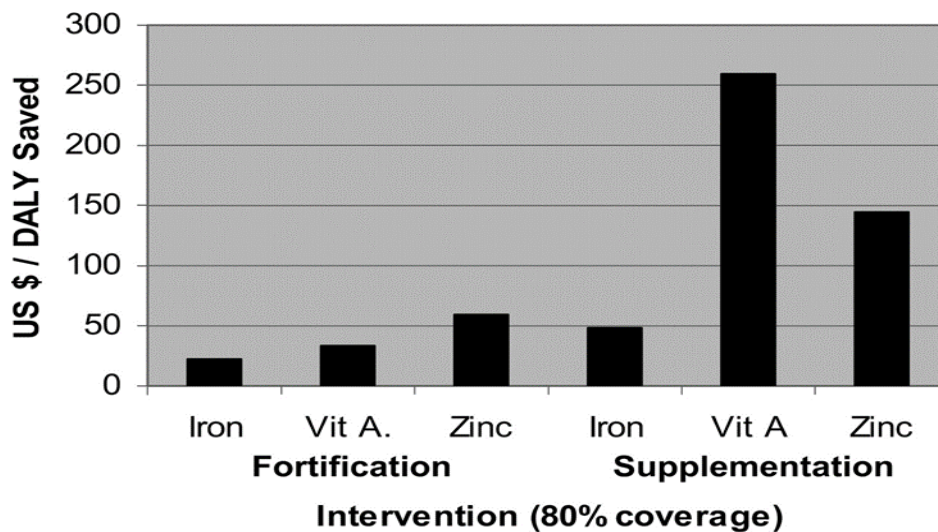
Interventions should enhance their access and control over resources and provide them equitable opportunities of growth, development and optimum health.

Projected outcomes:

The projection of outcomes in terms of different criteria is based on the available data and evidence based theories. It can be ranked as high, moderate or low for different alternatives based on a comparative evaluation.

In terms of efficiency, the present intervention (status quo) is ranked low as it has high costs of administration and low impact on micronutrient deficiency in the target population till now. There is a high neonatal, infant and maternal mortality percentage in India despite intervention. It is plagued with issues of corruption such as pilferage of food in supplementary nutrition program, low intake/compliance of IFA supplements by target population etc.

A study compares the cost- effectiveness of fortification and supplementation alternative. As per unit cost of saved DALYS, results for one sample region (East Africa) are shown in figure below (source WHO)¹³.



Although cost per DALY saved are very low for both the interventions but supplementation is more costly than fortification. Therefore, in terms of efficiency, the supplementation has a moderate rating. Fortification is more efficient than supplementation and can be ranked as high. A detailed study across 48 countries and 250 possible fortification interventions identifies wheat fortification with multi micronutrients in India to be most cost effective. At 15.76 US \$ per

¹³ Horton Sue, The economics of fortification, Journal of Nutrition. April 2006 ,vol. 136 no. 4

DALY saved.¹⁴ A study calculates &):1 as the benefit- cost ratio for iodization of salt¹⁵. For iron fortification, The benefit: cost ratio for fortification with iron gives an estimate of 6:1 in terms of increased physical productivity and including the benefits of cognition, this ratio is increased to 36:1¹⁶. For food coupons program, the cost effectiveness is likely to be low. Although it has been proven to be effective in WIC program in USA, its budgetary implication is huge for a country like India where there is a large number of the target population. It is likely that it will be less efficient in terms of benefit-cost ratio as the benefit is likely to be diverted to non-target population due to socio-economic factors.

In terms of effectiveness, as discussed above, the status quo approach ranks low as despite more than four decades since its implementation, micronutrient deficiency and morbidity/mortality burden in the target population is very high. Several research studies have brought out that supplementation reduces anemia, improves the status of micronutrient deficiency and contributes to cognitive and physical growth in children^{17,18}. However, in India despite iron supplementation, majority of the target population is anemic. Provision of supplementation can be ensured under this intervention but monitoring consumption can be a challenge. As per NFHS (2015-16)¹⁹, pregnant women who received 100 IFA tablets are 30% only. Therefore, effectiveness of supplementation is moderate at the best. The fortification of food involving various strategies such as fortification of staple food like wheat flour or rice, bio-fortification of crops and point of use fortification of food through multi micronutrient powder sprinkles is comparatively more effective as the reach and regular consumption of this food is likely to be better. No change in food habits is required. A study has shown that in India, in the state of Karnataka, iron fortified salt led to drastic reduction in anemia in children from 16.8% to about 8% after a consumption

¹⁴Fiedler JL; Macdonald B., A strategic approach to the unfinished fortification agenda: feasibility, costs, and cost-effectiveness analysis of fortification programs in 48 countries, *Food and nutrition bulletin*, 2009 Dec;30(4):283-316.,<https://www.ncbi.nlm.nih.gov/pubmed/20496620>

¹⁵Horton S. The economic impact of micronutrient deficiencies. In: *Micronutrient deficiencies during the weaning period and the first years of life*. Nestle Nutrition Workshop Series Pediatric Program. Vol.54. Geneva: Karger; 2004. p. 187–97. <http://jn.nutrition.org/content/136/4/1068.long>

¹⁶ Horton S, Ross J. The economics of iron deficiency. *Food Policy*. 2003; 28:51–75.

¹⁷HopleT, Burger J., ‘Multiple micronutrient supplementation improves anemia, micronutrient nutrient status, and growth of Vietnamese infants: double-blind, randomized, placebo-controlled trial’, *The Journal of Nutrition*, 2005 Mar; 135(3):660S-665S Internet Source-<https://www.ncbi.nlm.nih.gov/pubmed/15735111>

¹⁸Allen, L H, Peerson, J M, Olney ,D K, ‘Provision of multiple rather than two or fewer micronutrients more effectively improves growth and other outcomes in micronutrient-deficient children and adults’, *The Journal of Nutrition*, 2009 May. Internet source-<https://www.ncbi.nlm.nih.gov/pubmed/19321586>

¹⁹ <http://rchiips.org/NFHS/pdf/NFHS4/India.pdf>

period of ten months²⁰. Similarly, another study showed that Vitamin A, iron and Vitamin D fortified milk reduced anemia in children in Sao Paulo from 62% to about 26%²¹. Therefore, the effectiveness of fortification is high. For the food coupon based approach, the WIC in USA has been very successful in fulfilling the nutritional needs of the vulnerable population. Several studies have found this intervention to be highly effective in reducing hospital costs for mothers and children, low birth weight problem and infant deaths.²²

In terms of equity, supplementation has better targeting for the vulnerable population. The probability of sustained and sufficient consumption of fortified food by the target population is comparatively low due to low socio-economic status of women and her position in the household generally. Similar is the situation for food coupon based rations as it is likely to be divided amongst other members of the household. These two interventions rank as moderate as per this criteria. Supplementation is more equitable comparatively in short term as it provides support to more at-risk population and improves the life chances of children of undernourished mothers or from resource poor population. The present intervention is also highly equitable in its approach as it targets the most vulnerable population, the women and children from 'below the poverty line' families. The matrix of projected outcomes for different alternatives based on laid down criteria is as below:-

²⁰ Best, C, Neufingerl, N, Del Rosso, J M, Transler C, van den Briel T, Osendarp S., 'Can multi-micronutrient food fortification improve the micronutrient status, growth, health, and cognition of schoolchildren? A systematic review', Nutrition reviews, 2011 Apr; 69(4). doi: 10.1111/j.1753-4887.2011.00378.x. Internet source: <https://www.ncbi.nlm.nih.gov/pubmed>, © 2011 International Life Sciences Institute

²¹ Eichler, K, Wieser, S, Rüthemann, I, Brügger, U, 'Effects of micronutrient fortified milk and cereal food for infants and children: a systematic review', BMC public health, 12(1), 506, 2012, https://www.researchgate.net/publication/228439744_Effects_of_micronutrient_fortified_milk_and_cereal_food_for_infants_and_children_A_systematic_review

²² Avruch, S, Puente C, Alicia, "Savings Achieved by Giving WIC Benefits to Women Prenatally", Public Health Reports. , 1995, quoted at <https://en.wikipedia.org/wiki/WIC>

Outcome Matrix

<i>Alternatives</i>	Status quo	supplementation	Fortification	Food Coupons
<i>Criteria</i>				
Efficiency	low	moderate	high	low
Effectiveness	low	moderate	high	high
Equity	High	High	Moderate	Moderate

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