Cereal Fortification Programs in Developing Countries

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Abstract

Malnutrition is a major problem among children especially in the developing world. In most developing countries children show growth faltering between 6 and 24 months of age due to inadequate complementary feeding. Complementary foods are transitional foods given in addition to breast milk, following exclusive breastfeeding during the first 6 months, to meet the full nutritional requirements of the infant. Strategies to improve the availability of and accessibility to low cost complementary foods can play an important role in improving the nutritional status of infants and young children. Cereals constitute the most suitable vehicle for delivering micronutrients to an at-risk population because of their widespread consumption, stability and versatility. To reduce the vulnerability to the health impacts of micronutrient deficiencies, several developed and developing countries have adopted various innovative, cost-effective strategies to fortify cereal-based complementary foods and to reach children through public programs. This article reviews cereal fortification programs in developing countries, with special reference to low cost fortified complementary foods, and emphasizes the need for public-private-civic sector initiatives to improve the health and wellbeing of people around the world.

Introduction

Malnutrition is one of the major problems of public health significance in developing countries; it tends to severely affect the most vulnerable groups such as women and young children in rural areas. The increasing migration of rural people to urban and semi-urban areas for economic pursuits is contributing to a third significant group in the form of slums in the urban areas. Malnutrition of children remains of particular concern in the developing
world (fig. 1). The first 2 years of life are a critical window for mental and physical development. The damage that occurs during this period due to malnutrition is often irreversible even if corrective actions are taken later in life. Approximately one third of children less than 5 years of age in developing countries have low height-for-age ratio (≤2 SD with respect to reference data) [1]. It is estimated that around 5.6 million children die from malnutrition each year.

**Nutritional Problems in Developing Countries**

While being underweight or stunted is recognized as an important risk factor for the increased prevalence and severity of infection and high mortality rates, there is increasing evidence on the enhanced risks due to micronutrient deficiencies, and three key nutrients are well known to play a vital role [2]. The prevalence of iron deficiency among children is high in most developing countries and is particularly high in South Asian countries (especially India, Bangladesh, Pakistan and Nepal). During infancy and early childhood, iron deficiency is associated with increased infant mortality, impaired psychomotor development, cognitive function and reduced learning capacity that may be irreversible. Vitamin A deficiency has grave consequences for the survival and wellbeing of children. Improving vitamin A status has been shown to reduce child morbidity and mortality as well as pregnancy-related
mortality. Iodine deficiency is the leading cause of preventable mental retardation among young children. Other effects of iodine deficiency in the mother range from stillbirths, birth defects to growth retardation and cretinism. The linkages between micronutrient deficiencies and the Millennium Development Goals are highlighted in table 1.

Increasing evidence on the role of zinc and folic acid for young child survival and growth is also being reported. Improving zinc status reduces stunting, morbidity and mortality from diarrheal and respiratory infections [3]. Each year folate deficiency near conception causes 250,000 unnecessary infant deaths or paralysis from folic acid-preventable spina bifida and anencephaly. Spina bifida is devastating as it manifests itself in newborn children as paralysis, bladder and bowel incontinence, bone deformities, or hydrocephalus. It is a significant socioeconomic burden in several developing countries, including India, where the incidence has been reported to be very high [4].

Infancy is a time of rapid physical growth and, therefore, nutritional requirements are at the highest during this period. Adequate nutrition during the first 2 years of life is critical to ensure optimal physical and mental development of infants and young children. Development of successful interventions to improve child feeding practices, in particular, is necessary to avoid serious adverse consequences in the future.

Fortification of Cereals

Fortification of foods has been practiced for several decades in developed countries. Foods that have been fortified with single or multiple micronutrients include margarine, milk, bread, sugar, wheat and other grains, tea, dairy foods, edible oils, formula foods, malted beverages, salt and other specialty items [5–9].

When micronutrient deficiencies are population-wide and result from a combination of low intake and/or low bioavailability, fortification of commonly consumed cereal flours with iron, folic acid and other vitamins offers a number of strategic advantages because cereals flours are widely and regularly consumed, and mostly processed in centralized facilities with established distribution and marketing capacity. Cereal fortification has played a major role in improving the health of the world populations at large. Wheat is the most widely produced cereal in the world, most of which is destined for human consumption. The processing of whole wheat to flour is generally concentrated in a few large mills. The resulting flour is used to make bread, biscuits, pasta, and other products. In a population of school-age Filipino children, it was observed that the routine consumption of a wheat-flour bun fortified with only 33% of the RDA of vitamin A improved vitamin A status [9]. In January 1999, the Government of Indonesia, with support from UNICEF and through an initial premix donated by Mother Care/USAID, started a program for
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fortifying wheat flour with iron. This strategy is believed to have contributed substantially to the reduction of iron deficiency anemia in Indonesia [10].

Folic acid fortification of cereal flours is having remarkable impact in reducing women's risk of having a baby born with a birth defect of the spine or brain (spina bifida or anencephaly). Food fortification was determined to be the best strategy for increasing blood folate levels, as the critical period for adequate intake of folic acid is in the first weeks of pregnancy before most women know that they are pregnant and begin taking supplements. In the US, the fortification of enriched cereal grain products with folic acid began in 1996. By 1999 the National Health and Nutrition Examination Survey conducted by the Centers for Disease Control found that the average level of folic acid in the blood of US women had almost tripled in 5 years [11]. Fortification of flour, pasta and cornmeal has become mandatory in Canada since 1998, and a study in Ontario showed that the incidence of neural tube defects had fallen to 8.6 cases/10,000 pregnancies, down from 16.2 in 1995 [12].

Currently, nearly 40 countries fortify cereal flour. In Latin America flour fortification is implemented on a large scale. Fortification of wheat and maize flours with multiple nutrients has been made mandatory in South Africa and Nigeria. There is growing interest in wheat flour fortification in South and South East Asian countries like Nepal, Bangladesh, Pakistan, Afghanistan, India and China.

**Fortification of Complementary Foods**

In the first 6 months, the dietary requirements of infants can be fully met by breast milk, as specified in WHO guidelines. Thereafter, complementary foods need to be given to augment energy and nutrient intake. Although breastfeeding is common in most developing countries, children show growth faltering between 6 and 24 months of age due to inadequate complementary feeding. Most children are given a small portion of adult diet. The ‘bulk’ of the cereal-based diet does not allow the young child to consume sufficient quantities to meet their energy and protein requirements. Hence, from the food technology perspective, the challenge is to increase both the energy density of complementary foods and levels of micronutrients at an affordable price. From the public health perspective, we need a combination of proper regulation that protects infant health yet supports industrial innovation and strong public education on appropriate infant feeding practices and psychosocial care of the infant.

The fortification of commercially marketed staple foods such as cereal flours, cooking oils and dairy products could have a small but significant impact for preschool children. However infants and children under the age of 24 months consume a different dietary pattern than older individuals. Cereals are the first complementary foods to be introduced and are intended to
accustom the infant to solid foods. Industrially produced fortified complementary foods are recommended by pediatricians worldwide as an essential part of a nutritionally adequate infant diet (beyond the age of 6 months) and as complementary to breast milk and home-prepared foods. This is essential in order to meet the micronutrient requirements of infants, especially for iron and zinc. Beyond the superior micronutrient content of industrially fortified complementary foods over home-prepared porridges and other traditional infant foods, they also have the advantages of delivering micronutrients of higher bioavailability, energy density and protein quality, and are safe and convenient.

Multiple fortification of infant cereals is common in developed countries. Since the 1950s, the National Supplementary Food Program administered by the Chilean Ministry of Health through primary care health centers, provided milk-based complementary foods free to children from birth to 5 years of age, along with other health and nutrition services. The milk is fortified with iron, ascorbic acid, zinc and copper. The program has helped reduce anemia in Chilean infants from 21 to approximately 1% today [13]. Similarly, data from the CDC pediatric nutrition surveillance system show a reduction in the prevalence of anemia among low income children in the US [14] which could be attributed to increased consumption of fortified ready-to-eat cereals [15]. In a survey in Canada it was observed that 96% of the children between 4 and 10 months received fortified cereals, which were the main source of iron in their diets [16].

Controlled trials in Chinese infants of 6–12 months of age revealed that feeding cereals fortified with iron resulted in a significant reduction in the prevalence of anemia [17]. Recent attention has been focused on the fortification of staple food with iron compounds which may have limited bioavailability and, hence, biological impact [18]. Plant foods high in protein (e.g., legumes) are often mixed with cereals in fortified complementary foods [19]. Both contain a large amount of phytic acid, a powerful inhibitor of trace element and mineral absorption. The influence of phytic acid on calcium, copper and magnesium absorption is of less concern than its effect on iron and zinc absorption [20]. Ascorbic acid is usually added in quantities that exceed the RDA to facilitate iron absorption in mixtures with high levels of phytate. Addition of ascorbic acid in iron-fortified chocolate flavored milk drink increased iron absorption in Jamaican children [21]. It has been observed in various studies that fortification of foods with iron does not have a negative effect on zinc absorption [22].

Given the severity of the problem, it is evident that the burden of micronutrient deficiency can be reduced through a holistic approach that includes promotion of healthy weaning practices, targeted micronutrient supplementation (e.g. high dose vitamin A supplementation every 6 months as recommended by WHO) and use of appropriate complementary foods along with improving the nutritional value of such foods [23].
Strategies to improve the availability of and accessibility to low cost complementary foods can play an important role in improving the nutritional status of infants and young children. It is possible to manage a large proportion of severely malnourished children at home using ready to use therapeutic foods or supplements or using a diet that combines home-based food with vitamin and mineral supplements.

**Targeted Fortification Programs**

Fortification of foods that are targeted to vulnerable and low-income groups needs high priority. There are several opportunities in developing countries which, if seized and applied, could make a vast difference to millions of people suffering from micronutrient deficiencies.

Fortified complementary foods provided through public feeding programs and commercially marketed foods have also had a good impact. In Ecuador, the Ministry of Public Health developed a complementary feeding program by targeting all eligible infants and young children between 6 and 24 months of age living in conditions of extreme poverty by providing coupons to redeem a micronutrient-fortified complementary food (Mi Papilla). At the final survey, the hemoglobin levels in children in the program group were significantly higher compared to children in the non-program group (27.6% prevalence of anemia in the program group versus 44.3% in the non-program group) [24]. In Mexico, the Progresa Program, a large incentive-based development program reaching children and pregnant and lactating women of 4.5 million families with fortified nutrition supplements was associated with better growth in height and hemoglobin values among the poorest and younger infants [25].

There is growing evidence for the impact of home-fortification of complementary foods using premixes in single-dose sachets containing micronutrients in a powder form that can be added to any homemade food for children at risk. These newer methods for addressing iron deficiency include micronutrient Sprinkles™, which were shown to be effective and efficacious in improving the hemoglobin status in anemic infants in several studies conducted in Ghana, Cambodia and many other countries with different levels of iron and various periods of time [26, 27].

The Government of Pakistan is planning to distribute Sprinkles™ through their ongoing Lady Health Worker Program, a large public sector primary health care program. In Bangladesh, BRAC, the largest national NGO in the country, is planning to distribute Sprinkles™ through their on-going Female Community Health Worker Program. In both these countries, Sprinkles™ would be produced locally through public-private partnerships, via a technology transfer agreement.

In India, several public programs such as the Integrated Child Development Services (ICDS), Mid Day Meal (MDM) and Targeted Public
Distribution System (TPDS) provide supplementary food to various age groups. Although ICDS has a life cycle approach reaching children 6 months to 6 years of age, as well as adolescent girls and pregnant and lactating mothers, they too often still only meet the macro level requirements of energy and protein and do not address micronutrient deficiencies sufficiently. However, recently with the efforts of the Government of India and several state governments and support from various international agencies, fortified supplementary foods are being distributed through these programs in states (fig. 2).

Distribution of fortified wheat flour through the TPDS to 0.6 million population living below the poverty line resulted in a significant reduction in the prevalence of anemia and vitamin A deficiency in the state of West Bengal.

The impact of fortified ready-to-eat food – a mix of wheat flour and chick pea flour distributed through ICDS in the state of Gujarat, reaching 0.35 million beneficiaries, revealed a significant reduction from 2 to 0.1% in the prevalence of night blindness amongst children in the intervention area.

In the state of West Bengal, Khichdi (rice, lentils and oil) is the supplementary food distributed through ICDS. A micronutrient premix popularized as Vita ShaktiTM consisting of vitamin A, iron and folic acid, which may be added to prepared Khichdi at the Anganwadi (village) center is also being used in ICDS. The feasibility and acceptability were proved by the high program compliance with both Anganwadi workers to implement and enroll children who consumed most of the Khichdi each time it was served to them. The study also demonstrated that fortified Khichdi was efficacious in improving iron status and reducing the prevalence of iron deficiency and iron deficiency anemia in children aged 3–6 years [28].

An indigenous multiple micronutrient dry powder sachet, meeting one full RDA per child under 2 years of age, has been developed and distributed in two Indian states. The operational feasibility and acceptability of this product tested on 70,000 children have shown high compliance by both mothers and children on parameters such as ease of administration, taste, compliance, etc., while distributing the products to the mothers who were trained in the usage of the sachets along with a single serving of the complementary food [unpublished data]. While the feasibility of distributing Sprinkles™ to over 15,000 children was also reported in Mongolia [29], high acceptability was reported in China because of the perceived benefits and ease of use [30].

**Conclusion**

The first 2 years of life is a critical window during which the optimal mental and physical development of the child needs to be enhanced. Adequate nutrition that combines energy density, proteins and adequate micronutrient levels is a critical component. This requires foods specially tailored and accessible either through commercial channels or through public programs. A number
of promising initiatives on cereal-based fortified foods have been proven effective and can be replicated and scaled-up. Given that most affected populations are extremely poor and that most governments have limited resources, cost limitations need to be borne in mind. Experiences from several countries
have shown that affordable products can be produced and made accessible to
the poorest segments of the population. However, much more work needs to
be done to scale-up and sustain these efforts. Particularly in resource-poor
settings, the sustainability of programs can be greatly enhanced through pub-
lic-private-civil society partnerships. By improving the nutritional status of
young infants we could make an enormous difference to the health and well-
being of future generations around the world.

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Fortification of Complementary Foods


Discussion

Dr. Guano: We have moved from voluntary to mandatory fortifications. In the study by Florentino et al. [1] iron- and vitamin A-fortified wheat buns were given to school children and the efficacy trial showed that they were able to reduce the prevalence of iron deficiency anemia by as much as 92%. Our prevalence of iron deficiency anemia in infants is still at 66%. What do your long-term studies show? What happens to long-term outcomes such as school performance and productivity later in life?

Dr. Bulusu: As I showed in our study on wheat fortification in preschool children, at the end of 1 year of intervention we found that the decrease in the prevalence of anemia was up to 15–20% among the children, but we did not really look at cognitive development or school performance in these children. We do have qualitative results on these parameters collected through group discussions with the local community workers who are teachers in the Integrated Child Development Services (ICDS) as well as the Mid Day Meal (MDM) program, who say that the performance of these under-6-year-old children who come to the center (preschool education before they actually enter formal schools) has improved a lot, not only school performance in the sense of learning, but also their agility has improved. We just started the programs over the last 4–5 years and are still struggling with the form of iron compound to be used because often issues are raised about this.

Dr. Fisberg: In recent years we have seen that, in many developed countries, industries are privately fortifying various staple and industrial foods with iron. Many of these products, especially juices, yogurts and other products, are fortified with iron, usually 20–30% of the RDA. So if children eat all or the majority of these products, their iron levels might be above the upper limits. What do you believe would be the safety level for all these foods?
**Dr. Bulusu:** Until now in India, ever since Micronutrient Initiative (MI) started in 1998–1999, this question, which has been raised by several scientists in the country, has remained the same. Our target has mainly been through government programs, the MDM, the ICDS and the Targeted Public Distribution Scheme (TPDS) programs. Six to eight years ago there were no fortified products through government programs, except for the World Food Program which distributed their India Mix which was fortified with all the micronutrients at very high levels, 80% of the RDA. Today most of the multinational companies coming to India sell their fortified products over the shelf on the open market. I asked my president, who lives in Canada, to list the different fortified products consumed during the day in developed countries. Most of the people in developed countries cover the requirements of most of the micronutrients at breakfast itself. I do agree that there could be an issue of toxicity but in a developed country where people are consuming it and have been able to reduce most of the micronutrient deficiencies, I am sure that in a country like India, or any other developing country, it is safe and the only way to reach at least the poorest of the poor, who otherwise cannot afford fortified substances, through closely monitored government programs.

**Dr. Brown:** I don’t know if this is something to worry about or not, but I would say that in the more affluent countries we have absolutely no control over the total nutrient intake from fortified products and I think this is something that we should be concerned about. Just one example, in the US 90% of infants are consuming more than the upper limit of zinc. In the same study where we looked at trends in zinc consumption over the 5 years for which we had CSFII dietary data, we found that just over those 5-year periods, from the mid to late 1990s, there was a significant increase in zinc intake among preschool children in the US, most of whom are already consuming above the upper limit [2]. When we brought that down by food source of zinc, there was absolutely no change in the zinc consumption from zinc endogenous or intrinsic to a food, but a significant year-by-year increase over that 5-year period in the amount of zinc consumed from fortified foods.

**Dr. Bulusu:** I would like to add one more point. In India we have a National Nutrition Monitoring Bureau that actually monitors the consumption profile of both the food intake as well as the nutrient intake. In most cases across the country it has been seen that the intake of micronutrients is less than 40–50% of the RDA [3]. So we still have another 40–50% if not 60% to be covered through micronutrient fortification of food.

**Dr. Fisberg:** I agree with you that in very developing countries it is important to have this kind of initiative. I really worry about some of the countries, especially those in the transitional phase, where we have to cope with the situation that 50% of small children have anemia, and at the same time the mothers are buying a lot of products from the supermarkets. We probably have to take some kind of control of it.

**Dr. Solomons:** The two stories that you began your talk with, one from Mexico and the other from Chile, are illustrative of two points. The point you made is related to their effectiveness to reduce micronutrient malnutrition. However, the authors from those nations today seem more concerned with a negative effect that both programs have had in provoking excess energy and macronutrient intakes along the way [4, 5]. The unintended consequence of both the Mexican and Chilean public health interventions was an increase in obesity rates in the children covered by the programs. India may or may not be in danger of that consequence. Your local sprinkles are basically calorie free and targeted to a very specific group. But, what I would add in the case of India is the unusual biological and epidemiological situation, the so-called ‘Indian paradox’, that is of the ‘thin-fat’ baby; this suggests that if you, Dr. Bulusu, also link your micronutrients to macronutrient-laden, sweet-tasting vehicles in government-sponsored
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programs, you may fall into the same problems the Chileans and Mexicans have experienced, with adverse consequences for metabolic health.

Dr. Bulusu: Thank you for that excellent point, but I would like to mention that in ICDS the supplementary nutrition components, whether anuka or nutri candy, are always provided along with the food. I would also like to add that though this program started way back in 1975 with the objective of providing 300 calories and 10 g of proteins, it still has not achieved its goal of controlling undernutrition, as is evident from the NFHS-II data. In most cases a substitution nutrition is used instead of supplementary nutrition, so the question of overfeeding may not arise in the near future.

Dr. Solomons: I would point out once again my concern for energy imbalance. India still has a vast number of rural poor with low access to dietary energy, but there is an increasing urbanization of the population. If your programs become general entitlements, without exquisite targeting to the neediest segments of the population, you run the risk of seeing the adverse outcomes and unintended consequences mentioned for Chile and Mexico \cite{4, 5}. Chile and Mexico now openly admit it is the unintended consequence of an inspiration to do good; they did some good, they did some harm, but unfortunately they don't neutralize one each other; so they are rethinking the whole process to tailor to do good plus good.

Dr. Ibe: The costs of these programs, are they subsidized? Is there a move to make them attractive to industry so that they are marketed and made more accessible to the population?

Dr. Bulusu: The costs of the programs are not subsidized. The supplementary nutrition component was being given by the government, the micronutrient component was being supported by the MI to begin with. They are extremely cost-effective, for example ‘Vita Shakti’ costs just 3 Indian cents. As the cost is minuscule, today the government is bearing the cost in some states, which makes it sustainable.

Dr. Ibe: I am worried about the sustainability of the programs. If they are subsidized and paid by the government, is there any chance that at some point the government will refuse to pay, and then is it affordable?

Dr. Bulusu: There are 2 or 3 issues here. First of all ‘fortification’ was a forbidden word in India about 8 years back. Dr. Solomons was in India way back in 1999–2000, when we were having workshops on food fortification where questions about promoting multinational companies in the country were raised. To counteract this most of the products I am developing are within the country, that’s one issue for sustainability. Secondly, there was no question of fortification for the poor, whereas that was the need. So these government programs, that are today bearing the cost of the supplementary nutrition component, have increased the budget several fold. Now the question is if they withdraw funding. First of all it won’t happen because the government has just issued notification, after 9 years of struggle by the MI and World Food Program, that all food going to children in the country and pregnant and lactating mothers through the government-supported programs should be fortified with 9 micronutrients including iron, vitamin A, folic acid, vitamin C, iodine, the B complex group such as B_{6}, B_{12}, B_{2}, and others. We are also trying to target the open market which is going to take time due to the type of population in India where illiteracy is so high. For these people to come to a stage where they understand what are micronutrients, to take those micronutrients on a regular basis and to buy those fortified foods, the government needs to advocate micronutrient consumption. The government is presently promoting the concept of micronutrients in the country through government programs, but for the middle income and high income groups there is fortified flour on the market and today it is being bought by these groups. The poor income group is the beneficiary of these programs where it is supplied free of cost. But the time will come, perhaps in 10 or even 20 years, where, as in the richest
countries such as the USA or Canada, every food is fortified and everybody has access to it.

Dr. Safavi: You have nicely shown the effect of supplementation, fortification and also education. My concern is that if we continue along one of these routes like supplementation or fortification or education alone, it won’t be beneficial to the community. As long as fortification is being given, education should continue. I was also in India during the nutrition congress, and I have seen this gap between the communities in India and as well in other countries. The question is how can we solve this issue of fortifying all the products available, you mentioned chocolate and candies, to avoid problems such as toxicity that might rise during supplementation or the use of these products?

Dr. Bulusu: Part of the question on toxicity has already been answered. First of all, all three strategies need to work hand in hand until such time that we can alleviate the problem of micronutrient malnutrition. The second thing is the supplementation program, I don’t know about Iran but in India it is very targeted. We have the biannual vitamin A supplementation program, but that is only for children from 9 to 36 months and today the government of India is planning to take it to 59 months. Pregnant and lactating mothers are supplemented with 100 tablets of iron and folic acid in the third trimester of pregnancy. In view of the increasing evidence of neural tube defect and spina bifida cases, with support from UNICEF and MI the government is presently supplementing particularly adolescent girls with iron and folic acid in some states because it has been realized that damage has already been done by the time an adolescent girl gets married and is supplemented in the third trimester of pregnancy. The other issue is that of compliance which today is only about 34% after 35 years of this program being in place, so it doesn’t happen. I think it should take a minimum of another 25–30 years, if not more, in a country like India by the time fortification really gets to the stage that it becomes toxic. With dietary diversification over the last 50 years, we have not been able to eradicate even one single deficiency disorder in the country. I am not saying that we don’t need to be careful because there is no toxicity, there could be toxicity. There was one incident in 2001 in the state of Assam where 23 children died during the biannual vitamin A campaign. Later a committee which investigated the whole issue said that it was not because of vitamin A per se but because of a change in the modus operandi of giving the vitamin A. So that was one case over the last 15–18 years in the country. I can at least talk about India, and of course we have offices in Nepal, Bangladesh, Pakistan, Sri Lanka and Indonesia, and to my knowledge also in these countries there has not been any case of hypertoxicity.

Dr. Agostoni: Maybe I have missed something; 23 children died, for what reason?

Dr. Bulusu: This was in 2001 during the biannual vitamin A supplementation campaign, and everybody wanted a push because coverage was so low. In the state of Assam, 23 children died, but it was basically due to the negligence of the local health workers in one particular area of the state where the spoon which was used to administer vitamin A was changed to a small container which was actually marked 500,000 and 200,000. Without proper training the local health worker was probably giving 500,000. But the doctors also said that it may not have been exclusively due to vitamin A alone, it could also have been because those children may also have had some other unknown physiological problems which may have been triggered off by the administration of 500,000 international units of vitamin A.

Dr. Agostoni: I am a little worried, 500,000 units of vitamin A could be the cause of these deaths?

Dr. Solomons: Calculating that given the under-5 mortality rate in the state of Assam the number of children who are eligible to be pulsed in that campaign would be 63 deaths of children on any given day of the year. Now how do you figure out which 23 of them died due to exposure to excess vitamin A? You could similarly argue that
Assam mothers kissed their children on any given day and 63 died. Hence, kissing children is hazardous.

Since Dr. Brown and I visited your country in 2000, the situation continues to evolve. It must be obvious that, through 59 years of Indian independence, the inability to eradicate even a single micronutrient deficiency means that the traditional dietary practices are ideal. The fact that Indian professional opinion now accepts a contribution of micronutrient fortification as a beneficial and necessary policy perhaps indicates some backing off from the former insistence that a strict vegetarian fare can provide all essential nutrients. There is a dialectic conflict. I think the concept of fortification in micronutrients has won in the ensuing debate over these 6 years, and that Dr. Bulusu and her persistence are a partial factor in that advance in the dialectical resolution.

Dr. Bulusu: Since then the government has changed the campaign mode and administration is not on a single day. Every state has been requested to conduct the vitamin A supplementation program over a period of time, e.g. a month, so in different districts supplementation is taken on different days, so that the local people and health workers are more vigilant on that issue.

References
